SESSION II.
1923.
NEW ZEALAND.

PUBLIC WORKS STATEMENT

BY THE HON. J. G. COATES, MINISTER OF PUBLIC WORKS.

MR. SPEAKER,—

The operations of the Public Works Department during the past year have resulted in very material progress in the works of railway-construction, hydro-electric development, irrigation, road construction and improvement, as well as in other works individually smaller but none the less of importance.

The costs of construction materials and plant have receded to some extent. To this, and the application of mechanical apparatus wherever possible, is due the fact that, compared with last year, a much greater extent of work has been obtained for an equivalent expenditure of money.

Assuming an efficient works organization, progress in the shape of completed works is mainly a matter of money available for expenditure. Given unlimited funds more might have been done. Although the works to which our loan-moneys are devoted are developmental and open the way to increased productivity, and consequently increase the country's capacity to bear the burden of interest and sinking-fund charges on capital expenditure, we must on no account lose sight of the fact that loan indebtedness must be kept well within the country's capacity to honour its obligations. To this end the earning-capacity of works created out of loan-money must be carefully considered and weighed, and progress of expenditure on development-works regulated to our ways and means. It is necessary for us to demonstrate to our own satisfaction, as well as to those from whom we borrow, that the progressive expenditure on our development is carefully considered and fully justified by the increased productivity induced by such works. It would be unwise, and indeed impossible, for this country to raise and spend the money necessary to build, in the minimum of time, all the works necessary for the full development of areas which at present, owing to lack of means of transport, are in a partially developed state. As in all young countries whose financial resources are limited, the settler must be the pioneer, not the railway or the high-class road. These can follow only as the country's financial position and the return from partial development of land by the settler make the expenditure justifiable. This must be regarded as the position, at any rate, for the present. I have no doubt that within reasonable time the more intensive development of natural resources and secondary industries within the areas already served by adequate means of transport will result in the creation of a balance of national assets over liabilities sufficient to enable us to confidently undertake the construction of first-class roads, or even railways, to follow developmental settlement much more closely than at present.

For the time being, however, it is our policy to push railway-construction projects to their natural conclusion only after most careful consideration by both the Department responsible for construction and the Department which, on completion of the work, will be responsible for making the line pay its way as a part of the New Zealand railway system.

RAILWAYS.

During the financial year a 7 miles 65 chains section of the Waiuku Branch Railway was completed and handed over to the Railway Department.

The two outstanding achievements have been the completion of the gap between railheads on the line running north from Auckland and south from Bay of Islands and Whangarei, thus linking to the North Island Main Trunk system 200 miles of railway system north of Auckland; while in the South Island the east and west coast railway systems have been connected; and general railway traffic established in both these cases.

The attached table shows 4 miles 54 chains of railway as being actually handed over to the Working Railways Department since the 31st March. In addition, rails were actually laid over 66 miles 35 chains of the 287 miles 46 chains now in course of construction. General traffic is being run by the Public Works Department over 103 miles 60 chains of line, and in addition goods traffic only is being run over 25 miles 68 chains of line. 14 miles 29 chains are now under inspection with a view to handing over to the Working Railways Department, and within six months a further 18½ miles will be ready for handing over.

The general advancement of work on other sections is such that it is expected that within one year a further 82 miles will be ready for handing over to the Working Railways Department, and within two years a further 149½ miles.

As I indicate later, in a reference to the particular section of railway, arrangements have been made for the invitation of tenders for construction of the Aongatete, Apata, and Te Puna Sections of the Tauranga Westwards Railway, a total length of 18 miles 18 chains.

The reasons for this step are twofold. First, it is always desirable that a constructional Department such as the Public Works Department should have the opportunity from time to time of proving that its own methods of construction and its costs of carrying out work are satisfactory. Secondly, the creation of an equipment of mechanical apparatus and plant to enable every work to be taken in hand under concentration methods would involve the purchase of an amount of equipment which could not be continuously used. The letting of a contract to a big construction company would avoid the necessity of the Government providing the plant, as it would have to do if it undertook the work itself. Furthermore, it is highly desirable that the 50 miles of completed railway from Tauranga eastwards, on which traffic is at present being run by the Public Works Department, should be connected with the North Island railway system at as early a date as possible, and a satisfactory contract for the 18-mile section in question will, it is hoped, enable this to be done. The Government will not, of course, consider the letting of a contract unless the best tender received is entirely satisfactory both as to price and guarantee of performance of contract.

It must not be assumed from the foregoing that it is the intention to abandon the co-operative-contract system by which so many of our works of great importance have been constructed. This system, so long as its cost is adequately checked, has many advantages, and will be continued particularly for the employment of those men who have stood by the Department for years in its pioneering and have done excellent work often under most adverse conditions. While on this subject I should like to emphasize the continued effort that is being made to improve, wherever possible, the working and living conditions of these men. Construction-works in back country inevitably mean somewhat primitive conditions, and it is only by providing reasonable conditions of comfort and the opportunity of social amenities for the men and their families that the best men can be attracted to and retained on the works.

It has been the practice in the past to include in the Minister's Statement a mass of detail of work done during the year on each section of railway. Full particulars of all this are to be found in the report of the Engineer-in-Chief, to which I refer honourable members.

The attached table hereto gives a complete statement of the work now in progress and the extent to which it is anticipated it can be completed during the next two years, assuming, of course, that sufficient financial provision will be available.

I propose now to sketch the programme of operations during the next two years and indicate the programme which I consider it will be possible to put in hand thereafter. Certain works are now being pushed to completion. As these are wholly or partially completed the expenditure thereon naturally diminishes and enables other works to be taken in hand and pushed to completion. The position is a simple one. The amount of money available annually for railway-construction is limited. It is obvious, therefore, that the soundest policy is to concentrate that expenditure on the most urgent works, complete them, and thus enable them to earn interest on their construction-cost.

During the present year it is anticipated that expenditure by the Public Works Department will cease on the Whangarei Branch connection to the North Auckland Main Trunk, and also on the Huarau–Waiotira Section of the North Auckland Main Trunk. Passenger and goods traffic is actually being run over these lines at the present time, but there still remains the necessity of a considerable expenditure on ballasting, station-yard, and buildings work. Portion of the country through which this line runs is of an extraordinarily unstable nature, and will require close attention during the next few months.

The main line departs from the Whangarei Branch line at Waiotira Junction. The main line objective is Kirikopuni, on the Wairoa River. It is estimated that this section can be completed in two years.

With respect to the North Auckland Main Trunk Railway, now under construction to Okaihau, and which section is now almost completed, the objective of this railway has been considered for some years as at Mangamuka, or, at any rate, as far as Te Tio, on the Hokianga Harbour. The very extensive bridging and other heavy work which would be necessary between Rangiahua and Te Tio leads me to think that it would be sufficient at the present to look upon Rangiahua as the objective. Representations have been made vigorously of late to the effect that if the railway is extended to Okaihau, and a good road is made from there to navigable water on the Hokianga, this is all that is required. The question whether country beyond Okaihau can be adequately or better served by good roads fit for heavy traffic will be carefully gone into in the immediate future, and on the receipt of the results of these investigations the Government will definitely consider the position and decide whether or not they will carry the line to the Hokianga Harbour. In any case it will not be possible to concentrate on this work until the work farther south is more advanced.

Coming now to the East Coast Main Trunk line, which from a construction point of view runs east from Tauranga to Taneatua, a distance of 63 miles, and west from Tauranga to Waihi, a distance of 41 miles, it is estimated that the Tauranga–Taneatua Section can be completed in two years. On the Tauranga westwards section to Waihi a certain amount of work has already been done by the Department, mainly at the Waihi end. Tenders are being invited for the construction of the intervening section of 18 miles 18 chains. The time allowed for completion of this section is three years from the end of this financial year, within which time the Department will have completed the work which it has in hand.

On the Napier–Gisborne line the section to Eskdale has already been completed and opened for traffic. It is intended to extend the construction programme this year, and to concentrate next year to enable connection to be made at as early a date as possible with the main Napier–Gisborne Road at Tutira.

On the Wairoa–Waikokopu line, which is a branch of the eventual Napier–Gisborne line, traffic is already being run by the Public Works Department, but ballasting, station-yards, and buildings will probably take eighteen months to complete. In addition, it has become necessary for the Department to build the wharf at Waikokopu. This latter work should be completed by the end of next summer, and thus provide a satisfactory outlet from the Wairoa district.

On the Stratford–Main Trunk connection at Okahukura traffic is being run as far as Matiere, and from the Stratford end as far as Tahora. Lying between these points is a section of heavy construction and tunnel country. It is intended to

push ahead steadily with the construction from the Matiere end towards Heao Valley, and next year to renew operations at the Tahora end. By this programme work at the two ends should simultaneously encounter the difficult section referred to. I estimate that there will then be money available to enable this section to be dealt with under concentration methods. The detail surveys are not yet complete, but given adequate votes three years should see the completion of work up to the heavy section.

It is anticipated that the Opunake Branch line will be completed and out of hand within the next two years.

Having thus defined the present objectives of railway-works now in actual course of construction and enabled the House to appreciate the probable demands upon the Public Works Fund for the present and the near future for the completion of those works to the objectives, I now invite consideration of three special undertakings upon which I advise that the expenditure of moneys available should next be concentrated.

The first is Westport–Inangahua. At present the whole export of the Westport coalfields finds outlet from Westport Harbour. A large proportion of this coal is shipped to the east coast of the South Island. If these fields were given railway connection to the East and West Coast Railway systems, now connected by the opening of the Otira Tunnel, the coal would be transported over the railway and earn freight, not only over this particular section but over from 200 to 250 miles of open railway. The provision of railway communication would also lead to the opening-up of other coalfields, to say nothing of the interchange of stock and farming products from Canterbury.

The other two works are of practically equal importance, each being designed to provide improved connection between the Port of Wellington and the districts in the Dominion lying to the north-east and north-west of that port. They are known as Tawa Flat deviation of the Wellington – Palmerston North portion of the North Island Main Trunk line, and the Rimutaka Deviation of the Wellington–Wairarapa line.

The increasing difficulty of running suburban and general traffic on grades such as exist on the Manawatu line has become so intense that it is impossible to extend services unless the line is double-tracked at least as far as Tawa Flat. It would be absurd to double-track the existing alignment if a better alignment can be found. Trial surveys have been made which show that a double-track line can be built on grades and alignment between three and four times as favourable as the present route.

The Rimutaka Deviation is recognized as a necessary work which should be put in hand and carried to completion at the earliest possible time.

The intention of the foregoing statement is to show that as work is completed or expenditure slackens on sections approaching completion so shall we be able to enlarge expenditure on other works now proceeding under restricted finance, and undertake other works which have been awaiting their turn in the order of their urgency and importance.

While, owing to the continuance of a certain measure of unemployment, it has been necessary to continue a number of works which otherwise would have been temporarily closed down to enable a policy of concentration to be given full effect, the extraordinary results which have been achieved from the policy of partial concentration as indicated by the number of miles of line which will be ready for handing over in two years' time, must convince honourable members of the soundness of that policy. Not only will the capital invested in works become reproductive at the earliest possible date, but those works which are for the time being deferred will actually be completed in a much shorter time under concentrated effort than would have been the case had a greater number of works been kept going under methods other than those of concentration. The best results can be achieved only by planning out a definite programme that is possible with ways and means available, and driving that programme with all the plant, mechanical apparatus, and human energy that can be economically employed on its completion.

ROAD-CONSTRUCTION.

The expenditure for the year ending 31st March, 1923, on road construction and maintenance has surpassed all previous records.

The amount of construction-work carried out was large and diversified in character. It has been necessary to employ large numbers of unskilled men on relief works, and the object has been, so far as practicable, to employ such men on work of general utility to the Dominion. Consequently, several of the leading highways that came under this category were selected, and have, by means of this labour, been greatly improved by regrading, realignment, and surfacing with metal.

The style of construction has, as far as possible, been standardized, special attention being given to the matter of curvature, as that feature is of great importance to motorists in regard to safety, economy, and comfort.

In bridge and culvert work the durability, strength, and adaptability of concrete, whether plain or reinforced, are being increasingly recognized and made use of.

In addition to the allocation of available funds between different districts, based on the usual factor of population, length of road, cost of completing present roads and forming new ones, present loan indebtedness, &c., special allowances are being made for relief works and for certain roads that will act as temporary substitutes for railways, as well as for roads on which there are gaps that are at present in such a state as to interfere with through traffic.

The works for which special allowances have been made, as well as the large bridge-construction works, have been carried out under the direct supervision of the Department, but other works have, as heretofore, been entrusted to local authorities in accordance with plans and specifications approved by the Department.

As always has been the case, the applications for assistance were more than could be fully met, consequently it was only possible to provide for what seemed to be the most urgent and deserving cases, though every request has received careful and impartial consideration.

The Main Highways Act, though passed during the session of 1922, does not come into active operation till the 1st April, 1924. Meantime, however, much information is being and will still have to be collected, and many problems considered by the Board constituted in terms of the Act.

ROADS AND TRANSPORT.

Doubtless secondary development of the country by means of railway is essential at a certain stage, yet the primary development in any country must be by roads. Very great progress has been made in this direction during the past year, both in materially improving existing roads and in constructing new roads. The expenditure of the parliamentary appropriations for this purpose has been carried out by both the Public Works Department and local-body organizations.

Before passing to other matters I feel it is necessary to specially direct the attention of honourable members, and to ask them in turn to impress upon the country, the absolute necessity of co-ordination between all governing authorities concerned in the provision of means of transport of goods and passengers by land. The authorities in question are the Railways Department, which runs the open railways; the Public Works Department, which constructs railways and roads; the Main Highways Board, recently constituted with the object of co-ordinating and assisting in financing the effort of local bodies in improving the construction and maintenance of what may be termed the main traffic roads, and in addition the local bodies who operate on roads which will not, for the time being at any rate, receive benefits under the Main Highways Act. A co-ordination of the policies of all these authorities must result in the saving of hundreds of thousands of pounds. The absence of a co-ordinated system must inevitably result in disjointed, ill-considered effort, unnecessary duplication of means of transport, competition that is entirely unprofitable to the community as a whole, and, in the final conclusion, the

still remaining necessity to start afresh to plan again what should have been planned in the beginning.

It will serve no good purpose to criticize what has been done or left undone in the past, nor would it be just to do so. Times are changing rapidly—motor transport has enormously increased the range of travel, and organization that has served in the past must give way by a natural process of evolution to broader administrations resulting in well-considered and co-ordinated effort of all concerned.

FLOOD DAMAGE.

During the whole of the year the progress of work generally has been considerably hampered by persistently bad weather. In certain localities very serious floods occurred, resulting in heavy damage and destruction of roads, bridges, and river-protection works. In many cases the cost of restoration has been of such magnitude as to be altogether beyond the resources of the local-governing authorities. It has therefore been necessary for the Government to come to the assistance of local bodies, which will mean a heavy addition to normal expenditure.

HYDRO-ELECTRIC DEVELOPMENT.

Substantial progress is being made with the development of the hydro-electric power of the Dominion. The total outlay on all schemes during the year has been £450,247, and the total outlay at the end of the year was £2,170,100.

Two schemes, Lake Coleridge and Horahora, are in full operation and are being extended. The construction power plant for Waikaremoana has been installed, and is being used pending construction of the main plant to supply the local demand, and two of the larger schemes are under construction, viz., Mangahao and Arapuni.

Lake Coleridge Electric-power Supply.

Satisfactory supply has been maintained from Lake Coleridge during the year. The financial result is as follows :—

		£
Capital outlay		843,033
Revenue for year		69,153
Working-expenses	19,271	
Interest	35,275	
Depreciation	9,307	
Total annual costs		63,853
Profit for year		£5,300

This enables the accumulated deficiency on the Profit and Loss Account to be reduced from £29,176 to £23,876. But it must still be noted that no provision has yet been made for the sinking fund, the accumulated deficiency on which is now about £37,765, which, in accordance with the State Supply of Electricity Act, must be paid before the installation can be considered as paying its way. The total deficiency is therefore £61,641.

The installation at the Lake Coleridge power-house has been brought up to full capacity of the present tunnel—viz., 12,000 kilowatts, or 16,000 horse-power—by the recent addition of two new generating units each of 3,000 kw., and the further extensions for which provision has been made will entail a second tunnel and intake works.

The Harper River diversion has been completed and is operating satisfactorily. In order to give the additional storage required for the future extensions the outlet-weir has been raised, and the water has already overflowed the higher level.

The proposed extensions beyond the present capacity will consist of two units each of 7,500 kw. (10,000 h.p.) with the provision for the future addition of a third similar unit. Towards this increased capacity the necessary transformers at the power-house and the transmission-lines to Addington have now been completed,

leaving the tunnel, power-house extension, and Addington substation extension to enable the increased supply to be given. Plans and specifications for these are ready, and will be issued as soon as the Christchurch City is prepared to enter into a contract to take the additional output necessary to justify the works.

The line to Ashburton and Timaru has been completed, and arrangements have been made to supply power to the Power Boards in both these places at the same rates as to all the other reticulating authorities except Christchurch City.

It is recognized that as the load develops with the extended plant it will be possible in a few years to reduce the standard charges: estimates indicate that it will be necessary to maintain them until 1928, but an offer has been made to the Christchurch City of a ten-years contract to commence at once at 10 per cent. below the standard rates.

The load on the power-house has increased rapidly during the year owing to the removal of restrictions. On the 31st March it had reached 9,390 kw., as compared with 7,600 kw. at the beginning of the year, and has since increased to 10,500 kw., of which Christchurch City is taking one-half.

The estimated cost of the extensions to the Lake Coleridge plant to increase its capacity by 15,000 kw. is £371,000. The Christchurch City Council have obtained a valuable report on the possibility of developing the Waimakariri River at Otarama Gorge, which is estimated to cost over £900,000 for a plant of the same capacity. It is claimed that this installation would have a greater capacity for future extensions than the Lake Coleridge plant; but, as 15,000 kw. will be sufficient for many years to come, this cannot be considered an advantage which would justify an additional expenditure of over £500,000. As a result of this difference in capital outlay, the necessary additional power can be given from Lake Coleridge earlier and at a cheaper rate than from the Waimakariri. Moreover, if the Waimakariri scheme were developed the present power from Lake Coleridge would have to be sold mainly in North and South Canterbury. This will involve a large outlay in transmission-lines, which will be necessary in any case, but the cost would have to be borne by a smaller output, and the load would take three or four years to develop.

Moreover, this smaller load would have to carry the burden of capital charges for a large outlay which has been incurred especially for the supply to Christchurch, and which is practically useless for the supply of the remainder of the demand. As a result it would involve a substantially higher cost of power to consumers outside the city. At the offer now made to the city for a ten-years contract the actual cost of power from Lake Coleridge will be cheaper than the cost of Waimakariri power as estimated by the city for nine years out of the ten, and after the tenth year, of course, the question of the further reduction of rates which can be made on the renewal of the contract will come up for consideration.

Horahora Electric-power Supply.

Service has been maintained satisfactorily during the year, and the reticulation has been rapidly extended by the Power Boards into the farming districts. The number of electric milking-machines connected to the mains of the four Power Boards in the district has increased during the year to 880. The financial results of the year's operations are as follow:—

	£	£
Capital outlay		395,022
Revenue		41,818
Working-expenses	9,721	
Interest	19,208	
Depreciation	6,620	
Total annual costs		35,549
Profit		£6,269

This has enabled the accumulated deficiency of £5,882 to be paid off, and £386 is available towards the accumulated sinking-fund deficiency of £8,459.

The load at Horahora reached 6,900 kw. during the year, which is 10 per cent. overload on the present installed capacity of 6,300 kw.

An arrangement was entered into during the year with the Auckland Electric-power Board to give them 2,000 h.p. from Horahora in advance of the power-supply from Arapuni, which cannot be given until 1928, and the construction of the necessary transmission-line for this purpose is in hand, together with the necessary extension at Horahora, consisting of two units each of 2,000 kw., to supply this and the normal extensions to the demand in the Waikato.

The arrangement with the Grand Junction Company to utilize their steam plant at Waihi as standby has proved very useful on several occasions during the year, and enabled the supply at Waihi to be maintained during the annual shut-down for the overhaul of the transmission-line.

Waikaremoana Electric-power Supply.

The main plant for Waikaremoana is designed for 40,000 h.p., capable of extension to 60,000 h.p. at the one site, and up to 130,000 h.p. in three power-stations. But the most urgent necessity was for about 500 kw. to supply the Wairoa Borough and freezing-works. This was provided by installing in a temporary power-house the two ultimate exciters for the main power plant, each consisting of a 500 h.p. pelton wheel coupled to a 500 K.V.A. synchronous motor used as a generator in the meanwhile, and a 350 kw. direct-current generator. This plant was put into service in December, 1922, and is giving satisfaction, thus rendering the industries of Wairoa independent of the fuel-supply.

Mangahao Electric-power Plant.

The construction of this work is making substantial progress. On No. 1 tunnel, a length of 81 chains, excavation has been completed, and concrete lining carried for a quarter of the length. No. 2 tunnel is 1 mile 28 chains in length, and excavation is complete here also, while approximately 27 chains of lining has been done. The excavation and lining of the By-pass tunnel is completed. The Mangahao and Arapeti dams are under construction, and good progress has been made in spite of considerable difficulty and damage owing to numerous floods. The surge-chamber excavation has been completed, and concrete lining is in hand. Pipe-line excavation is completed, and the majority of the pipe-supports placed in position. The power-house construction is now well in hand, and although it has been delayed by shortage of carpenters it is hoped to have the building sufficiently advanced to enable the erection of the machinery to be commenced about November. The surveys of the transmission-lines to Wellington, Marton, Dannevirke, and Masterton are completed, and the survey parties are now working from Dannevirke towards Napier, and erection is making substantial progress.

In view of the early completion of this plant, it has been necessary to negotiate the supply contracts with the Wellington City and the seven Power Boards which have been formed to undertake the distribution of the power. This scheme is being installed to its full capacity of 24,000 K.V.A. at once, and it is necessary to obtain the greatest possible output from the start in order to ensure financial success.

The greatest demand—probably 12,000 K.V.A.—will come from Wellington City, and the balance of the power is being reserved for the Power Boards. But in order to ensure its utilization and its distribution over the widest possible area guarantees are being asked from each Board, dependent upon the reservation of power capacity required for the district concerned.

It is recognized that it will take some years to build up a load in each district to the amount required to be reserved, and the full guarantee is therefore not required until the fifth year, proportionately smaller amounts being required to be guaranteed for the earlier years. Under these conditions only two of the Boards have accepted their full allocation, three have accepted guarantees based on reduced allocations, and two others are not yet prepared to accept any guaranteed allocation. Out of the 24,000 K.V.A. power-house capacity there are still 5,250 K.V.A. available for allocation. This power will, of course, be given to the first district within reach of the mains that is in a position to give a guarantee to take the power actually available, and with this object in view arrangements are being made to extend the mains to Napier and Wanganui in order to reach a wider market.

Negotiations for the sale of power to the city are proceeding, and it is anticipated they will reach finality shortly.

Arapuni Electric-power Scheme.

In accordance with the contract entered into with the Auckland Electric-power Board, specifications have been drawn up and issued for the construction of the dam and headworks at the Arapuni Rapids, Waikato River, and tenders close early next year. Several inquiries have been received from large construction firms in Great Britain and America. Meanwhile tenders for the power-house building and plant will be advertised shortly.

The Department has already let contracts for the construction of the access road between the railway and the dam-site, and has organized a haulage plant for metalling operations. The object of this is to avoid delay in opening up the work when the dam-construction is undertaken.

In order that Arapuni shall be remunerative from the start it is necessary to ensure a combined load of at least 30,000 kw. on this station and Horahora. Towards this the Auckland Power Board will have an installed capacity at the end of this year of 30,000 kw., and has recently decided to install a further 5,000 kw. in order to cope with the demand it anticipates before 1928. A proposal is also in hand for the formation of the Franklin Electric-power Board, which will further increase the demand. This, with the 10,000 kw. of load which it is anticipated Horahora will be carrying in 1928, will give the full amount of business which is required to render the Arapuni scheme remunerative from the start.

Hydro-electric Power generally: Future Development of Hydro-electric Power in Dominion.

As indicated in the table reproduced herewith, the following works are provided for:—

(*a.*) Completion of Mangahao to 20,000 kw. in 1924, with transmission-lines to supply Wellington, Masterton, Dannevirke, and Marton, and with early extensions to Napier and Wanganui.

(*b.*) Construction of Arapuni headworks, together with first three generating units, amounting to 45,000 kw., in 1928, with additional units of 15,000 kw. each as required; also duplicate transmission-lines to Auckland.

(*c.*) The extension of the existing power-house at Horahora, which is now in hand, and will be completed early in 1924, bringing up its capacity from 6,300 kw. to 10,300 kw., with transmission-lines to Auckland, Te Kuiti, and Rotorua, in addition to the existing lines to Waihi, Hamilton, and Te Awamutu.

(*d.*) The extension of Lake Coleridge by addition of two units, each of 7,500 kw. capacity, in 1926. Plans and specifications for the work are ready, and the work will be proceeded with as soon as a definite contract can be entered into with the Christchurch City Council to take the power. The programme for development of Lake Coleridge includes extensions of transmission-line to Waimate, Oamaru, and North Canterbury, in addition to the lines to Ashburton and Timaru, which are practically complete.

(*e.*) In addition to the above, preparations are being made for the installation of a major scheme at Waikaremoana. This will probably take the form of two units of 10,000 kw. each. In the attached programme this is scheduled for completion in 1928, but will not be undertaken until the power demand in sight assumes proportions in keeping with a station of this size.

Preliminary investigations have been made of suitable sources for power for Otago, Marlborough, Nelson, and Westland.

In addition to the Government developments, the Dunedin City are extending their Waipori Falls station, now of 6,000 kw. capacity, by the addition of a 3,000 kw. generator, with provision ultimately for three more such units, and arrangements have been made whereby they will give supply over the Government transmission-lines.

The Southland Power Board is pushing on the Monowai scheme of two units, each of 2,000 kw., with provision for future extension by means of four more such units.

The New Plymouth Borough has plans in hand for a power-station of 4,500 kw. on the Waiwakaiho River, and the Taranaki Power Board one of 1,500 kw. at Tariki, and the Wairarapa Power Board, Tauranga Borough, and Taumarunui Borough have smaller water installations in hand and approaching completion.

The steam reserve plants at Auckland, Wellington, Wanganui, and Invercargill are being extended and reconstructed, and the steam reserve which will be available in the course of a few years will be a follows: Wellington City, 10,000 kw.; Auckland Power Board, 25,000 kw.; Waihi Grand Junction Company, 3,000 kw.; Wanganui Borough, 1,750 kw.; Christchurch Tramways, 2,500 kw.; and Invercargill Borough, 2,200 kw. These, with the existing power plants already in operation, will amount in 1930 to 181,500 kw. of water-power and 45,750 kw. of steam plant, compared with the present total of 29,000 kw. of water-power and 31,000 kw. of steam and other power already in service.

This development will amply meet the demands and give a margin for attracting special industries depending on a supply of cheap power. The question of large surplus power to attract special export industries by offering cheap electric power is an important one, and is receiving the fullest consideration. The Dominion is at present too dependent for its export trade on agricultural produce, the prices of which are liable to serious fluctuations, and as the agricultural industries of the world are restored to their pre-war output the prices of agricultural produce will inevitably fall. It is therefore important that every effort be made to develop an export trade in manufactured goods or chemical or metallurgical products, and in this direction cheap power can assist very largely. The provision of such power is met in the above programme by the possibility of large extensions to several of the power-stations, particularly Arapuni and Waikaremoana.

The continued demand for hydro-electric power indicates the necessity for the Department putting in hand surveys and investigations of available schemes considerably in advance of the actual requirements, so as to ensure that the developments made will be in the best interests of the Dominion as a whole rather than that of isolated districts. Consequently portions of this work have been carried out, and as soon as the survey parties have completed the surveys required for actual construction it is proposed to carry on with this work, particularly in the direction of the supply to North Otago, North Canterbury, Westland, Buller, Nelson, and Marlborough, and in the detail location and survey of one or two of the most economical sources with a view to their being made available for the development of large electro-chemical or electro-metallurgical industries.

In view of the magnitude of the works now under construction and projected for the development of the hydro-electric resources of the Dominion, it has been decided that officers of the Department should be required to keep in touch with the modern developments in other countries by periodic visits to the countries in which developments are proceeding most actively along similar lines to those of the Dominion. In pursuance of this policy, Mr. F. T. M. Kissel has, during the year, visited the main hydro-electric developments of California, Canada, Norway, Sweden, France, Switzerland, and Italy, and the factories of England and America. As a result of this visit it is anticipated that the latest improvements and economies will be incorporated in the designs now being drawn up.

The management of the various electrical-power plants of the Department, including the sale of power therefrom, together with the supervision and control of the operations of the various Electric-power Board districts and other electric-supply organizations, is of considerable proportions, and in a few years will have grown to very considerable magnitude. With this in view it will be necessary to set up a special body to take over the administration of the electric-supply services, and so relieve the Minister of many of the details with which he is at present concerned. The Minister will still, however, retain general control of the Department and the general finance. The exact composition of this body has not yet been determined, but its general functions will be as indicated above, and before anything is done the question of its detailed powers and personnel will be given very careful consideration.

Complete details of all the hydro-electric works and matters will be found in the Chief Electrical Engineer's report, while the schedule attached hereto sets out the scheme of development of hydro-electric power for the next six years.

Scheme of Hydro-electric-power Development.

Schemes to be developed.—Coleridge (36,000 h.p.), Mangahao (24,000 h.p.), Horahora (14,000 h.p), Arapuni (60,000 h.p.), Waikaremoana (40,000 h.p.): total, 174,000 h.p.
Extensions and additional Schemes.—Arapuni (40,000 h.p.), Otago (25,000 h.p.), Westland (10,000 h.p.), Marlborough, Nelson, and Buller (10,000 h.p.): additional total, 85,000 h.p.

Schemes.	Expended to 31st March, 1923.	1924.	1925.	1926.	1927.	1928.	1929.	Later Expenditure.	Total.
	£	£	£	£	£	£	£	£	£
Surveys, &c.	16,000	4,000	4,000	4,000	4,000	4,000	4,000	..	40,000
Lake Coleridge—									
Headworks	400,000	50,000	150,000	150,000	..	..	..	..	750,000
Transmission	530,000	65,000	60,000	50,000	50,000	..	..	..	755,000
Horahora—									
Headworks	236,000	50,000	..	..	..	..	..	..	286,000
Transmission	200,000	100,000	50,000	..	..	..	..	..	350,000
Mangahao—									
Headworks	523,000	190,000	180,000	17,000	..	..	..	..	910,000
Transmission	110,000	120,000	100,000	100,000	100,000	100,000	..	..	630,000
Arapuni—									
Headworks	20,000	200,000	200,000	250,000	200,000	100,000	..	240,000	1,210,000
Transmission	58,000	65,000	100,000	50,000	200,000	200,000	100,000	200,000	973,000
Waikaremoana—									
Headworks	77,000	20,000	100,000	200,000	200,000	200,000	136,000	100,000	1,033,000
Transmission	..	..	50,000	50,000	100,000	100,000	200,000	800,000	1,300,000
Otago—									
Headworks	..	..	..	80,000	100,000	100,000	100,000	320,000	700,000
Transmission	..	100,000	100,000	120,000	100,000	100,000	100,000	330,000	950,000
Westland—									
Headworks	..	..	..	..	20,000	100,000	100,000	100,000	320,000
Transmission	..	..	..	..	..	..	200,000	200,000	400,000
Marlborough, Nelson, and Buller—									
Headworks	..	..	..	..	20,000	100,000	100,000	180,000	400,000
Transmission	..	..	..	..	..	..	100,000	300,000	400,000
Totals	2,170,000	964,000	1,094,000	1,071,000	1,094,000	1,104,000	1,140,000	2,770,000	11,407,000

EXPENDITURE.

The total net expenditure under all votes and accounts appearing on the public-works estimates for the financial year ended 31st March, 1923, was £4,939,520.

Of this sum £3,912,447 was expended out of the Public Works Fund, and the balance, £1,027,073, out of accounts which have their own ways and means and are quite separate from the Public Works Fund.

A brief summary of this expenditure, as well as the total expenditure since the inception of the public-works policy to the 31st March last, is shown below in tabular form :—

Class of Work.	Expenditure.	
	Expenditure for Year ended 31st March, 1923.	Total Expenditure to 31st March, 1923.
Railways—	£	£
New construction	1,358,931	29,821,780
Additions to open lines	751,928	13,021,549
Roads	648,006	13,759,722
Public buildings	257,694	8,891,421
Immigration	90,611	2,597,742
Purchase of Native lands	...	2,061,739
Lighthouses, harbour-works, and harbour-defences	9,784	1,184,102
Tourist and health resorts...	5,435	309,616
Telegraph extension	512,657	5,502,002
Development of mining	*Cr.* 98	883,922
Defence-works (general)	1,702	1,087,291
Departmental	111,367	1,928,643
Irrigation and water-supply	58,131	391,023
Payment to Midland Railway bondholders	...	150,000
Lands-improvement	26,204	184,050
Minor works and services	...	312,607
Plant, material, and stores	*Cr.* 19,708	415,930
Timber-supply and sawmills for Public Works Department ...	14,725	31,094
Motor Transport Services	22,679	22,679
Cost and discount, raising loans, &c.	62,399	1,489,937
	3,912,447*	84,046,849
Wellington–Hutt Railway and Road Improvement Account { Railway	...	228,374
Wellington–Hutt Railway and Road Improvement Account { Road ...	...	101,658
Railways Improvement Account	...	641,275
Railways Improvement Authorization Act 1914 Account ...	57,763†	872,142
Loans to Local Bodies Account—Roads to open up Crown lands	...	697,408
Opening up Crown Lands for Settlement Account—Roads to open up Crown lands	...	206,626
Land for Settlements Account—Roads to open up Crown lands	78,350	481,463
National Endowment Account—Roads to open up endowment lands	...	53,401
Aid to Water-power Works and Electric Supply Account ...	472,874	2,110,881
Waihou and Ohinemuri Rivers Improvement Account... ...	66,708	310,162
Education Loans Account...	351,378	1,129,150
Totals	4,939,520	90,879,389

* Exclusive of expenditure under Ellesmere Land Drainage Act, 1905.
† Includes proportionate cost of loan raised under this account.

WAYS AND MEANS.

		£
On the 1st April, 1922, the available ways and means for public-works purposes were		429,682
Additional funds were received as follows :—		
(*a.*) Under the Aid to Public Works and Land Settlement Act, 1921	£ 2,902,420	
(*b.*) By transfer from Railways Improvement Authorization Account in terms of section 5, subsection (1), Finance Act, 1922	1,000,000	

	£	£
(*c.*) Recoveries on account of expenditure of previous years	9,045	
(*d.*) Unauthorized	11,082	
(*e.*) Ellesmere and Forsyth Reclamation and Akaroa Railway Trust Account receipts	1,742	
(*f.*) Miscellaneous receipts	469	
		3,924,758
Thus making available for expenditure a gross total of		£4,354,440

The net expenditure on all works and services chargeable against the Public Works Fund for the year was—	£	£
(*a.*) Under appropriations	3,850,048	
(*b.*) Under Ellesmere Land Drainage Act, 1905	439	
(*c.*) Under New Zealand Loans Act, 1908 (stamp duty)	5,123	
(*d.*) Charges and expenses of raising loans	57,276	
Making a total of		£3,912,886

This left a credit balance of ways and means at 31st March, 1923, of	£	£ 441,554
Legislative authority exists for raising a further additional	4,000,920	
It is proposed to transfer from accumulated surpluses to capital purposes to the extent of	1,000,000	
Also to ask for further legislative authority to borrow when required a further	4,000,000	
		9,000,920
Thus making available for public-works purposes a total of		£9,442,474

The estimated expenditure on public works for the current financial year (exclusive of those accounts which have their own ways and means) is £4,806,212, which will leave an estimated credit balance in the fund at 31st March, 1924, of £4,636,462.

Quite separate from the before-mentioned fund there are certain public undertakings of considerable importance which have their own ways and means. The most important of these are—

(*a.*) Electric Supply Account—	£	£
The available balance under this head at 31st March, 1923, was	1,952,919	
And in addition there is an unexhausted authority for raising an additional	6,506,990	
		8,459,909
(*b.*) Waihou and Ohinemuri Rivers Improvement Account—		
Balance at 31st March, 1923, was	15,143	
While legislative authority exists for raising further loans amounting to	124,000	
		139,143
(*c.*) Railways Improvement Authorization Act 1914 Account—		
Balance at 31st March, 1923	850,530	
Unexhausted authority for raising additional funds	1,458,310	
		2,308,840
(*d.*) Main Highways Account—Revenue Fund		121,413
Total		£11,029,305

	£
From these figures it will be observed that at the end of last financial year the unexpended balance of the Public Works Fund, plus existing and proposed authorities for raising further moneys, amounted to	9,442,474
While the balance at the same date in respect to some of the more important public works which form no portion of the Public Works Fund proper, plus legislative authority to raise additional loans, amounted to	11,029,305
Or a total of	£20,471,779

It is gratifying to me to know that the administration of the Public Works Department still retains the confidence of the Legislature, as evidenced by the establishment of these credits and the placing of them at my disposal for the development of the Dominion under a progressive policy of railway, road, hydro-electric, and irrigation construction.

Railways Improvement Authorization Act, 1914.

The expenditure under the Railways Improvement Authorization Act, 1914, amounted to £53,636 for grade easements; duplication of line, Horotiu to Frankton Junction; a new station and station-yards, goods-sheds, and terminal facilities at Auckland, Wellington, Christchurch, and Lyttelton; and signal, interlocking, and safety appliances.

Additions to Open Lines.

The expenditure out of the Public Works Fund under the head "Additions to Open Lines" amounted to £751,928, in the provision of additional rolling-stock, tarpaulins, Westinghouse brakes, steam-heating, electric headlights for locomotives, workshops machinery, improvements and additions to station buildings, extensions of sidings, bridge-work and subways, cranes, weighbridges, additions to workshops, tablet, telegraph and telephone facilities, additional dwellings, signals and interlocking appliances, and purchase of land.

PUBLIC BUILDINGS.

General.

Parliament Buildings, Wellington.—The first portion of the new Parliament Building has now been completed, and a description of the design and erection is given by the Government Architect in his annual report, Appendix C.

Departmental Buildings.—The Departmental Buildings, Wellington, have been efficiently maintained. External painting is well in hand, as also are internal renovations, including extensive alterations to the sanitary conveniences.

Courthouses.

A new Courthouse was erected at Morrinsville. Renovations and additions have been carried out at the following: Whangarei, Bull's, Kaitaia, New Plymouth, Kaikohe, Wanganui, Hikurangi, Hunterville, Auckland Supreme Court, Auckland Magistrates' Court, Taumarunui, Te Kuiti, Hamilton, Napier, Huntly, Hastings, Paeroa, Gisborne, Pukekohe, Wellington, Onehunga, Martinborough, Te Awamutu, Feilding, Taihape, Upper Hutt, Patea, Masterton, Opunake, Christchurch Supreme Court, Manaia, Wyndham, Stratford, Winton, and Balclutha.

Prisons.

The Department's building operations were again restricted to the completion of urgently required institutional and farm buildings and warders' cottages. The work of modernizing the metal-crushing plant at the Auckland Prison is now well advanced, and the completed installation will very soon be brought into full use. In addition to general improvements to the Waikeria Reformatory Farm property, inmates from the latter institution have been employed extensively on the Tokanui Mental Hospital Reserve clearing and preparing virgin land for cultivation. The

reconstruction of the Ohakune–Waimarino Road has been carried on by a party of prisoners from the Waikune Camp, Erua. The sawmilling plant at Waikune has been extended, and a quantity of timber supplied for other Departments' purposes during the past year. The development of pumice lands at Hautu Camp, near Tokaanu, has been pushed forward vigorously, and about 150 acres cleared, stumped, and partly sown in cereals and English grasses. A stiff-plastic-brickmaking plant has been installed at the Wi Tako Prison Brickworks, Trentham, and all necessary buildings have been completed. The second cell-range at Paparua Prison is rapidly nearing completion, the ground-floor cells being already occupied. A new cottage has been completed. At Invercargill Borstal Institution two additional dairies have been erected, also stables and barn. The kitchen block at the Borstal Institution has been completed and is now in occupation. Among the more important buildings to be proceeded with during the year is a new trial and remand prison for Wellington, for which preliminary plans have been prepared and financial provision asked. Pending the completion of the new prison, temporary provision will be made for the accommodation elsewhere of a proportion of the Terrace Prison population, so that the work of demolition and reduction of levels to provide sites for further school buildings can be commenced at an early date.

Police-stations.

New police-stations during the year have been erected at Hawera, Inglewood and Mohaka, additions to Millerton Station, and a lock-up built at Putaruru.

Additional accommodation, the erection of which has been postponed for financial reasons during the last few years, is required at several places to replace old buildings which are beyond repair, and provision for these is being made on this year's estimates to the extent of moneys available for that purpose.

Post and Telegraph.

The great expansion of departmental business has rendered additional accommodation necessary at many places. This can be provided in most cases by additions to existing buildings; but in others the erection of new buildings is necessary, and provision will be made accordingly as funds permit.

At Dannevirke, Patea, and Stratford the post-office buildings, which were no longer serviceable, are being replaced by modern structures.

During the year post-office buildings were erected or their erection was completed at Duvauchelle, Mangawai, Ngatea, Patetonga, Rata, Te Teko, Waimauku, and Whakapirau; and a Postmaster's residence was erected at Whakatane.

The Takapuna automatic-exchange building was completed; and new buildings for the accommodation of the automatic exchange are in course of erection at Dunedin and Wellington.

The extended use by the Department of motor-vehicles has necessitated the provision of garages and motor-workshops. At Auckland a building was purchased for this purpose. At Christchurch and Dunedin substantial additions have been made to existing garages. At Palmerston North and Wanganui, buildings to be used as garages and workshops are now being erected. At Wellington a large three-story concrete building, to be used as a garage and to provide additional store accommodation, is nearing completion.

It is proposed in the near future to undertake the erection of a new chief post-office building at Dunedin. The existing temporary accommodation is in the Garrison Hall, which is too cramped, and adequate provision must be made in the shape of a new building. Plans for this were prepared some time ago, but the whole plan is being remodelled to coincide with the most up-to-date ideas of public-office construction, and to enable the staff to be organized for the purpose of greatest efficiency. Owing to the growth of public services such as post and telegraph work it has been found necessary to entirely reconsider previously existing ideas as to office and staff accommodation.

Provision is also being made this year for new post-offices at Paeroa and Napier, and for substantial additions at Gisborne.

Mental Hospitals.

Considerable maintenance work with structural alterations and improvements has been and is being carried out at Auckland, and the additions to Park House have been furnished and are in occupation.

At Tokanui a brick admission unit for males has been completed and furnished, and a supply of concrete blocks has been made from river-gravel on the estate for building villa units in the near future.

At Porirua maintenance work has been carried out.

At Nelson the Reception Hospital has been completed and supplied with a small electric-light plant, and much maintenance work has been done, with structural alterations and adaptations, in connection with the change-over from Nelson to Stoke, with the object of keeping the former institution for the mentally deficient.

At Hokitika the central block of kitchen, bakehouse, store, and staff rooms and quarters has been completed, and a drainage system, which provides for future extensions, has been instituted. The installation of electricity for light and power is being proceeded with.

At Sunnyside extensive additions to Nos. 2 and 4 wards are furnished, and a similar addition to the dining-room is in progress. The site for the new male staff quarters had been prepared, and a considerable amount of renovating-work has been carried out.

At Seacliff a nurses' messroom has been erected on the plan of the attendants' messroom, which has proved successful. A row of single rooms on the women's side has been removed, and greatly improved the amenities. The new unit at Waitati has been furnished and is in occupation, and in addition much maintenance work has been accomplished.

Hospitals and Charitable Institutions.

The recently erected St. Helens Hospital at Auckland has been handed over to the Health Department for administration. Although the building is in occupation there are still a number of internal fittings to be completed.

All the hospital buildings and residences at Queen Mary's, Hanmer, have been painted, sanitary blocks erected, and alterations to heating and lighting carried out.

Considerable capital expenditure is required for laying a new pipe-line and repairs to the reservoir which supplies the Queen Mary's Institution at Hanmer, also for the erection of a new block for the accommodation of female patients. When the new block is built the building now occupied by these patients will be used for nurses' quarters.

This institution is fulfilling a very necessary function, and it is hoped, as soon as the necessary finances are available, to proceed with the programme outlined above.

Lighthouses.

The transfer of the lighthouse station from East Island to the mainland has been completed, and the light is giving satisfaction.

The conversion of the present light on Tiritiri Island to an automatic (unwatched) light will be effected as soon as the apparatus is received in the Dominion, and it is hoped to effect a similar conversion of the light at Cape Foulwind in the near future. These changes will result in a very considerable reduction in maintenance charges.

A new automatic (unwatched) light has been erected at Gable End Foreland, and one also on Ohena Island, one of the Mercury Group.

At Stephen Island oil-engines are being installed in place of horse-driven whims for hauling stores from the landing. As all the supplies for this light and for the lightkeepers' families have to be transported over two separate inclines it is anticipated that this work will greatly improve conditions at the station, in addition to facilitating the despatch of the lighthouse tender.

The question of a light on the Three Kings Islands was again gone into very carefully. The Marine Engineer, accompanied by a survey party, visited the islands, spent some days there, and surveyed a tram route two miles in length from

the only practicable landings on the main island to the site which was selected as most favourable for a lighthouse on the western corner, and this was also surveyed. The Western King, which was suggested for the proper site for the light, was also closely examined, and as a result of this survey and examination alternative estimates were prepared, either for a fully equipped watched light-station, with a radio beacon on the main island, or, alternatively, for a duplicate automatic unwatched light on the Western King. Later on the Department, with the assistance of the Post and Telegraph Department, carried out a number of experiments with a radio-beacon apparatus on the Great King, to ascertain whether there would be any undue interference with the wireless waves by reason of the shape or constitution of the ground. The results were quite satisfactory.

For the current year provision is being made for an automatic light on Matakaoa Point (Hicks Bay), and for the erection of a wireless outfit at Puysegur Point Lighthouse; also for a light and any other aids to navigation that may be necessary on the Three Kings.

HARBOUR-WORKS.

The following works were carried out during the year:—

Little Wanganui.—A survey was made and plans and estimates for the improvement of the harbour were prepared. New beacons were erected, the flagstaff renewed, and a tide-gauge erected.

Okuru.—Repairs were effected to the wharf, and new mooring-piles driven.

Bruce Bay.—Plans were prepared and the work commenced of a landing and goods-shed on Flower-pot Rock, together with an approach bridge and road.

Karamea.—A considerable amount of repair work was carried out on the training-wall, a number of piles being driven and sheathed to strengthen the wall and to prevent wave-action at the back.

Kaikoura.—The various works in hand towards the improvement of the boat-harbour have been completed, the principal works being the provision of a new slip and repairs to the old one; repairs to the wharf, construction of dinghy-landing, skids, &c. Certain works in connection with the removal of rocks from the berthing-area were also taken in hand, the services of some of the Defence staff used to submarine mining being secured.

Mokau.—The construction of a snagging-punt out of funds provided by the Government has been completed, and the punt is operating satisfactorily.

Wade River.—Dredging has been carried out to provide better facilities for shipping using the wharf.

Contributions have been made by the Government to the following wharves erected by the local authorities concerned: Tangowahine, Naumai, Kawakawa Bay, Miranda, and Kutarere.

TOURIST AND HEALTH RESORTS.

The installation of a Diesel engine stand-by plant and the erection of a new power-house in connection with the Rotorua electric installation are in progress. Excavations for the foundations for the machinery have been completed, and the concrete-work is in an advanced stage. A commencement has been made with the erection of the power-house. The engine and generator are ready for installation as soon as the building is sufficiently advanced.

An order has been placed for the supply and delivery of cast-iron water-pipes to replace the existing wooden water-mains.

At Helensville a new swimming-bath has been completed, and additions and improvements made at Morere Hot Springs and Tongariro National Park.

TELEGRAPH EXTENSION.

The bulk of expenditure last year was incurred in developing the telephone-exchange system, which was extended during the year by the opening of twenty new manual exchanges and the connecting with these and other exchanges throughout the Dominion of 10,200 subscribers, the greatest number yet connected in any

financial year. The addition of new subscribers necessitated the providing of additional switchboard accommodation at twenty-five exchanges, and the installing of underground and aerial cables at a number of places where the pole-lines were so heavily laden as to make extension impracticable and maintenance a costly item.

The automatic-telephone-exchange system was extended during the year by the opening of a satellite exchange at Khandallah (Wellington), and the conversion of the Palmerston North exchange from manual to automatic working. In addition the automatic-exchange systems in the Auckland, Christchurch, and Wellington metropolitan areas and at Blenheim and Hamilton were extended by the installation of equipment for 2,310 lines. In each case the installation was necessary to meet the present-day demand for telephone service. The installation of automatic exchanges is still proceeding at Auckland and several suburban exchanges in that area, and also at Wanganui.

The telegraph and telephone toll systems were extended during the year by the erection of 199 miles of new pole-line, carrying 1,197 miles of wire. Among new works completed during the year were the metallic circuits between Auckland–Paeroa (two), Auckland – Otahuhu, Auckland – Takapuna, Balclutha – Glenomaru, Hawera – New Plymouth, Isla Bank – Fairfax, Lower Hutt – Taita, Lumsden–Balfour, Manutuke–Muriwai, Murchison–Ariki, New Plymouth – Opunake, Pihama–Opunake, Rotorua–Hamurana, Rotorua–Whakatane, Seddon–Jordan, Stratford–Whangamomona, Wairoa–Waikaremoana, Westport – Inangahua Junction, Whakatane – Te Teko, and the opening of a comparatively large number of new telephone-offices, chiefly in the backblocks. Notwithstanding the progress made during the year, the programme of new works in hand and in view shows no signs of diminishing.

The multiplex telegraph system, which considerably increases the carrying-capacity of telegraph circuits, has been installed between Wellington and Auckland, and has permitted a number of circuits previously required for telegraph purposes to become available for long-distance telephone communication. So much success has attended the introduction of this system that it is intended in the near future to further extend it by connecting Napier with Wellington and Auckland, and Christchurch with Dunedin. When these installations are completed the long-distance telephone facilities between these places will be considerably improved and extended without the erection of any additional circuits.

CONTINGENT DEFENCE.

The installation of electric light at Burnham Camp is in hand under contract. The development of Burnham and Ngaruawahia as ordnance depots is a matter of some urgency, and will be put in hand when funds for the purpose are available.

IRRIGATION AND WATER-SUPPLY.

Where irrigation was carried on last year it has been continued this year with marked success to the farmer and increasing revenue to the Government.

The construction of headworks and main diverting-channels through very difficult country has presented many engineering difficulties and been responsible for fairly heavy expenditure. It is pleasing, however, to record that this heavy pioneering-work has now been successfully overcome, and the comparatively easy task of constructing supply-races in order to deliver water for irrigation purposes right on to the consumer's property has in many cases been completed, and in others is in hand.

With the work carried out during the year just closed, as well as that included in this year's programme, it is anticipated the area commanded by constructed races will be increased from 7,000 acres to approximately 40,000 acres, and a marked increase in production may be looked for from Central Otago in a very few years.

The Ardgour irrigation scheme will be in full working-order this year, while the Last Chance scheme, given reasonable weather conditions, will also be working this year. A commencement will also be made during the year with extension of the Tarras scheme, which has already been partially developed by private enterprise.

Full details of each scheme will be found in Appendix B.

RIVER-PROTECTION.

On the Taieri Plain heavy floods greatly damaged the existing flood-protection works, and generally caused such damage and loss of crops and stock as to force the conclusion that a comprehensive scheme of flood-protection works, embracing adequate protection for some 30,000 acres of most valuable land, must be undertaken. The losses of crops and stock which have occurred from time to time are of such magnitude that the position must be remedied, and to this end the Government has agreed to share the cost of the work with the ratepayers of the district. This is not intended to cast any reflection on the very excellent work which was done by the pioneer settlers and which coped with the smaller floods. The lands have now become so valuable, and the interests at stake so extensive, that works to deal with any floods which may reasonably be expected have become an absolute necessity.

The Waihou and Ohinemuri drainage-scheme work is still being carried forward, but in order to accelerate progress and hasten the day when immunity from flood will be obtained it has been arranged to construct another suction dredge of considerably greater capacity than the one already in use. The material for this is already on order, and immediately it comes to hand the construction of the machine will be pushed ahead. In addition to this floating dredge two extra drag-line excavators, of the largest size yet used in this country, have been procured and set to work.

MECHANICAL APPARATUS.

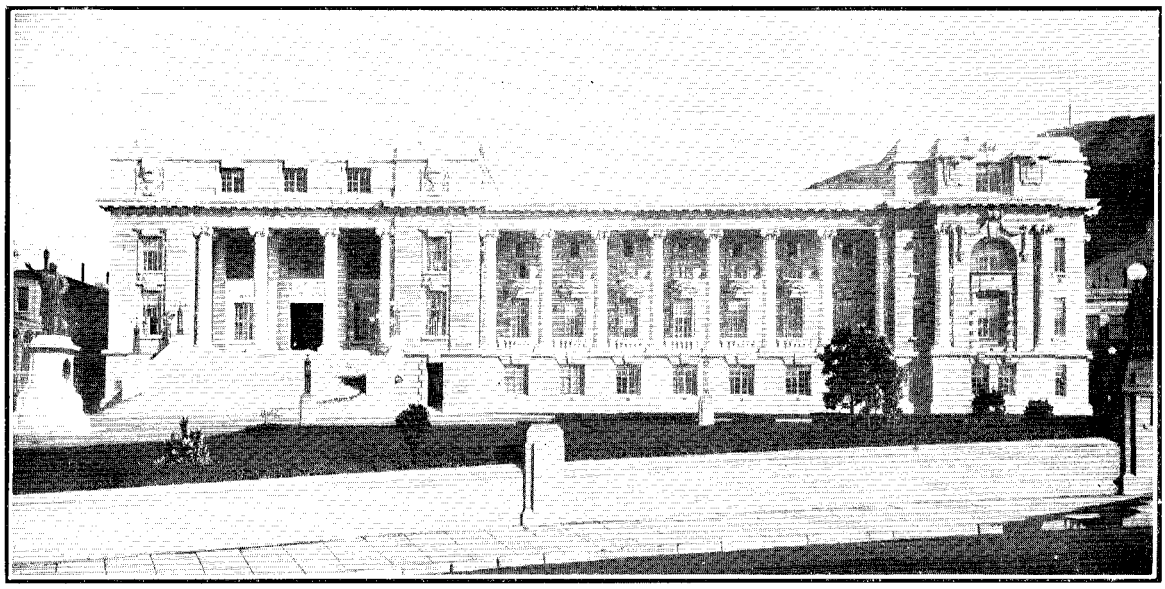
In order to keep construction-works adequately supplied with necessary mechanical apparatus and plant the equipment has been or is being increased by three locomotives, two drag-line excavators, a suction dredge, two road-rollers, and four portable oil-driven air-compressors.

CONCLUSION.

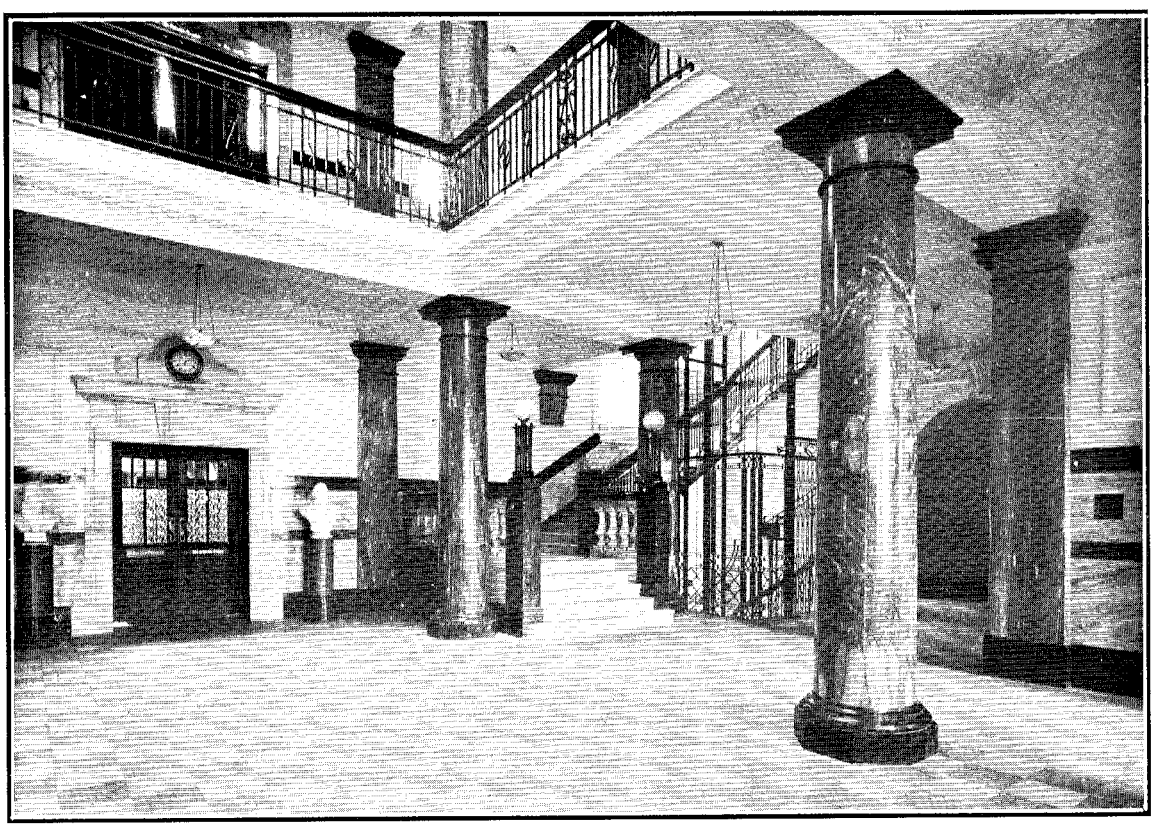
In conclusion, the Government conceives its duty to be not merely to concentrate on present-day requirements, but to visualize future necessities with the object of placing our Dominion in a position to receive and settle a greatly increased population. Apart from meeting existing reasonable requirements, we must at the same time comprehend and provide as far as possible for the stimulation of settlement and development of natural resources as yet almost untouched. It is only by judicious balancing of present necessities and anticipation of future requirements as well that a proper perspective can be obtained and the Government effectively carry out the trust reposed in it by the people.

Schedule showing Particulars of Railway-lines under Construction at 1st April, 1923.

Railway.	Length of Section.	Length under Construction.	Handed over to Railway Department on 1st April, 1923.	Rails laid during Year.	Length over which Traffic is being run.	Length over which Goods Traffic only is being run.	Length ready for handing over to Railway Department.	Ready for handing over to Railway Department within Six Months.	Ready for handing over to Railway Department within One Year.	Ready for handing over to Railway Department within Two Years.	Amount spent to Date.	Estimated Amount to Complete.
	M. CH.	M. CH.	M. CH.	M. CH.	M. CH.	M. CH.	M. CH.	M. CH.	M. CH.	M. CH.	£	£
Kaihu Valley	4 54	..	4 54	..	..	..	..	..	..	..	87,650	5,000
North Auckland Main Trunk—												
Whangarei Branch	14 52	14 52	..	..	14 52	..	..	..	14 52	..	293,872	20,654
Waipu Branch	16 0	9 20	..	..	..	..	..	..	..	..	25,303	105,000
Okaihau Section	8 20	8 20	..	..	8 20	..	..	8 20	..	..	189,827	13,567
Okaihau–Te Tio	21 0	..	..	..	..	..	..	..	..	..	25,956	472,500
Huarau–Waiotira	15 70	15 70	..	9 0	15 70	..	..	..	15 70	..	618,561	90,000
Waiotira–Kirikopuni	15 0	10 0	..	..	..	..	..	..	..	12 0	84,243	386,000
Pukehuia–Dargaville	13 40	..	..	..	..	..	..	..	..	..	..	229,500
Huntly–Awaroa	1 60	1 60	..	1 60	..	1 60	..	1 60	..	..	64,984	16,729
East Coast Main Trunk—												
Waihi–Tauranga	41 5	19 63	..	..	..	..	..	..	..	9 68	187,500	683,000
Tauranga–Taneatua (including Mount Branch)	63 12	63 12	..	3 15	38 23	12 24	..	..	..	63 12	938,338	425,380
Taneatua–Opotiki	25 0	..	..	..	..	..	..	..	..	..	..	500,000
Gisborne–Wairoa	70 0	14 12	..	..	11 18	..	..	..	11 18	..	255,724	1,510,000
Wairoa–Napier	70 0	19 13	..	8 0	..	11 64	11 64	..	..	..	263,666	1,520,000
Waikokopu Branch	24 58	24 58	..	21 20	..	..	..	..	..	24 58	354,505	120,000
Stratford Main Trunk—												
Kohuratahi–Tahora	5 14	5 14	..	..	5 14	..	..	..	5 14	..	213,599	18,000
Tahora–Ohura	24 0	..	..	..	..	..	..	..	..	..	28,060	750,000
Ohura–Okahukura	19 0	19 0	..	10 23	10 23	..	..	..	10 23	8 60	390,738	305,000
Opunake Branch and Manaia Branch	28 49	28 49	..	8 40	..	..	..	..	12 49	16 0	174,385	220,000
Midland—												
Glenhope–Inangahua	55 0	3 71	..	..	..	..	..	..	3 71	..	63,341	1,300,000
Otira–Arthur's Pass	8 40	8 40	..	..	..	..	..	8 40	..	..	1,412,084	150,000
Westport–Inangahua	22 0	..	..	..	..	..	..	..	..	..	152,702	600,000
Greymouth–Port Elizabeth ..	2 45	2 45	..	..	..	..	2 45	..	..	..	70,963	2,827
South Island Main Trunk—												
Wharanui–Parnassus	83 0	..	..	..	..	..	..	..	..	..	..	2,000,000
Laurence–Roxburgh—												
Beaumont–Miller's Flat ..	15 0	10 63	..	4 37	..	..	..	..	..	15 0	93,443	135,000
Miller's Flat–Roxburgh ..	10 0	..	..	..	..	..	..	..	..	..	..	130,000
Orepuki–Waiau	8 24	8 24	..	..	..	..	..	..	8 24	..	37,049	25,777
Balclutha–Tuapeka Mouth ..	22 50	..	..	..	..	..	..	..	..	..	..	250,000
Rimutaka Deviation	13 24	..	..	..	..	..	..	..	..	..	..	970,000
Wellington–Tawa Flat Deviation	8 0	..	..	..	..	..	..	..	..	..	..	950,000
Totals	..	287 46	4 54	66 35	103 60	25 68	14 29	18 40	82 1	149 38	6,026,493	13,903,934

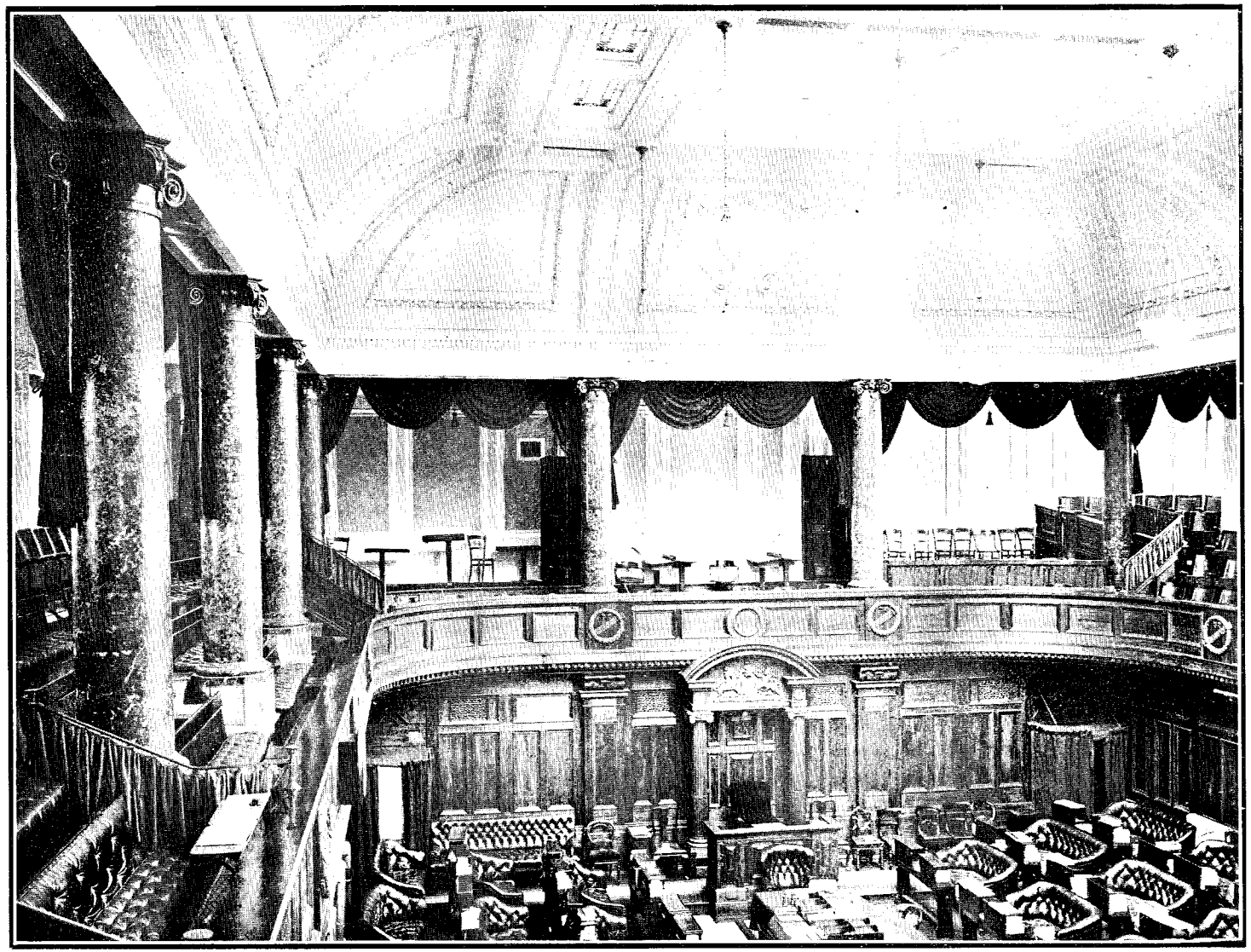


Parliament Buildings, Wellington: Front Elevation facing Molesworth Street.

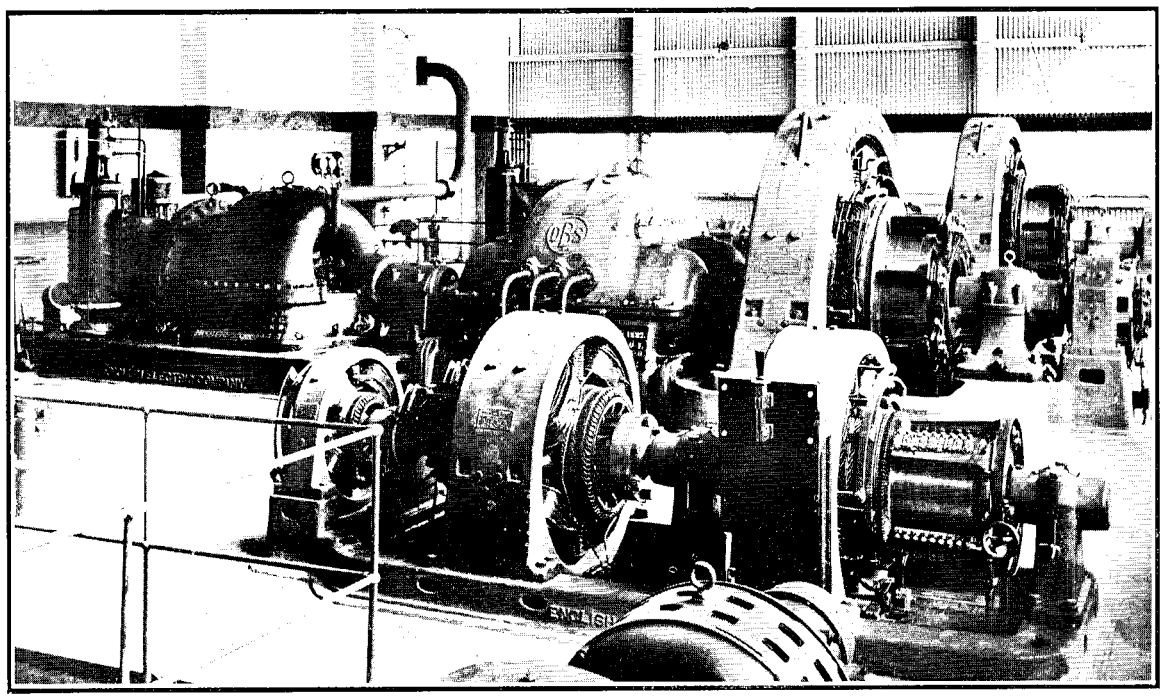


Parliament Buildings, Wellington: Main Entrance Hall.

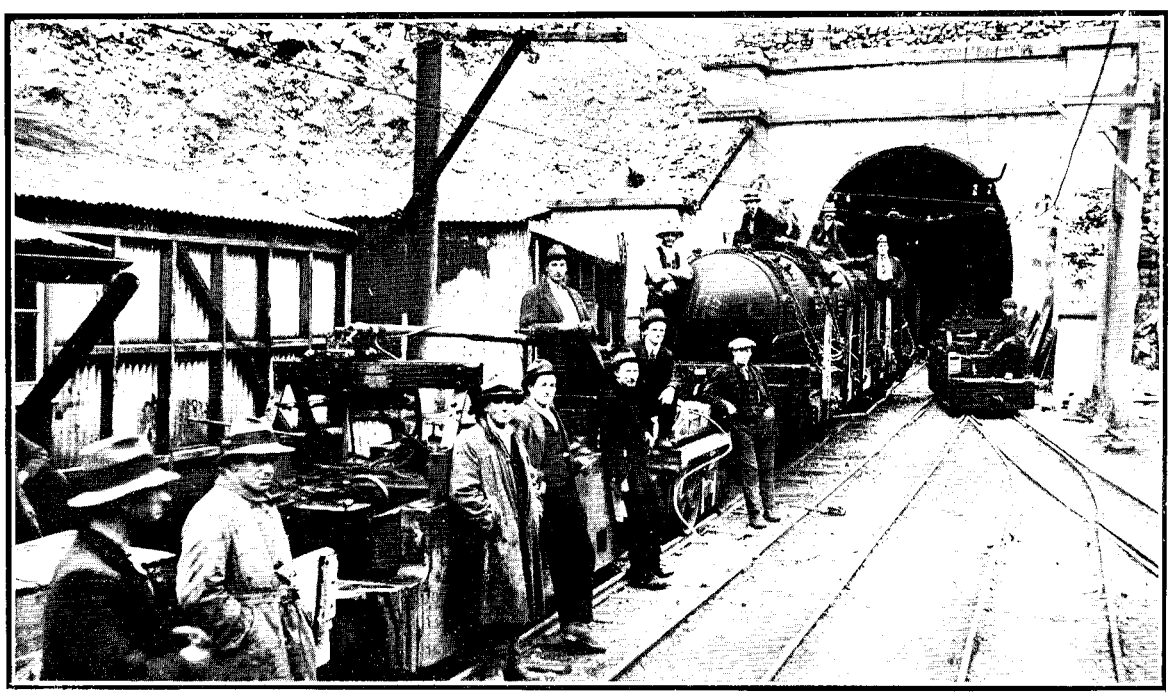
Floor consists of black and white marble slabs; columns, dado, &c., of polished marble, staircase of white marble, all from Sandy Bay, Nelson.



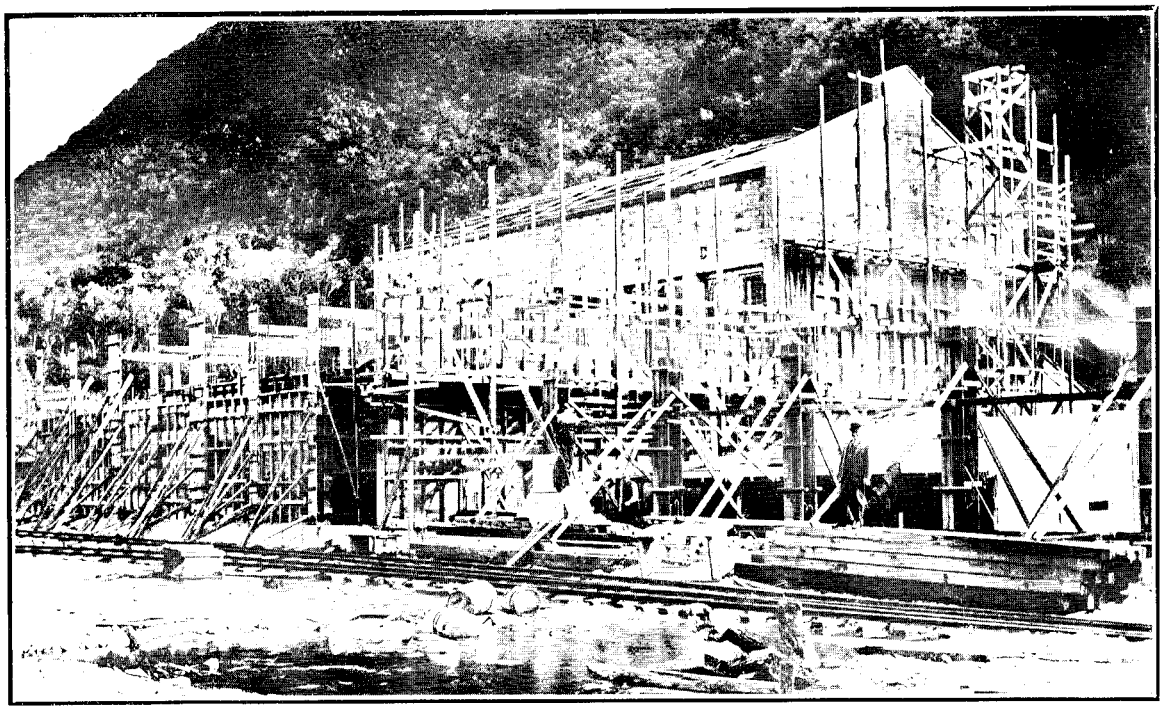
PARLIAMENT BUILDINGS: CHAMBER OF HOUSE OF REPRESENTATIVES.
View of portion of Chamber, showing Speaker's chair.



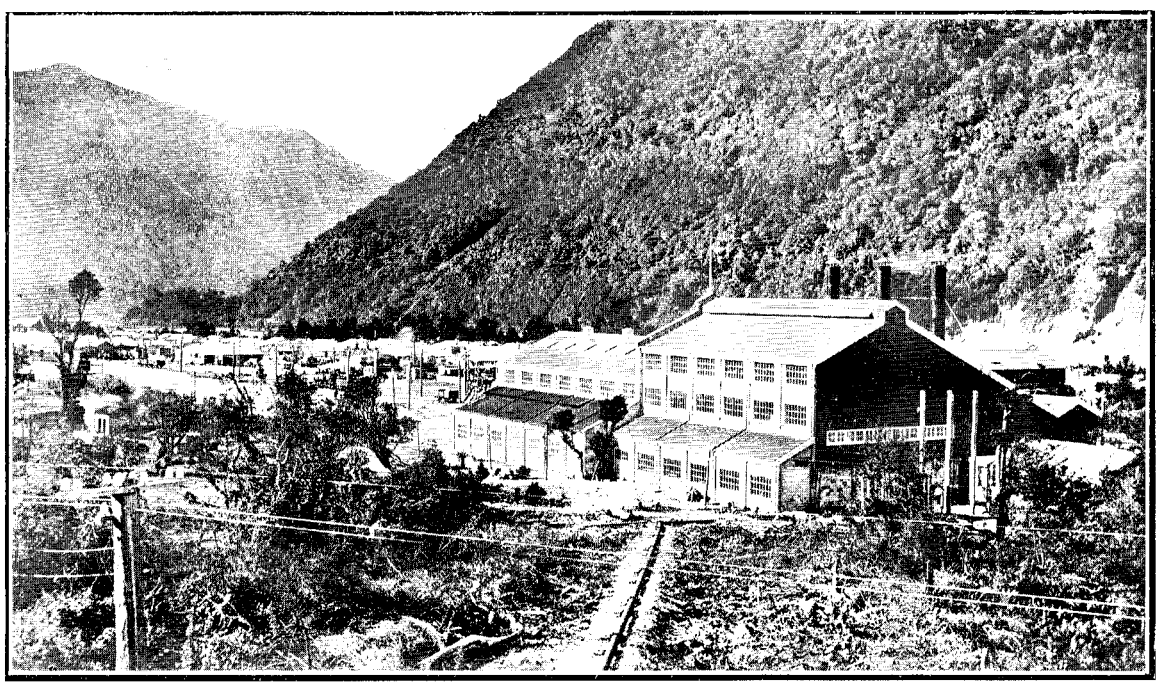
Arthur's Pass Tunnel: Interior of Power-house at Otira, showing Turbine.



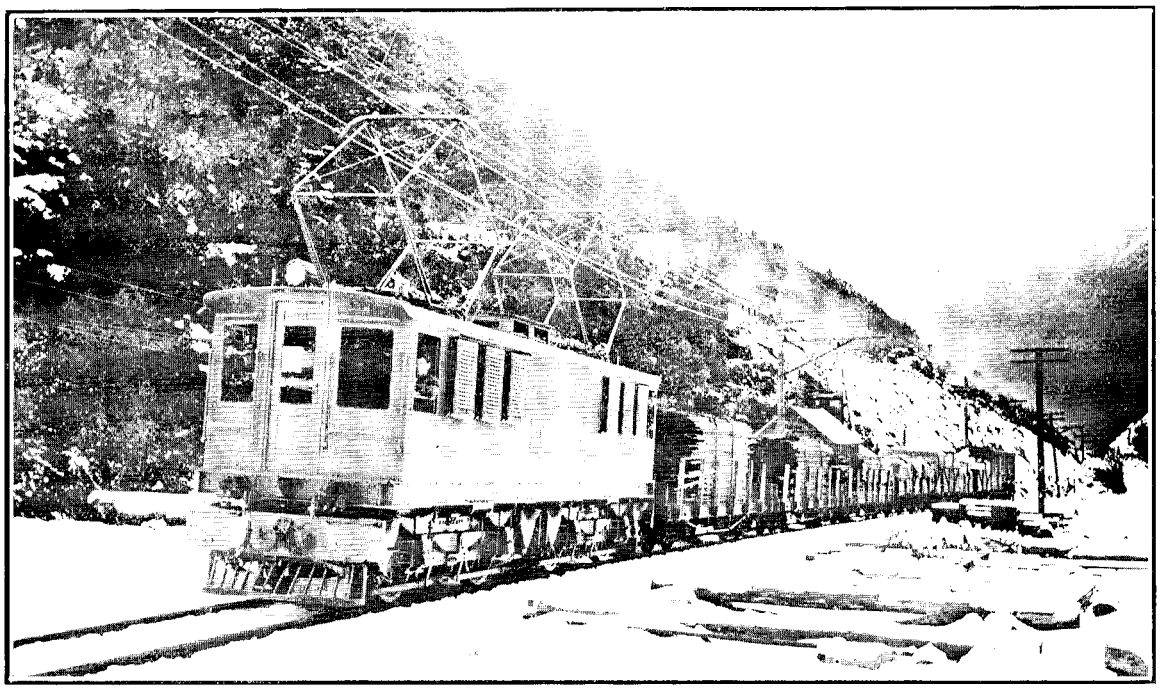
Arthur's Pass Tunnel: First Train to pass through Tunnel, Jeffery Electric Locomotive hauling Machinery for Power-house.



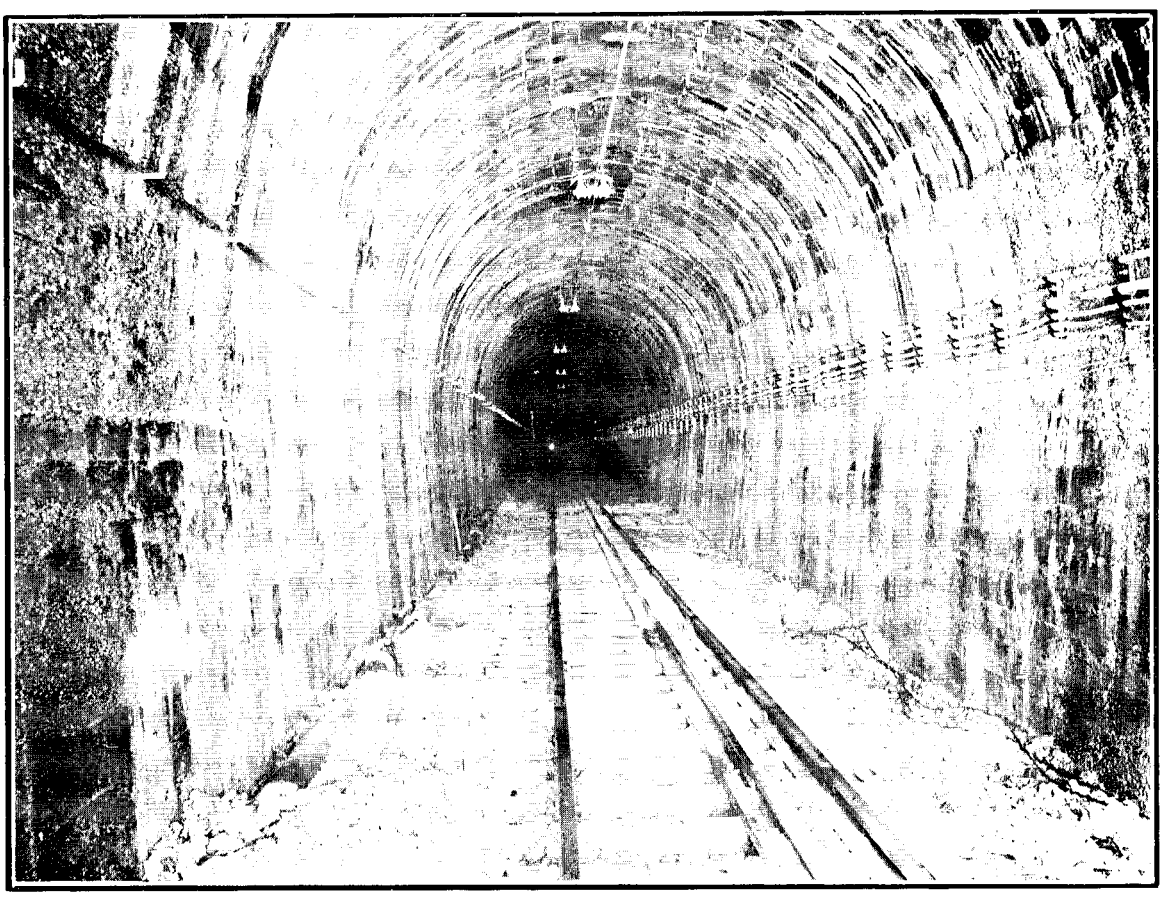
Power-house at Otira under Construction.



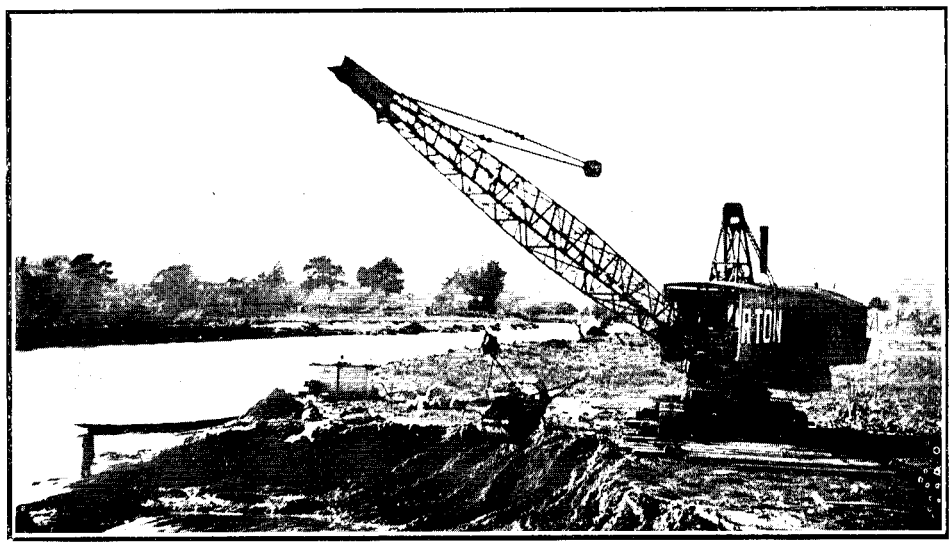
Arthur's Pass Tunnel: Otira Power-house and Village.



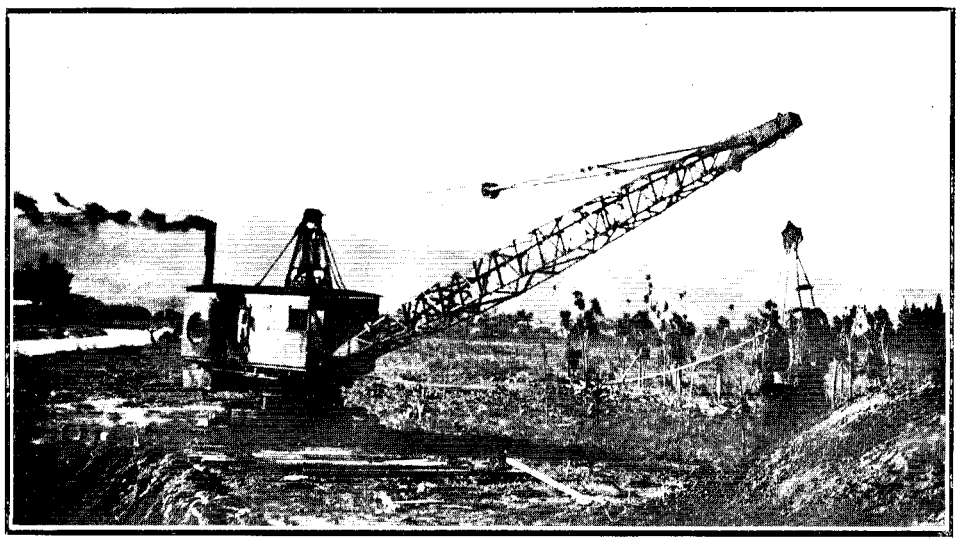
Arthur's Pass Tunnel: Electric Locomotive on Main Line.



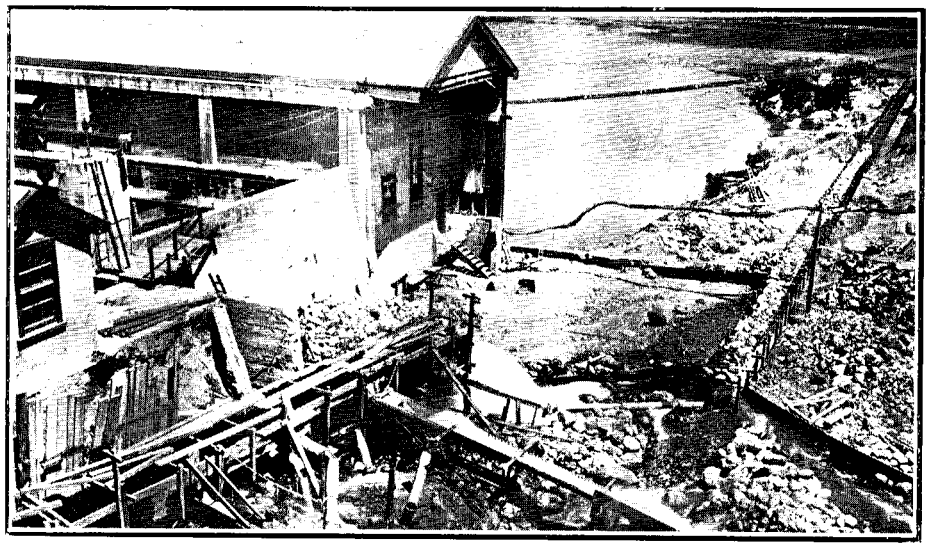
Interior View of Tunnel, showing Feeder Cables and Overhead Suspension.



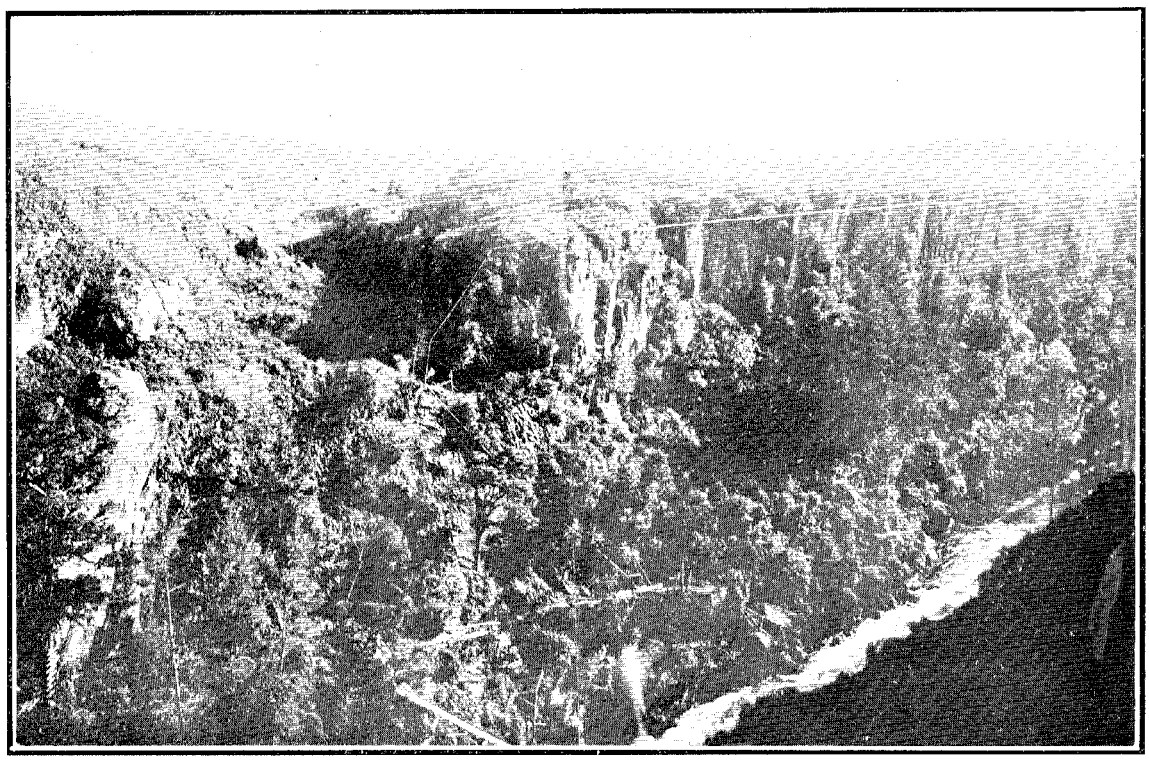
Waihou and Ohinemuri Rivers Improvement.—Ohinemuri Left bank: Drag-line Excavating.



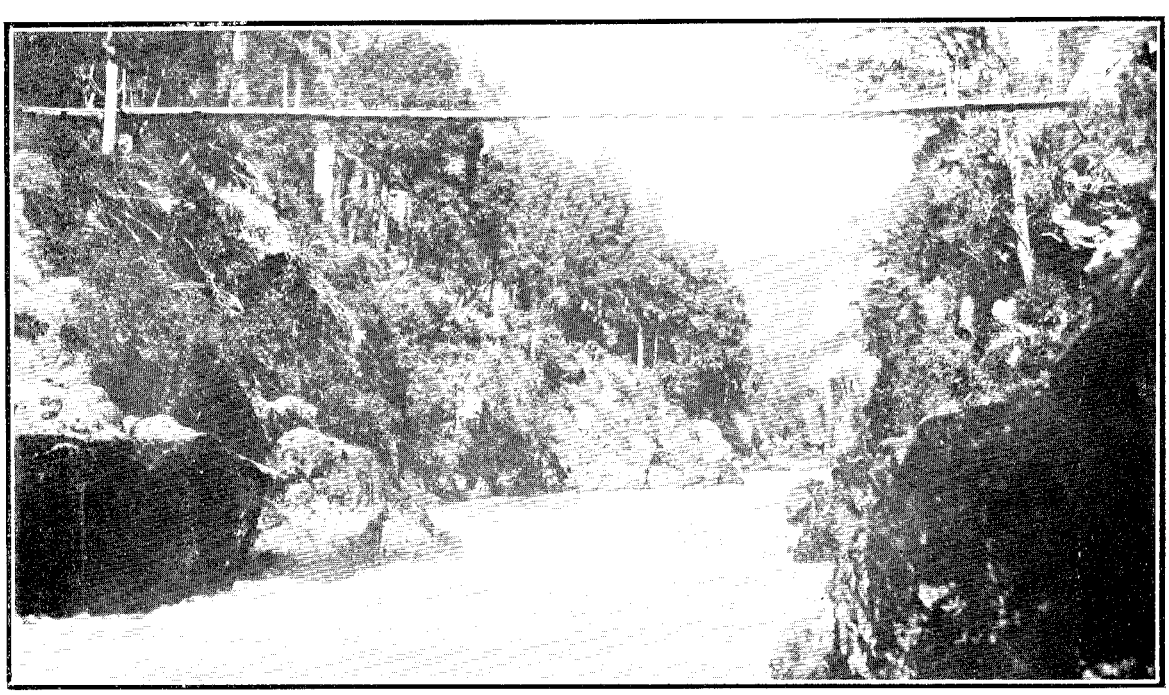
Waihou and Ohinemuri Rivers Improvement.—Ohinemuri Left bank: Drag-line Depositing.



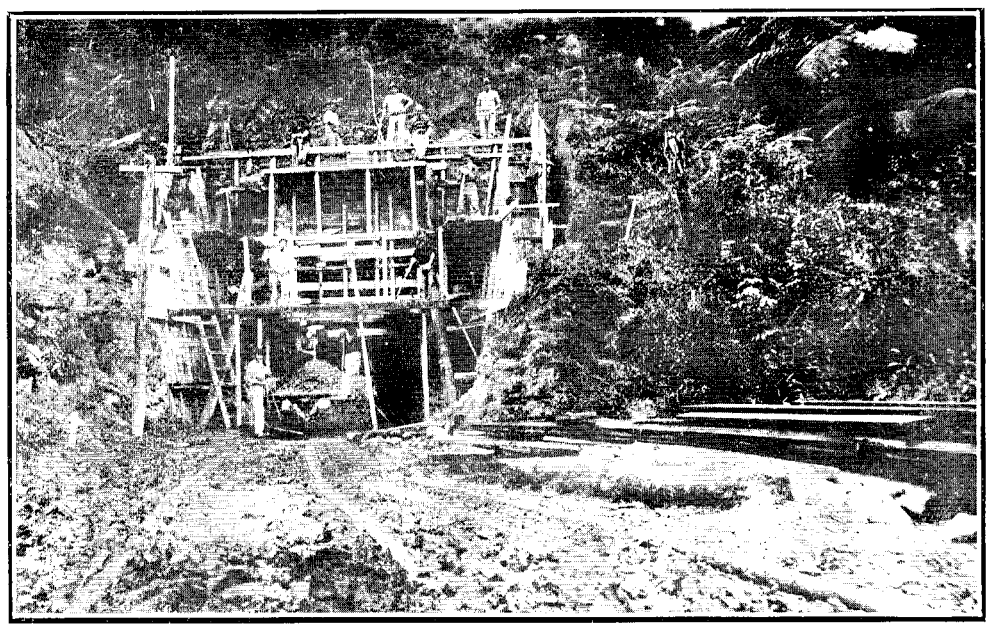
Horahora Power Scheme, showing Boulders left after sluicing Bank.



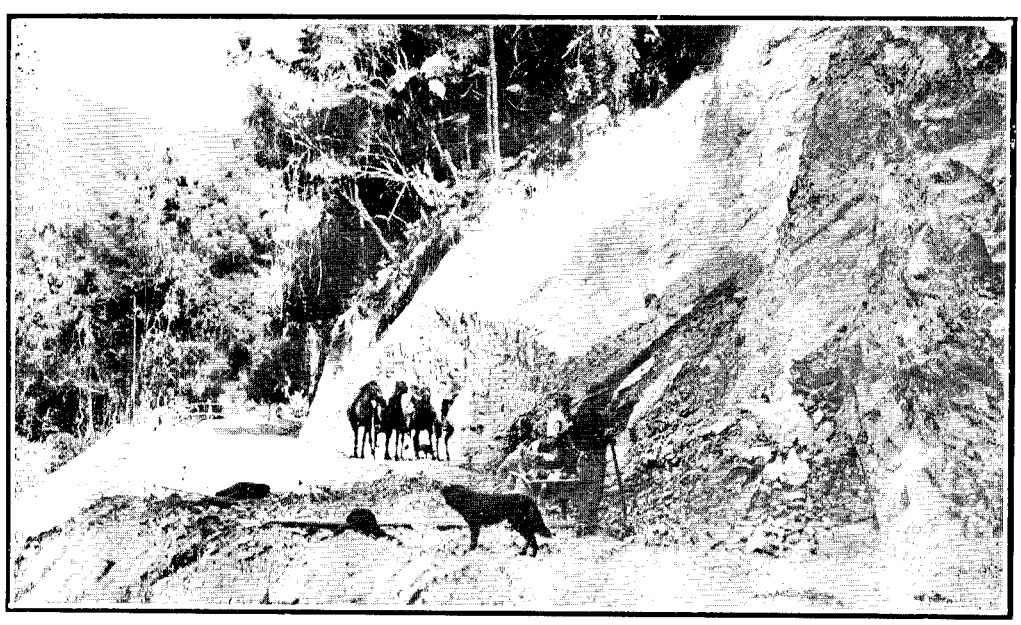
Arapuni Gorge.



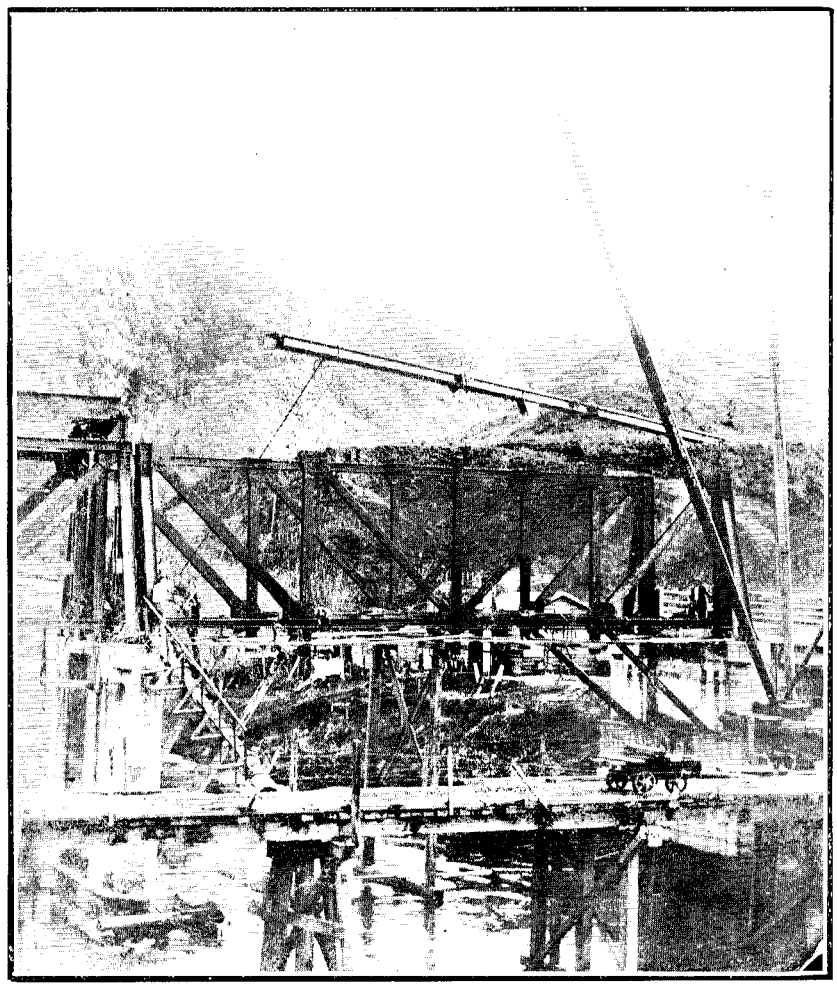
Waikato River at Arapuni Dam Site.



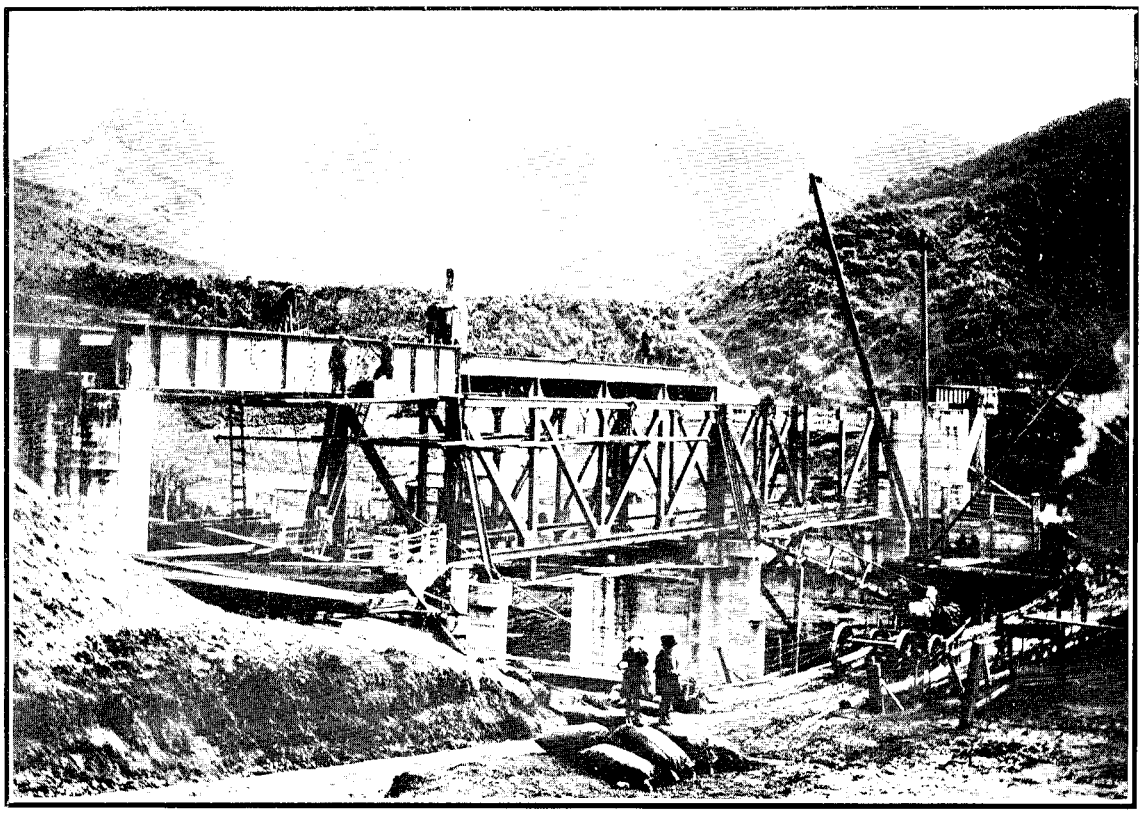
North Auckland Main Trunk Railway: Golden Stairs Tunnel, South Portal.



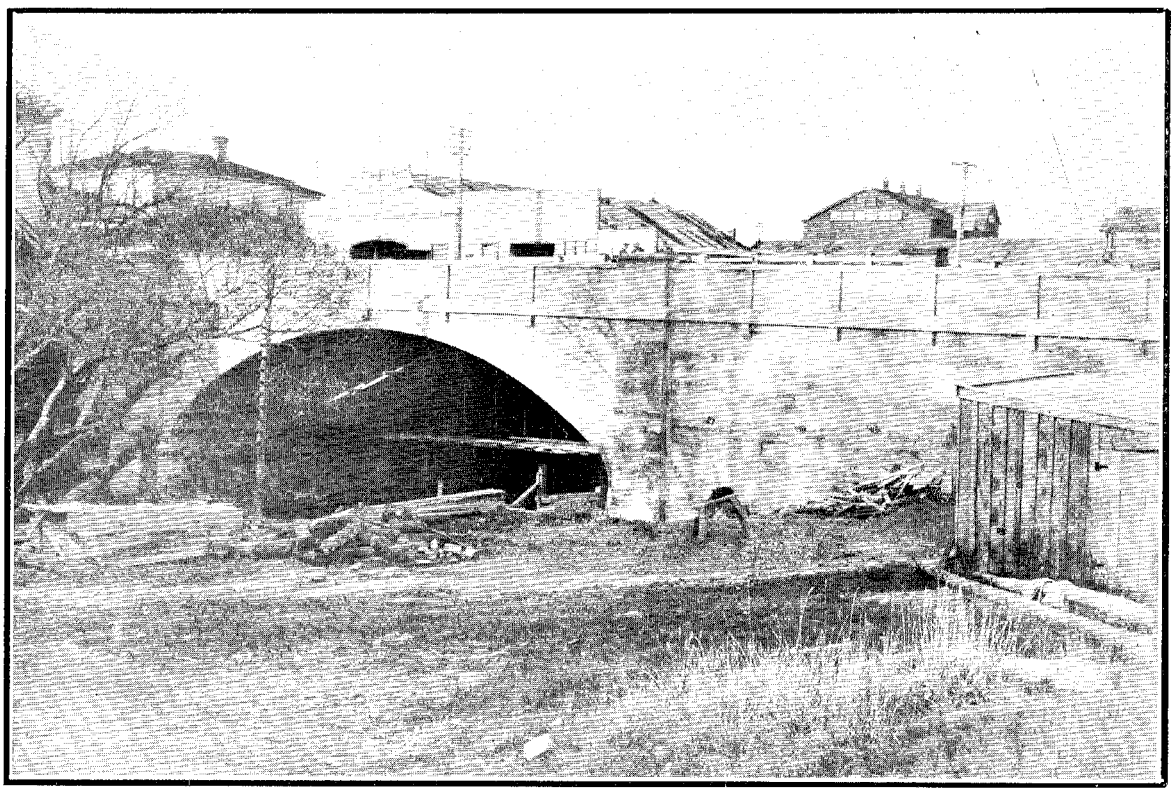
Urewera Country. Waimana River Valley Road: Bluff at 9 Miles 65 Chains.



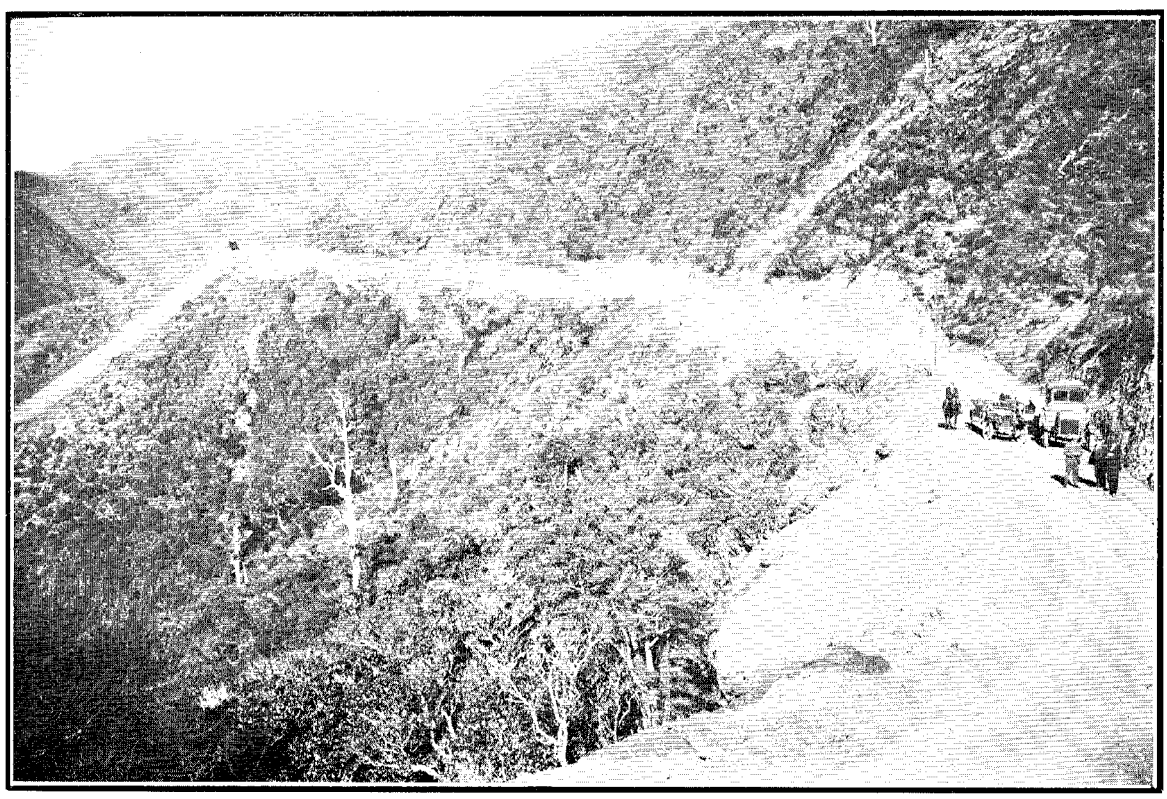
Stratford Main Trunk Railway: Combined Road and Railway Bridge over Ongarue River at Okahukura (under Construction).



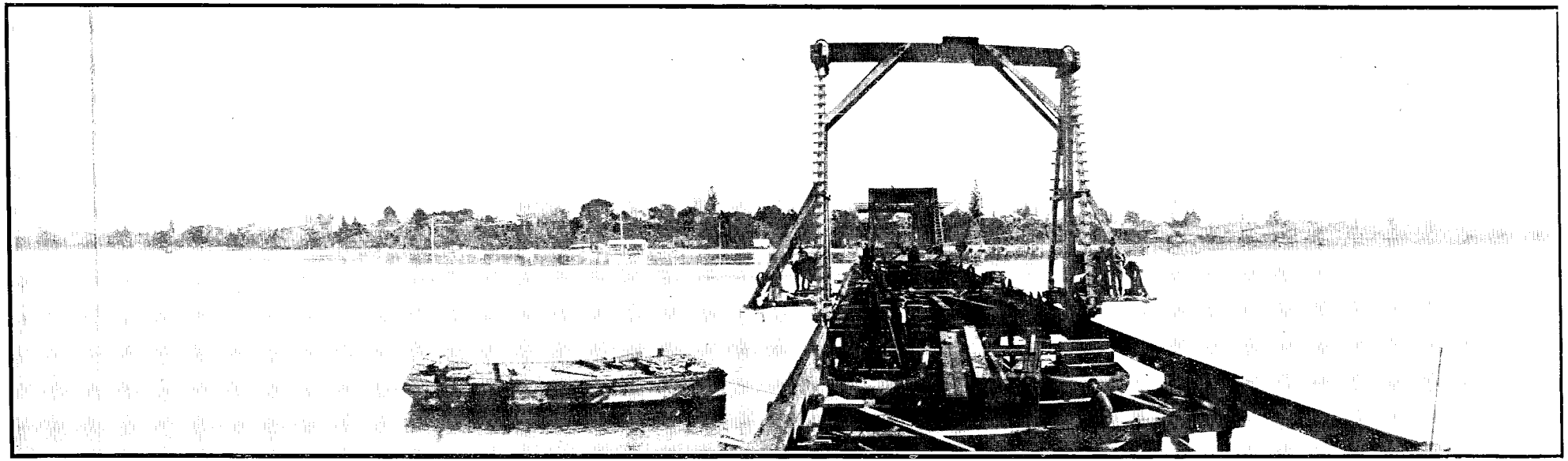
Stratford Main Trunk Railway: Combined Road and Railway Bridge over Ongarue River at Okahukura (under Construction).



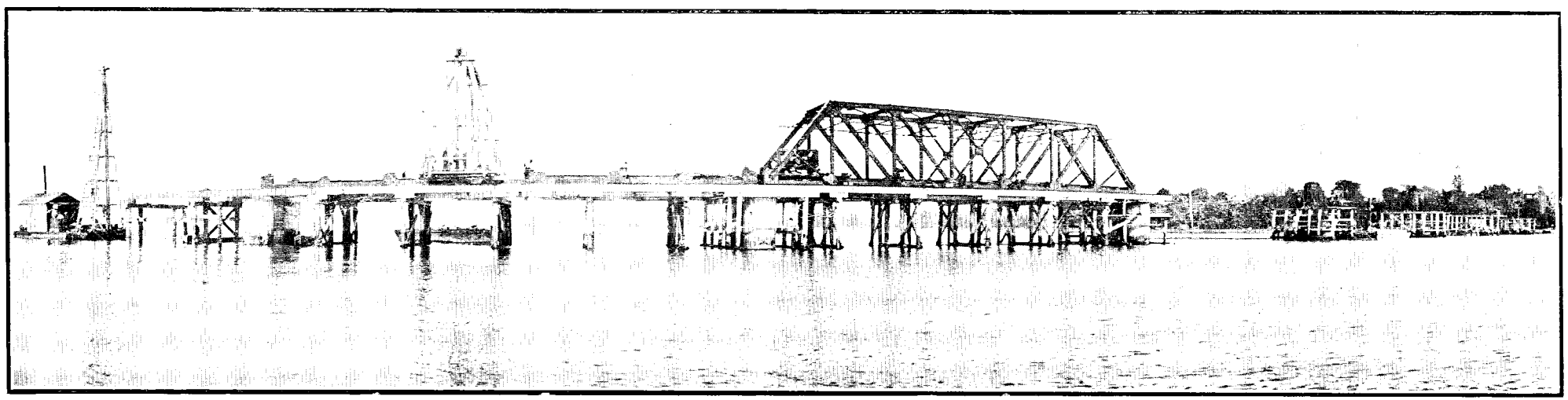
Patea River Bridge, Stratford: Western Elevation.



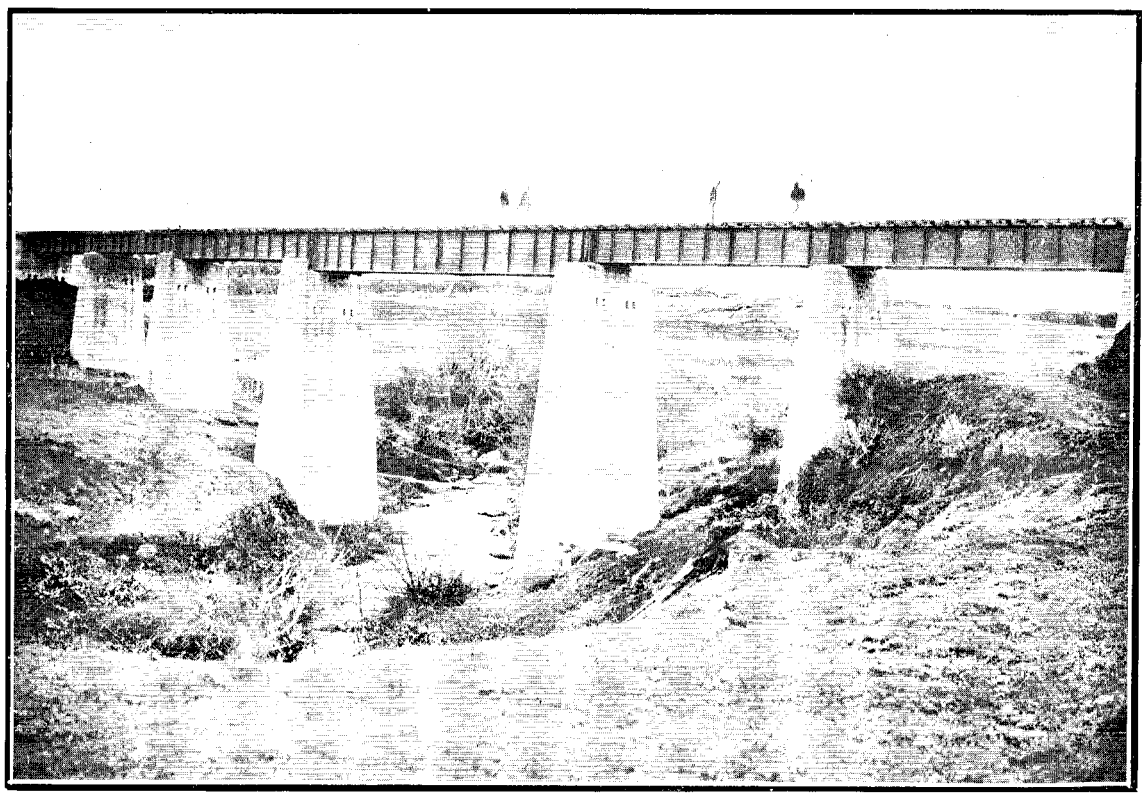
Rimutaka Road Improvement: View showing Character and Dimensions of New Road.



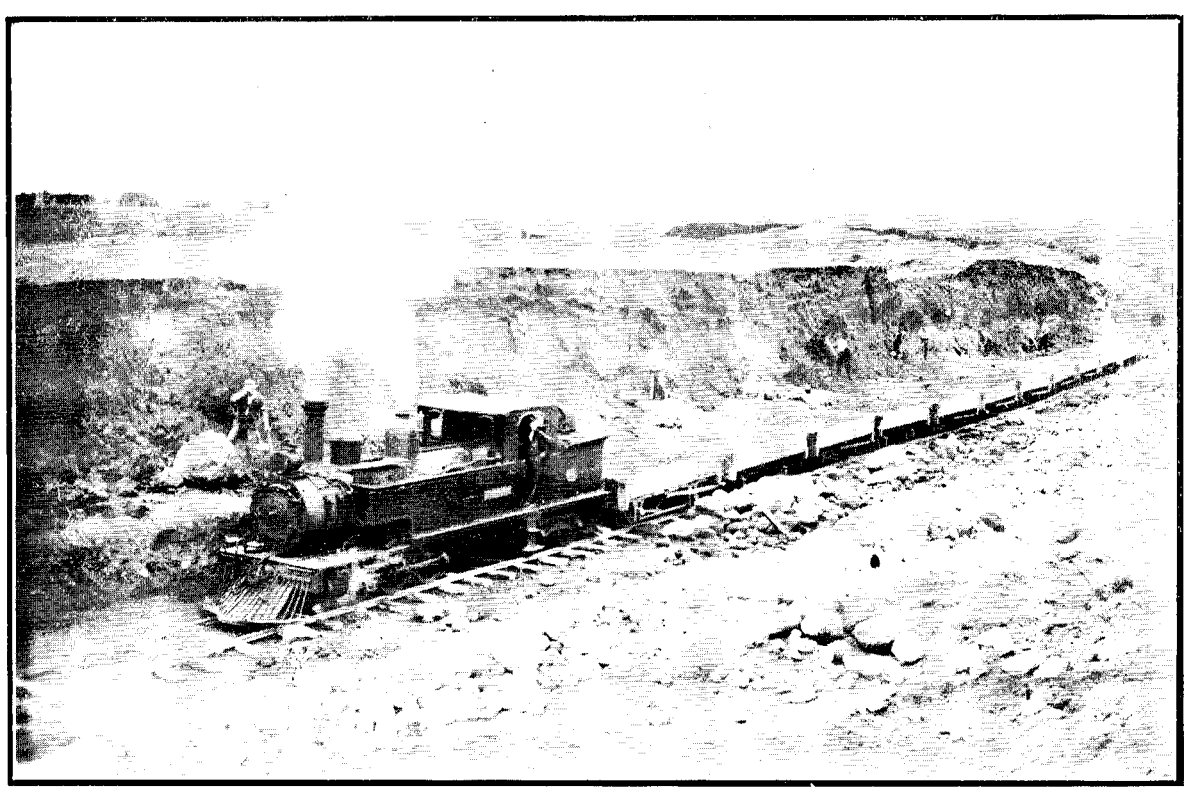
TAURANGA HARBOUR BRIDGE, SHOWING STAGING FOR SPAN.



TAURANGA HARBOUR BRIDGE, SHOWING PIER "P" IN FOREGROUND.



Te Roti—Opunake Railway: Bridge over Mangatoki Stream.



Te Roti—Opunake Railway: Ballast-pit at Kaupokonui River, Kapuni.

PUBLIC WORKS STATEMENT, 1923.

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TABLES.

APPENDICES.

TABLE No. 1.

SUMMARY SHOWING THE TOTAL EXPENDITURE ON PUBLIC WORKS AND OTHER SERVICES OUT OF PUBLIC WORKS FUND TO 31ST MARCH, 1923, AND THE LIABILITIES ON THAT DATE.

Number of Table containing Details.	Works.	Total Net Expenditure to 31st March, 1922.	Expenditure during Twelve Months ended 31st March, 1923.	Recoveries on Account of Services of Previous Years.	Total Net Expenditure to 31st March, 1923.	Liabilities on 31st March, 1923.	Total Net Expenditure and Liabilities.	Works.
		£	£	£	£	£	£	
3	Railways*	40,735,641	2,110,859	3,171	42,843,329	261,910	43,105,239	Railways.
..	Roads	13,111,960	648,006	244	13,759,722	257,731	14,017,453	Roads.
..	Development of mining	835,805	*Cr.* 98	1,785	833,922	..	833,922	Development of mining.
..	Telegraphs	5,000,427	512,657	11,082	5,502,002	360,027	5,862,029	Telegraphs.
..	Public buildings	8,635,603	257,694	1,876	8,891,421	93,346	8,984,767	Public buildings.
..	Lighthouses, harbour-works, and harbour-defences	1,175,553	9,784	1,235	1,184,102	3,918	1,188,020	Lighthouses, harbour-works, and harbour-defences.
..	Departmental	1,817,407	111,367	131	1,928,643	513	1,929,156	Departmental.
18 of 1878	Coal-exploration and mine-development	10,835	..	..	10,835	..	10,835	Coal-exploration and mine-development.
11 of 1877	Aiding works on Thames goldfields	50,000	..	..	50,000	..	50,000	Aiding works on Thames goldfields.
..	Immigration	2,507,271	90,611	140	2,597,742	..	2,597,742	Immigration.
..	Purchase of Native lands	2,061,739	..	..	2,061,739	..	2,061,739	Purchase of Native lands.
..	Defence	1,086,052	1,702	463	1,087,291	..	1,087,291	Defence.
..	Charges and expenses of raising loans	1,427,538	62,399	..	1,489,937	..	1,489,937	Charges and expenses of raising loans.
..	Interest and sinking fund	218,500	..	..	218,500	..	218,500	Interest and sinking fund.
..	Rates on Native lands	68,672	..	..	68,672	..	68,672	Rates on Native lands.
..	Thermal springs	14,600	..	..	14,600	..	14,600	Thermal springs.
..	Tourist and health resorts	304,181	5,435	..	309,616	493	310,109	Tourist and health resorts.
..	Lands improvement	157,846	26,204	..	184,050	1,202	185,252	Lands improvement.
..	Payment to Midland Railway bondholders	150,000	..	..	150,000	..	150,000	Payment to Midland Railway bondholders.
..	Irrigation and water-supply†	332,892	58,131	..	391,023	3,512	394,535	Irrigation and water-supply.
..	Plant, material, and stores	435,638	*Cr.* 19,708	..	415,930	16,136	432,066	Plant, material, and stores.
..	Timber-supply and sawmills for Public Works Department	16,369	14,725	..	31,094	141	31,235	Timber-supply and sawmills for Public Works Department.
..	Motor Transport Services	..	22,679	..	22,679	..	22,679	Motor Transport Services.
	Totals	80,154,529	3,912,447	20,127	84,046,849	998,929	85,045,778	Totals.

* Exclusive of expenditure on Hutt Railway and Road Improvement and Railways Improvement Accounts.

† Includes £115,000 previously expended under Irrigation and Water-supply Account 1911–12 to 1915–16 and part 1917–18, now included in Public Works Fund.

TABLE No. 2.

GENERAL SUMMARY.

Showing NET YEARLY EXPENDITURE out of PUBLIC WORKS FUND, 1901–1902 to 1922–23.

N.B.—The figures in italics, prefixed by "*Cr.*," are either recoveries on account of services of previous years or receipts-in-aid applied in reduction of expenditure.

Description of Services.	Total Net Expenditure to 31st March, 1901.	Expenditure.										
		1901–2.	1902–3.	1903–4.	1904–5.	1905–6.	1906–7.	1907–8.	1908–9.	1909–10.	1910–11.	1911–12.
	£	£	£	£	£	£	£	£	£	£	£	£
Immigration	1,247,719	139	142	*Cr* 7	6,481	8,753	14,353	9,132	15,075	17,003	9,441	11,681
Public Works, Departmental	459,316	17,771	13,949	16,088	12,814	13,517	16,710	18,219	24,512	41,176	42,733	49,864
Development of Water-power	..	..	..	..	468	2,901	4,664	315	..	..	1,021	9,082
Irrigation and Water-supply	..	..	..	..	..	..	..	..	..	..	1,562	2,794
Railways	17,168,026	1,333,940	759,752	828,704	779,891	1,021,265	1,227,880	1,093,535	1,116,183	1,128,400	1,104,071 *Cr. 652*	1,125,905 *Cr. 6,987*
Payment to Midland Railway Bondholders	..	..	..	150,000	..	..	..	..	..	..	..	..
Roads :—												
Miscellaneous Roads and Bridges	4,759,464 *Cr. 347*	354,687	230,349	316,248	202,850	306,065	308,500	285,248	422,174	297,932	229,537	383,511
Roads on Goldfields..	487,879	47,573	51,690	45,594	26,112	45,139	38,970	38,494	47,375	40,830	25,626	41,067
Development of Thermal Springs and Natural Scenery ..	16,023	..	..	..	..	..	..	..	..	..	..	..
Lands Improvement Account*	300,930	..	..	..	..	..	..	..	..	..	..	..
Total, Roads	5,563,949	402,260	282,039	361,842	228,962	351,204	347,470	323,742	469,549	338,762	255,163	424,578
Development of Mining	686,353	15,326	24,213	16,278	6,258	18,533	11,064	8,633	32,859	18,597 *Cr. 1,000*	10,845 *Cr. 1,000*	21,244 *Cr. 30*
Purchase of Native Lands	1,472,990	18,261	15,782	5,352	6,281	13,777	9,135	2,190	2,099	30,567	2,976 *Cr. 2,286*	*Cr. 2,466*
Native Lands Purchase Account	491,980	..	..	..	..	..	..	..	..	..	..	..
Total, Land Purchases	1,964,970	18,261	15,782	5,352	6,281	13,777	9,135	2,190	2,099	30,567	690	*Cr. 2,467*
Telegraph Extension	906,158	31,729	68,578	47,228	79,298	77,186	114,068	155,491	163,032	123,423	111,867	147,692

* Subsequent expenditure under separate class "Lands Improvement," see next page.

[*Continued on page 4.*

TABLE No. 2—*continued.*

GENERAL SUMMARY—*continued*

Showing Net Yearly Expenditure out of Public Works Fund, 1901–1902 to 1922–23—*continued.*

Description of Services.	Total Net Expenditure to 31st March, 1901.	Expenditure.										
		1901–2.	1902–3.	1903–4.	1904–5.	1905–6.	1906–7.	1907–8.	1908–9.	1909–10.	1910–11.	1911–12.
	£	£	£	£	£	£	£	£	£	£	£	£
Public Buildings:—												
General (including Miscellaneous)	243,923	12,513	9,031	10,964	9,021	2,231	14,216	16,260	39,635	41,964	44,044	34,721
Parliamentary	55,026	4,424	1,503	602	697	71	1,047	4,119	5,172	3,157	237	2,004
Judicial { Courthouses	410,127	15,902	16,627	8,799	2,174	6,509	9,580	5,788	14,473	11,119	5,759	14,556
Judicial { Prisons		2,796	4,964	6,876	4,127	1,537	3,146	4,164	5,008	4,231	7,506	9,760
Judicial { Police-stations		10,030	11,633	10,303	6,782	7,853	22,466	18,986	17,730	16,256	9,030	19,817
Post and Telegraph	217,325	40,361	74,686	53,918	16,008	38,419	43,918	43,724	62,262	68,574	117,815	130,815
Customs	7,902	2,066	6,630	8,719	13,018	7,903	414	47	2,507	233	..	..
Quarantine Stations	6,441	424	..	..	..	..	..	..	..	..	..	..
Mental Hospitals	458,852	16,743	10,167	15,812	15,949	16,235	8,049	7,987	15,296	19,839	12,707	8,809
Public Health	..	..	..	6,315	4,265	7,926	1,765	7,497	4,402	319	..	..
Hospitals and Charitable Institutions	54,484	1,200	3,540	4,291	1,204	4,786	10,259	15,576	11,153	7,259	1,484	12,745
School Buildings	1,049,361	38,606	57,790	87,089	42,721	69,223	109,459	100,197	102,340	98,103	124,926	90,535
Agricultural	6,209	535	883	2,504	1,362	2,618	2,707	1,690	5,543	6,103	1,160	3,684
Workers' Dwellings	..	..	..	..	..	..	..	..	..	..	..	22,644
Total, Public Buildings	2,509,650	145,600	197,454	216,192	117,328	165,311	227,026	226,035	285,521	277,157	324,668	350,090
Lighthouses, Harbour-works, and Harbour-defences:—												
Lighthouses	145,378	2,060	6,082	6,206	2,167	962	..	1,417	7,481	6,762	1,470	5,428
Harbour-works	319,734	3,421	1,373	1,773	1,308	2,684	2,963	2,867	4,439	4,548	4,092	6,004
Harbour-defences	500,501	6,678	6,126	2,885	2,515	1,300	1,541	2,579	7,297	5,372	2,865	1,144
Total, Lighthouses, &c.	965,613	12,159	13,581	10,864	5,990	4,946	4,504	6,863	19,217	16,682	8,427	12,576
Rates on Native Lands	64,226	571	471	666	631	548	695	837	27	..	..	..
Contingent Defence	549,960	146,875	37,005	38,723	46,588	35,569	14,874	18,574	10,766	4,977	6,071	10,437
Tourist and Health Resorts	..	11,260	10,949	15,643	17,508	15,888	42,271	45,048	24,286	14,507	5,912	13,361
Lands Improvement*	..	1,741	2,349	2,019	2,248	1,052	5,605	9,561	19,542	6,910	11,125	20,394
Charges and Expenses of raising Loans	1,057,771	5,620 *Cr. 516*	88,180	87,249	10,764	236	*Cr. 5,175*	*Cr. 8,487*	575	17,715 *Cr. 12,000*	66,367 *Cr. 66,392*	67,470 *Cr. 66,954*
Interest and Sinking Funds	218,500	..	..	..	..	..	..	..	..	..	..	..
Coal-exploration and Mine-development	10,835	..	..	..	..	..	..	..	..	..	..	..
Thermal Springs	14,600	..	..	..	..	..	..	..	..	..	..	..
Total Ways and Means Credits	*347*	*516*	..	*7*	..	..	*5,175*	*8,487*	..	..	..	*10,530*
Grand Total—Net Expenditure	34,287,646	2,142,736	1,514,444	1,796,841	1,321,510	1,730,686	2,035,144	1,909,688	2,183,245	2,022,876	1,891,918	2,190,731

* For previous expenditure see Roads Class.

[*Continued on page 5.*

TABLE No. 2—*continued.*

GENERAL SUMMARY—*continued.*

Showing NET YEARLY EXPENDITURE out of PUBLIC WORKS FUND, 1901–1902 to 1922–23—*continued.*

Description of Services.	Expenditure.											Total Net Expenditure to 31st March, 1923.
	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.	1917–18.	1918–19.	1919–20.	1920–21.	1921–22.	1922–23.	
	£	£	£	£	£	£	£	£	£	£	£	£
Immigration	14,694	33,914	33,219	10,010 *Cr. 10*	6,533	3,856	*Cr. 12,018*	*Cr. 62,561*	*Cr. 7,806*	247,528	90,611 *Cr. 140*	2,597,742
Public Works, Departmental	57,426	66,650	100,719	111,489	131,701	127,962 *Cr. 2,662*	115,419 *Cr. 4,119*	121,677	143,280 *Cr. 6,281*	128,002 *Cr. 525*	111,367 *Cr.* 131	1,928,643 ..
Irrigation and Water-supply*	14,689	33,602	32,090	29,874	20,794	11,650	13,665	34,115	55,344	82,713	58,131	391,023
Railways	1,148,832 *Cr. 29,528*	1,104,897 *Cr. 5,485*	2,146,753† *Cr. 6,022*	1,065,171 *Cr. 4,633*	620,947 *Cr. 4,845*	495,771 *Cr.* 110	387,923 *Cr. 4,924*	748,649 *Cr.105,196*	1,365,466 *Cr.* 388	3,133,200 *Cr. 751*	2,110,859 *Cr. 3,171*	42,843,329 ..
Payment to Midland Railway Bondholders	..	..	..	..	..	..	..	..	..	..	..	150,000
Roads :—												
Miscellaneous Roads and Bridges	337,584	353,836 *Cr. 515*	484,365	400,062	203,746	128,730 *Cr. 600*	221,887 *Cr. 997*	376,097 *Cr. 603*	527,854 *Cr. 81*	552,895 *Cr. 197*	643,156 *Cr. 244*	..
Roads on Goldfields	36,761	24,143	30,065	24,432	17,099	6,912	4,186	12,465	11,050	11,264	4,850	..
Development of Thermal Springs and Natural Scenery	..	..	..	..	..	..	..	..	..	..	..	..
Lands Improvement Account	..	..	..	..	..	..	..	..	..	..	..	..
Total, Roads	374,345	377,464	514,430	424,494	220,845	135,042	225,076	387,959	538,823	563,962	647,762	13,759,722
Development of Mining	10,644 *Cr. 1,015*	4,889	2,384 *Cr. 255*	6,602	4,592	27 *Cr. 6,545*	518 *Cr. 1,000*	1,173 *Cr. 7,008*	2,153 *Cr. 1,606*	2,130 *Cr.* 51	*Cr. 98* *Cr. 1,785*	883,922 ..
Purchase of Native Lands	*Cr. 917*	*Cr. 857*	*Cr. 1,060*	*Cr. 972*	*Cr. 868*	*Cr. 57*	..	*Cr. 57*	*Cr. 57*	*Cr. 52*	..	..
Native Lands Purchase Account	..	..	..	..	..	..	..	..	..	..	..	..
Total, Land Purchases	*Cr. 917*	*Cr. 857*	*Cr. 1,060*	*Cr. 972*	*Cr. 868*	*Cr. 57*	..	*Cr. 57*	*Cr. 57*	*Cr. 52*	..	2,061,739
Telegraph Extension	251,375	392,648	288,395	249,554	203,311	213,955	198,611	249,379	336,468	590,981	512,657 *Cr.11,082*	5,502,002

* Previously included under Lands Improvement.

† Includes £1,000,000 expended 1908–9 and 1909–10 under Wellington–Manawatu Railway Purchase Account.

[*Continued on page 6.*

TABLE No. 2—*continued.*

GENERAL SUMMARY—*continued.*

Showing NET YEARLY EXPENDITURE out of PUBLIC WORKS FUND, 1901–1902 to 1922–23—*continued.*

Description of Services.	Expenditure.											Total Net Expenditure to 31st March, 1923.
	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.	1917–18.	1918–19.	1919–20.	1920–21.	1921–22.	1922–23.	
	£	£	£	£	£	£	£	£	£	£	£	£
Public Buildings :—												
General (including Miscellaneous)	44,719	43,199	52,239	22,050	12,648	11,646 *Cr. 15,067*	43,168	64,207	39,504	87,057	113,553	..
Parliamentary	18,806	23,612	31,478	17,133	22,586	37,233	..	..	..	..	..	..
Judicial — Courthouses	20,097	9,423	5,171	4,902	299	21	..	868	1,400	4,358	2,018 *Cr. 13*	..
Judicial — Prisons	6,911	4,928	14,515	17,786	15,685	13,195	16,299	20,981	30,038 *Cr. 800*	41,740	23,313	..
Judicial — Police-stations	18,423	14,094	19,122	25,484	21,147	18,814	6,157	24,944	36,843	22,544	6,298	..
Post and Telegraph	122,999	78,815	60,838	35,258	22,744	33,525	26,072	66,543	93,364 *Cr. 560*	112,906 *Cr. 675*	77,211 *Cr. 69*	..
Customs	..	..	..	..	..	..	..	..	..	..	..	..
Quarantine Stations	..	..	..	..	..	..	..	35,490	15,529	4,581	154	..
Mental Hospitals	46,181	26,001	53,996	54,898 *Cr. 15*	44,602	26,502	14,640	18,277	27,368	41,838	13,852	..
Public Health	376	..	..	..	..	..	..	..	..	..	20,981	..
Hospitals and Charitable Institutions	8,750	1,435	998	1,426	7,570	4,080	2,332	8,484	4,099	26,131	*Cr. 1,399*	..
School Buildings	105,000	121,954	122,940	97,972	70,367	63,082	115,656	195,500	244,722	2,469 *Cr. 9,255*	.. *Cr. 367*	..
Agricultural	6,475	4,398	2,428 *Cr. 34*	2,972	3,046	5,685	4,229	7,227	9,345	1,115	514 *Cr. 27*	..
Workers' Dwellings	46,455	41,741	68,275	55,893	35,437	15,505	7,293	26,674	..	..	..	..
Total, Public Buildings	445,192	369,600	431,966	335,759	256,131	214,221	235,846	469,195	500,851	334,809	255,818	8,891,421
Lighthouses, Harbour-works, and Harbour-defences :—												
Lighthouses	9,031	5,174	3,887	1,415	449	561	1,663	253	758	16,350	3,260	..
Harbour-works	7,415	3,346 *Cr. 1,462*	12,563	9,355	2,280	2,359	3,729	3,245	4,080	2,424	6,524	..
Harbour-defences	339	539 *Cr. 300*	681	2,903	1,038	56	..	..	..	..	.. *Cr. 1,235*	..
Total, Lighthouses, &c.	16,785	7,297	17,131	13,673	3,767	2,976	5,392	3,498	4,838	18,774	8,549	1,184,102
Rates on Native Lands	..	..	..	..	..	..	..	..	..	..	..	68,672
Contingent Defence	23,790	30,186	15,221	37,619	9,742	6,714	8,809 *Cr. 922*	10,187	8,701	15,586	1,702 *Cr. 463*	1,087,291
Tourist and Health Resorts	12,906	14,989	8,232 *Cr. 12*	5,167 *Cr. 500*	1,094	931	1,620	6,194	19,041	17,996 *Cr. 110*	5,435	309,616
Lands Improvement*	22,550 *Cr. 383*	16,996 *Cr. 432*	13,810 *Cr. 522*	5,936	*Cr. 2,731*	1,838	*Cr. 4,268*	2,964	2,064	17,478	26,204	184,050
Charges and Expenses of raising Loans	72,950 *Cr. 71,681*	105,449 *Cr. 96,741*	35,495 *Cr. 34,865*	5,037 *Cr. 5,030*	35	1	..	..	184	174,280	62,399	1,489,937
Interest and Sinking Funds	..	..	..	..	..	..	..	..	..	..	..	218,500
Coal-exploration and Mine-development	..	..	..	..	..	..	..	..	..	..	..	10,835
Thermal Springs	..	..	..	..	..	..	..	..	..	..	..	14,600
Plant, Material, and Stores	..	..	..	74,418	9,778	6,811	20,638 *Cr. 31*	47,682	169,910	106,432	*Cr. 19,708*	415,930
Timber-supply and Sawmills for Public Works Department	..	..	..	..	..	..	..	..	..	16,369	14,725	31,094
Motor Transport Service	..	..	..	..	..	..	..	..	..	..	22,679	22,679
Total Ways and Means Credits	*103,524*	*105,792*	*43,400*	*11,160*	*5,713*	*43,492*	*11,993*	*112,864*	*19,627*	*11,616*	*20,127*	..
Grand Total—Net Expenditure	2,362,654	2,455,066	2,597,109	2,363,658	1,502,588	1,237,422	1,207,482	2,020,714	3,121,131	3,449,351	3,892,320	84,046,849

* Includes expenditure on irrigation and Water-supply—1905–6, £22; 1906–7, £750; 1907–8, £1,554; 1908–9, £1,966.

TABLE No 3.

Expenditure on Railways to 31st March, 1923.

Lines of Railway.	Total Expenditure by General Government to 31st March, 1922.	Recoveries on Account of Expenditure of Previous Years.	Expenditure out of Public Works Fund during Year 1922–23.				Expenditure under Special Acts during Year 1922–23.*	Amounts previously charged to "Surveys of New Lines" now charged to Individual Lines.	Total Expenditure by General Government to 31st March, 1923.	Valuation of Works constructed by Provinces and Midland Railway Company.
			New Works.			Works on Open Lines.				
			Construction and Surveys.	Permanent-way.	Total New Works.					
	£	£	£	£	£	£	£	£	£	£
Kaihu Valley	161,872	..	11,940	1,060	13,000	203	35	..	175,110	..
Opua Wharf to Whangarei and Onerahi	528,659	117	..	..	..	6,822	148	..	535,512	..
Otiria to Ngapuhi	125,771	..	..	..	..	216	..	..	125,987	..
Whangarei (Kioreroa) to Waiotira	347,124	..	23,748	..	23,748	..	..	..	370,872	..
Waipu Branch	20,405	..	4,898	..	4,898	..	..	..	25,303	..
North Auckland Main Trunk—										
Ngapuhi Northwards	214,986	..	23,977	2,308	26,285	..	..	..	241,271	..
Helensville Northwards	1,385,425	..	213,393	30,036	243,429	807	..	..	1,629,661	..
North Auckland Main Trunk to Dargaville	474	..	..	..	..	..	..	..	474	..
Helensville to Te Awamutu	2,652,168	536	..	..	..	50,186	26,393	..	2,728,211	..
Waiuku Branch (Paerata to Waiuku)	201,507	..	4,853	596	5,449	76	..	..	207,032	..
Huntly to Awaroa	148,951	..	22,787	2,874	25,661	25	..	..	174,637	..
Waikokowai Branch	3,702	203	*Cr.* 25	..	*Cr.* 25	..	..	..	3,474	..
Waipa Gravel Access Branch	114	..	..	..	..	..	..	..	114	..
Frankton to Thames	371,547	100	..	..	..	2,989	1,176	..	375,612	..
Cambridge Branch (Ruakura Junction to Cambridge)	52,024	..	..	..	..	2,953	..	..	54,977	..
Morrinsville to Rotorua	378,618	..	..	..	..	2,320	1,142	..	382,080	..
Marton to Te Awamutu	2,859,659	..	..	..	..	10,114	1,210	..	2,870,983	..
Raetihi Branch	87,432	..	..	..	..	1,133	..	..	88,565	..
Paeroa to Waihi and Tauranga	285,309	..	45,555	43	45,598	..	..	..	330,907	..
Tauranga to Taneatua, including Te Maunga to Maunganui Branch	791,244	..	128,438	18,662	147,100	..	..	..	938,344	..
Gisborne to Motu	624,175	..	47	..	47	100	35	..	624,357	..
Gisborne to Ormond Tramway	4,975	..	..	..	..	..	..	..	4,975	..
Napier to Gisborne—										
Gisborne Southwards	237,125	..	10,526	2,134	12,660	..	..	..	249,785	..
Wairoa Northwards	19,241	..	232	..	232	..	..	..	19,473	..
Napier Northwards	166,850	..	62,322	34,494	96,816	..	..	..	263,666	..
Waikokopu Branch	163,956	..	118,599	71,950	190,549	..	..	..	354,505	..
Wellington to Napier—										
Napier to Woodville and Palmerston North	947,567	70	..	..	..	1,512	4,249	..	953,258	..
Wellington to Woodville, including Te Aro Extension	1,770,679	..	..	..	..	6,199	6,845	..	1,783,723	..
Featherston to Martinborough	399	..	..	..	..	..	..	..	399	..
Wellington to Waitara—										
Wellington to Longburn	1,041,611	..	..	..	..	2,230	2,676	..	1,046,517	..
Foxton to Waitara and Moturoa	1,591,215	375	..	..	..	2,141	1,997	..	1,594,978	..
Mount Egmont Branch	72,064	365	..	..	..	..	..	..	71,699	..
Moturoa to Opunake	759	..	..	..	..	..	..	..	759	..
Opunake Branch (Te Roti to Opunake)	106,582	..	43,806	23,997	67,803	..	..	..	174,385	..
Manaia Branch (Kapuni to Manaia)	14,061	..	5,192	..	5,192	..	..	..	19,253	..
Rangitikei River Quarry Line	206	..	..	..	..	..	..	..	206	..

* Railways Improvement Authorization Act 1914 Account.

TABLE No. 3—*continued.*

EXPENDITURE ON RAILWAYS TO 31ST MARCH, 1923—*continued.*

Lines of Railway.	Total Expenditure by General Government to 31st March, 1922.	Recoveries on Account of Expenditure of Previous Years.	Expenditure out of Public Works Fund during Year 1922–23.				Expenditure under Special Acts during Year 1922–23.*	Amounts previously charged to "Surveys of New Lines" now charged to Individual Lines.	Total Expenditure by General Government to 31st March, 1923.	Valuation of Works constructed by Provinces and Midland Railway Company.
			New Works.			Works on Open Lines.				
			Construction and Surveys.	Permanent-way.	Total New Works.					
	£	£	£	£	£	£	£	£	£	£
Strfatord to Okahukura (East End)	347,183	..	38,578	4,977	43,555	..	..	..	390,738	..
Stratford to Okahukura (West End)	764,116	..	14,417	4,019	18,436	..	..	..	782,552	..
Nelson to Greymouth—										
Nelson to Inangahua	386,669	..	13,969	..	13,969	..	35	..	400,673	78,307
Stillwater to Inangahua	213,276	..	..	..	..	111	..	..	213,387	279,685
Ngahere to Blackball	147,532	..	..	..	..	..	..	..	147,532	..
Westport to Ngakawau	189,320	..	..	..	..	71	130	..	189,521	..
Westport to Inangahua	152,609	..	93	..	93	..	..	..	152,702	..
Greymouth to Rewanui	255,076	..	..	..	..	570	..	..	255,646	..
Point Elizabeth Branch	48,055	..	17,388	5,520	22,908	..	..	..	70,963	..
Greymouth to Ross and Mikonui	341,916	..	..	..	..	398	..	..	342,314	..
Picton to Waipara—										
Picton Southwards	657,074	1,160	*Cr.* 41	..	*Cr.* 41	178	35	..	656,086	..
Waipara Northwards	375,414	101	..	..	..	1,940	...	..	377,253	..
Christchurch to Greymouth—										
Rolleston to Bealey	834,519	..	99	..	99	53,470	1,467	..	889,555	61,579
Whitecliffs Branch	25,021	..	..	..	..	..	..	..	25,021	..
Greymouth to Bealey	1,452,523	..	315,617	2,825	318,442	70,897	185	..	1,842,047	263,889
Hurunui to Waitaki—										
Main Line (Waiau to Waitaki)	2,052,860	10	189	..	189	15,962	5,196	..	2,074,197	316,135
Oxford Branch (Rangiora to Oxford West)	52,952	..	..	..	..	..	..	..	52,952	..
Eyreton Branch (Kaiapoi to Bennett's)	44,277	..	..	..	..	..	..	..	44,277	..
Lyttelton Branch	80,908	..	..	..	..	..	..	..	80,908	340,500
Southbridge Branch (Hornby to Southbridge)	91,377	..	..	..	..	64	..	..	91,441	..
Little River Branch (Lincoln to Little River)	109,185	..	..	..	..	..	..	..	109,185	..
Rakaia to Methven	74,676	..	..	..	..	..	..	..	74,676	..
Ashburton to Springburn	61,766	..	..	..	..	48	..	..	61,814	..
Orari to Geraldine	321	..	..	..	..	..	..	..	321	..
Fairlie Branch (Washdyke Junction to Fairlie)	67,924	..	..	..	..	132	..	..	68,056	75,124
Waimate Branch	80,859	34	*Cr.* 153	..	*Cr.* 153	..	..	..	80,672	..
Canterbury Interior Main Line—										
Oxford to Malvern	54,248	..	..	..	..	..	..	..	54,248	..
Whitecliffs to Rakaia	542	..	..	..	..	..	..	..	542	..
Temuka to Rangitata	5,152	..	..	..	..	..	..	..	5,152	..
Waitaki to Bluff—										
Main Line, including Port Chalmers Branch	3,338,577	..	..	..	..	5,722	4,346	..	3,348,645	82,259
Duntroon Branch (Pukeuri to Kurow)	97,311	..	..	..	..	154	..	..	97,465	37,500
Ngapara Branch (Waiareka Junction to Ngapara)	26,090	..	..	..	..	..	..	..	26,090	58,009

* Railways Improvement Authorization Act 1914 Account.

TABLE No. 3—*continued.*

EXPENDITURE ON RAILWAYS TO 31ST MARCH, 1923—*continued.*

Lines of Railway.	Total Expenditure by General Government to 31st March, 1922.	Recoveries on Account of Expenditure of Previous Years.	Expenditure out of Public Works Fund during Year 1922–23.				Expenditure under Special Acts during Year 1922–23.*	Amounts previously charged to "Surveys of New Lines" now charged to Individual Lines.	Total Expenditure by General Government to 31st March, 1923.	Valuation of Works constructed by Provinces and Midland Railway Company.
			New Works.			Works on Open Lines.				
			Construction and Surveys.	Permanent-way.	Total New Works.					
Waitaki to Bluff—*continued.*	£	£	£	£	£	£	£	£	£	£
Livingstone Branch (Windsor to Tokarahi)	82,785	..	..	..	..	..	..	..	82,785	..
Waihemo Branch (Palmerston to Dunback)	33,191	..	..	..	..	..	..	..	33,191	..
Fernhill Railway	1,415	..	..	..	..	..	..	..	1,415	..
Brighton Road Branch	6,474	..	..	..	..	..	..	..	6,474	12,829
Outram Branch (Mosgiel to Outram)	11,951	..	..	..	..	..	..	..	11,951	29,691
Lawrence Branch	341,083	..	53,608	4,086	57,694	..	..	..	398,777	..
Balclutha to Tuapeka Mouth	2,489	..	..	..	..	..	..	..	2,489	..
Catlin's River Branch (Balclutha to Tahakopa)	462,726	..	*Cr.* 4	..	*Cr.* 4	..	..	..	462,722	..
Heriotburn Branch (Waipahi to Edievale)	124,088	..	..	..	..	..	..	..	124,088	..
Waikaka Branch (McNab to Waikaka)	68,423	..	..	..	..	..	..	..	68,423	..
Gore to Lumsden	112,054	..	..	..	..	89	..	..	112,143	..
Edendale to Glenham	53,328	..	..	..	..	..	..	..	53,328	..
Riversdale to Switzers	82,304	..	..	..	..	..	..	..	82,304	..
Seaward Bush to Catlin's (Appleby to Tokanui)	185,144	..	..	..	..	216	..	..	185,360	..
Otago Central (Wingatui to Cromwell)	1,433,902	..	446	..	446	1,148	..	..	1,435,496	..
Invercargill to Kingston—										
Main Line	360,383	..	..	..	..	583	..	..	360,966	91,937
Mararoa Branch (Lumsden to Mossburn)	27,217	..	..	..	..	..	..	..	27,217	..
Winton to Heddon Bush	140	..	..	..	..	..	..	..	140	..
Makarewa to Orepuki and Waiau	272,370	..	9,211	..	9,211	520	..	..	282,101	37,097
Thornbury to Wairio	86,125	..	..	..	..	150	..	..	86,275	23,200
Forest Hill (Winton to Hedgehope)	23,337	..	..	..	..	..	..	..	23,337	..
Expenses of Railway Commissions and other Expenditure not chargeable to Individual Lines	10,337	..	..	..	..	..	..	..	10,337	..
Surveys of New Lines—										
North Island	38,443	100	2,829	..	2,829	..	..	..	41,172	..
Middle Island	5,763	..	..	..	..	..	..	..	5,763	..
Rolling-stock	8,565,107	..	..	..	..	509,479	462	..	9,075,048	..
Suspense Account, being proportion of cost of raising loan of £1,000,000 at 6 per cent. for Railways Authorization Improvement Act 1914 Account	..	..	..	..	..	..	63,192	..	63,192	..
Stock of Permanent-way Materials, 31st March 1922 £261,306	261,306	..	..	..	..	..	..	..	..	..
	42,459,669									
Stock of Permanent-way decreased by £37,184	37,184	..	..	..	..	..	..	..	..	..
Stock of Permanent-way Materials, 31st March, 1923 £224,122	..	..	..	..	..	..	..	..	224,122	..
Total	42,422,485	3,171	1,186,534	209,581	1,396,115	751,928	120,954	..	44,688,311	1,787,741†

* Railways Improvement Authorization Act 1914 Account. † Includes value for £150,000 paid to debenture-holders under the Midland Railway Petitions Settlement Act Amendment Act, 1903.

TABLE No. 4.

EXPENDITURE OUT OF SEPARATE ACCOUNTS ON WORKS UNDER THE CONTROL OF THE PUBLIC WORKS DEPARTMENT.

Year.	Loans to Local Bodies Account. Roads to open up Crown Lands.	Opening up Crown Lands for Settlement Account. Roads to open up Crown Lands.	Land for Settlements Account. Opening up Crown Lands for Settlement Account. Roads to open up Crown Lands.	National Endowment Account. Roads to open up National-endowment Lands.	Land for Settlements Account. Roads to open up Land for Settlements.	Waihou and Ohinemuri Rivers Improvement Account. Waihou and Ohinemuri Rivers Improvement.
	£	£	£	£	£	£
1890-91	25,000					
1891-92	64,000					
1892-93	800					
	89,800*					
1891-92	8,000†					
1892-93	29,833†					
1893-94	30,000†					
1894-95	6,114†					
1894-95	42,971‡					
1895-96	30,057‡					
1896-97	31,017					
1897-98	18,770					
1898-99	16,972					
1899-1900	31,363					
1900-1	37,390					
1901-2	31,979					
1902-3	18,578					
1903-4	25,753					
1904-5	28,895					
1905-6	38,801					
1906-7	47,371					
1907-8	38,524					
1908-9	54,713					
1909-10	40,507	..	..	4,975	..	..
	607,608§					
1910-11	..	45,691	..	5,619	..	..
1911-12	..	49,739	..	6,554	..	3,769
1912-13	..	47,951	..	2,689	..	9,555
1913-14	..	63,245	..	4,282	..	9,633
1914-15	..	..	92,975	9,151	..	10,004
1915-16	..	..	47,974	13,344	..	9,225
1916-17	..	..	24,730	6,787	..	10,407
1917-18	..	..	..	..	43,996	12,025
1918-19	..	..	..	..	51,355	27,402
1919-20	..	..	..	..	61,692	34,806
1920-21	..	..	..	..	28,920	62,249
1921-22	..	..	..	..	51,471	54,379
1922-23	..	..	..	..	78,350	66,708
	697,408	206,626	165,679	53,401	315,784	310,162

* Payment to the Public Works Fund under section 31 of the Government Loans to Local Bodies Act, 1886, in reduction of expenditure under Class "Roads."
† Paid into the Public Works Fund, reducing the expenditure under Class "Roads."
‡ Paid into the Lands Improvement Account (now included in Public Works Fund under Class "Roads"), reducing the expenditure on roads.
§ Expenditure under the Government Loans to Local Bodies Act Amendment Act, 1891.

TABLE No. 5.

EXPENDITURE ON PUBLIC BUILDINGS OUT OF PUBLIC WORKS FUND TO THE 31ST MARCH, 1923, AND THE LIABILITIES ON THAT DATE.

—	Total Expenditure to 31st March, 1922.	Expenditure for Year ended 31st March, 1923.	Total Expenditure to 31st March, 1923.	Liabilities on Authorities, Contracts, &c., 31st March, 1923.	Total Expenditure and Liabilities.
	£	£	£	£	£
Judicial*	1,161,803	31,416	1,193,219	3,494	1,196,713
Postal and telegraph	1,574,652	77,142	1,651,794	86,059	1,737,853
Customs	49,441	..	49,441	..	49,441
Offices for public Departments	588,205	1,086	589,291	329	589,620
Mental hospitals	960,731	13,852	974,583	1,099	975,682
Alexandra Depot, Wellington†	8,084	..	8,084	..	8,084
School buildings	3,100,759	*Cr.* 367	3,100,392	..	3,100,392
Hospitals‡	226,151	19,735	245,886	947	246,833
Quarantine-stations	62,464	..	62,464	..	62,464
Parliament Buildings (old buildings) ..	76,553	..	76,553	..	76,553
Parliament Buildings (new buildings) ..	277,039	111,937	388,976	1,361	390,337
Parliament Buildings (alterations to streets, surrounding grounds, and purchase of land)	14,187	..	14,187	..	14,187
Government House, Wellington (land and new building)	72,388	257	72,645	..	72,645
Agricultural	81,884	487	82,371	13	82,384
Workers' dwellings	319,916	..	319,916	..	319,916
Miscellaneous	61,346	273	61,619	44	61,663
Totals	8,635,603	255,818	8,891,421	93,346	8,984,767

* Includes Courthouses, prisons, and police-stations. † Expenditure *re* Defence requirements only. Other expenditure included in "Judicial" class. ‡ Includes 232,754 previously shown under "Public Health."

TABLE No. 6.

DEVELOPMENT OF WATER-POWER.

STATEMENT OF ACCOUNTS AT THE 31ST MARCH, 1923.

GENERAL BALANCE-SHEET AT 31ST MARCH, 1923, COMPARED WITH POSITION AT 31ST MARCH, 1922.

1921-22.	*Liabilities.*	1922-23.		1921-22.	*Assets.*		1922-23.	
£ s. d.		£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.	£ s. d.
	Aid to Water-power Works and Electric Supply Accounts—			814,050 14 1	Lake Coleridge scheme—			
	Debentures issued—				Assets as per separate balance-sheet ..		906,921 12 2	
350,000 0 0	At 4 per cent. interest	350,000 0 0		29,175 9 5	Profit and Loss Account—Accumulated loss to date		23,875 16 11	
119,000 0 0	At 4½ per cent. interest	119,000 0 0						930,797 9 1
..	At 5½ per cent. interest	4,000 0 0		843,226 3 6				
	Bonds issued (due 1930) at 5 per cent.				Lake Waikaremoana scheme—			
56,150 0 0	interest	56,150 0 0		62,566 4 3	Assets as per separate balance-sheet ..		76,650 17 8	
	N.Z. Consolidated stock—			..	Profit and Loss Account—Loss to date ..		390 5 0	
1,331,360 0 0	At 5 per cent. interest (due 1930) ..	1,331,360 0 0						77,041 2 8
..	At 5 per cent. (due 1935–45) ..	9,575 11 0		62,566 4 3				
..	At 5 per cent. (due 1935–45) ..	894 2 9			Waikato River schemes—			
1,076,938 9 3	At 6 per cent. interest (due 1936–51) ..	1,076,938 9 3			Horahora—			
807,703 17 0	At 6 per cent. interest (due 1936–51) ..	807,703 17 0			Assets as per separate	£ s. d.		
3,741,152 6 3			3,755,622 0 0	404,933 6 10	balance-sheet ..	436,755 0 4		
	Waihi Gold-mining Company (Limited)—				Profit and Loss Account — Accumulated loss to date..	..		
	Purchase of Horahora works—Deed of			5,882 15 9			436,755 0 4	
212,500 0 0	security at 5 per cent. interest ..	..	212,500 0 0	410,816 2 7				
3,953,652 6 3			3,968,122 0 0		Arapuni—			
	Consolidated Fund—				Headworks and surveys	17,565 18 10		
	Interest accrued on loans to 31st March,			13,848 13 9	Land at Auckland ..	500 0 0		
40,326 12 8	1923	..	41,363 12 5	500 0 0	Houses	56 11 9		
..	Sundry creditors for interest unclaimed ..	..	70 15 11	..	50,000-volt lines—			
				..	Horahora–Arapuni	4,267 0 6		
	Amount set aside as reserve to cover difference between interest payable on loans				110,000-volt lines—			
	raised and interest earned from their			..	Hamilton–Auckland	625 5 3		
..	temporary investment pending use ..	..	36,433 1 1	..	Arapuni–Te Kuiti	148 6 0		
	Lake Coleridge scheme—				Stocks of material for			
				46,353 0 0	line to Auckland ..	49,158 1 8		
54,536 19 0	Depreciation reserve	61,275 8 7			Interest during con-			
12,148 18 6	Sundry creditors	2,741 7 11		2,706 13 8	struction ..	6,508 2 9		
66,685 17 6			64,016 16 6	63,408 7 5	Debtors —			
					For rent paid in advance	9 14 2		
						..	78,839 0 11	
								515,594 1 3
4,060,664 16 5	Carried forward	..	4,110,006 5 11	1,380,016 17 9	Carried forward		..	1,523,432 13 0

TABLE No. 6—*continued.*

General Balance-sheet at 31st March, 1923, compared with Position at 31st March, 1922—*continued.*

1921-22.	*Liabilities.*	1922-23.		1921-22.	*Assets.*	1922-23.	
£ s. d.		£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.
4,060,664 16 5	Brought forward	..	4,110,006 5 11	1,380,016 17 9	Brought forward	..	1,523,432 13 0
	Horahora scheme—						
10,210 10 7	Depreciation reserve	16,605 7 10					
7,411 6 11	Sundry creditors	1,028 15 5			Mangahao River scheme—		
..	Net profit	386 8 0		8,527 11 2	Land and easements	12,221 11 0	
			18,020 11 3	52,676 0 0	Headworks, dams, tunnels, &c. ..	144,856 10 4	
17,621 17 6				39,487 10 8	Roads, trams, &c.	41,375 6 8	
				5,098 16 7	Pipe-lines, &c.	36,410 10 1	
	Arapuni scheme—			12,611 6 1	Buildings	53,714 17 11	
..	Sundry creditors	..	209 16 6	2,859 15 4	Power plant and machinery	13,968 0 1	
				78,301 16 4	Construction plant, tools, &c.	91,446 15 2	
				..	Transmission-lines	23,212 4 11	
	Mangahao scheme—			28,151 17 0	Workers' accommodation	30,088 9 2	
6,635 7 11	Sundry creditors	..	12,039 8 10	23,004 4 4	Surveys, engineering, &c.	33,535 9 3	
				56,955 14 9	Material on hand	108,231 11 11	
				16,929 1 3	Interest during construction	43,000 19 3	
	Waikaremoana scheme—						632,062 5 9
5,014 0 0	Sundry creditors	..	4,146 6 11	324,603 13 6	Sundry debtors	..	901 12 8
				1,544 15 1			
					Other schemes, surveys, &c.—		
					North Island—		
				376 13 11	Aratiatia (Waikato River)	376 13 11	
				423 9 6	Huka Falls (Waikato River) ..	433 9 6	
				2,754 17 3	Hutt River (including dam site) ..	2,750 17 3	
				38 9 0	Makuri River	38 9 0	
				1,355 4 4	Rotoiti-Kaituna	1,355 4 4	
				879 16 8	Tauherenikau River	879 16 8	
				236 6 8	Wairua River	236 6 8	
							6,070 17 4
				6,064 17 4			
					South Island—		
				803 1 9	Clarence River	803 1 9	
				5 0 0	Lake Kanieri	5 0 0	
				749 8 2	Nelson–Marlborough	749 8 2	
				96 1 0	Timaru–Oamaru	96 1 0	
				519 12 7	Opihi River	519 12 7	
				17 7 0	Toaroha River	17 7 0	
				543 0 5	Teviot River	543 0 5	
				11 19 0	Upper Taieri River	11 19 0	
				475 5 8	Lake Hawea	475 5 8	
							3,220 15 7
				3,220 15 7			
4,089,936 1 10	Carried forward	..	4,144,422 9 5	1,715,450 19 3	Carried forward	..	2,165,688 4 4

TABLE No. 6—*continued.*

GENERAL BALANCE-SHEET AT 31ST MARCH, 1923, COMPARED WITH POSITION AT 31ST MARCH, 1922—*continued.*

1921–22. £ s. d.	*Liabilities.*	1922–23. £ s. d.	1921–22. £ s. d.	*Assets.*	1922–23. £ s. d.	£ s. d.
4,089,936 1 10	Brought forward	4,144,422 9 5	1,715,450 19 3	Brought forward	..	2,165,688 4 4
			4,404 9 11	General expenditure not chargeable to any individual scheme	..	4,413 10 11
				Balance in Electric Supply Account at the end of the year—		
			4,788 11 1	Cash in Public Account	98,702 4 1	
			1,309 17 6	In hands of Government officers in New Zealand	732 18 9	
			60,558 10 6	In hands of Government officers in London	49,725 3 7	
			66,656 19 1			149,160 6 5
			2,104,460 0 0	Investment Account (funds invested until actually required for use)	..	1,803,758 6 10
			3,890,972 8 3			4,123,020 8 6
			28,905 17 2	Interest accrued on investments to 31st March, 1923	..	21,402 0 11
			3,919,878 5 5			4,144,422 9 5
			134,643 6 3	Suspense Accounts— Treasury charges for raising loans ..	..	..
			35,414 10 2	Interest not allocated to any scheme ..	..	..
			170,057 16 5			
4,089,936 1 10	Total	£4,144,422 9 5	4,089,936 1 10	Total	..	£4,144,422 9 5

I hereby certify that the balance-sheet has been duly examined and compared with the relative books and documents submitted for audit and correctly states the position as disclosed thereby.

G. F. C. CAMPBELL,
Controller and Auditor-General.

J. J. GIBSON,
Acting Accountant, Public Works Department.

TABLE No. 6—*continued.*

LAKE COLERIDGE HYDRO-ELECTRIC-POWER SUPPLY.

PROFIT AND LOSS ACCOUNT FOR YEAR ENDED 31ST MARCH, 1923, COMPARED WITH YEAR ENDED 31ST MARCH, 1922.

Gross Revenue Account.

1921–22.		1922–23.			1921–22.		1922–23.	
£ s. d.	To Generating expenses, headworks, and power-house—	£ s. d.	£ s. d.		£ s. d.	By Sale of energy—	£ s. d.	£ s. d.
2,971 13 3	Salaries	2,437 18 5			52,866 7 0	Wholesale	64,893 19 8	
1,016 16 11	Wages	851 16 0			1,869 15 11	Retail	2,100 11 1	
195 10 9	Supplies	142 10 3			54,736 2 11			66,994 10 9
651 11 0	Transport of stores, &c.	614 8 3						
	Maintenance and repairs—							
1,002 10 2	Maintenance, Harper diversion ..	568 6 1			10 3 9	Discounts forfeited	..	16 19 7
49 1 10	Headworks	159 10 9						
..	Pipe-lines	..						
49 0 0	Power-house building	69 12 6						
987 7 10	Power-house machinery	831 2 7				Rents—		
256 13 4	Roads and fences	454 16 4			813 17 10	Land and buildings	777 0 10	
120 11 4	Staff residences, &c.	234 5 2			169 14 0	Electric lines	281 2 1	
			6,364 6 4		20 14 4	„ plant	41 16 11	
7,300 16 5					1,004 6 2			1,099 19 10
	Transmission-line—							
518 6 4	Salaries	484 19 9						
593 0 10	Transport, including upkeep of horses, traps, cars, and cycles	357 12 1						
1,897 11 3	Repairs to power-lines	400 12 7				Fees for testing and repairing electrical appliances	..	726 15 11
146 10 0	Repairs to roads	..			746 3 1			
			1,243 4 5					
3,155 8 5								
	Substation, Addington—					Stand-by provision: Fees from wholesale consumers	..	80 0 0
1,124 9 7	Salaries	1,127 18 2			160 0 0			
679 0 9	Wages	519 17 9						
145 12 11	Supplies	106 0 0				Interest from local bodies in respect of reticulations sold on deferred payment ..	..	9 6 7
	Maintenance and repairs—				..			
185 11 5	Buildings and yards	335 15 8			156 19 4	Earnings motor-vehicles	..	224 17 6
147 11 8	Machinery	74 9 3						
			2,164 0 10					
2,282 6 4								
	Distribution—							
208 18 10	Salaries	211 2 3						
1 2 4	Wages	..						
143 7 1	Transport, including upkeep of motor lorry and car	147 19 1						
1,686 19 8	Maintenance of feeder cables, transformer stations, and tools ..	1,807 1 5						
772 14 4	Maintenance of secondary distribution	1,252 7 6						
244 1 5	Maintenance of and testing meters ..	205 9 9						
289 3 2	Earth-testing	138 5 6						
			3,762 5 6					
3,346 6 10								
16,084 18 0	Carried forward	..	13,533 17 1		56,813 15 3	Carried forward	..	69,152 10 2

TABLE No 6—*continued.*

LAKE COLERIDGE HYDRO-ELECTRIC-POWER SUPPLY—*continued.*

PROFIT AND LOSS ACCOUNT FOR YEAR ENDED 31ST MARCH, 1923, COMPARED WITH YEAR ENDED 31ST MARCH, 1922—*continued.*

Gross Revenue Account—continued.

1921–22.		1922–23.			1921–22.		1922–23.	
£ s. d.	——	£ s. d.	£ s. d.		£ s. d.	——	£ s. d.	£ s. d.
16,084 18 0	Brought forward	..	13,533 17 1		56,813 15 3	Brought forward	..	69,152 10 2
	To Stand-by provision—							
	Payment to Christchurch Tramway							
1,350 0 0	Board	1,350 0 0						
	Payment to Christchurch Tramway							
3,235 8 4	Board, for energy supplied ..	17 5 0						
			1,367 5 0					
4,585 8 4								
	Management and general expenses—							
2,316 7 3	Salaries	1,889 13 1						
174 12 8	Sick and holiday pay to workmen ..	167 11 2						
184 0 4	Travelling-expenses	171 3 7						
200 0 0	Office-rent	200 0 0						
65 10 0	Rent of other buildings	65 10 0						
178 5 2	Postages and telegrams	191 14 2						
111 5 5	Telephone subscriptions	92 10 3						
125 17 3	Printing and stationery	144 1 2						
53 12 3	Advertising	51 6 3						
526 16 1	Accident pay	206 6 10						
78 8 9	Fire insurance	89 12 2						
50 0 0	Audit fees	66 0 0						
377 4 11	Meter-reading and line-inspection ..	338 1 0						
66 9 0	Commission on collection of accounts ..	74 2 1						
714 11 5	Electrical testing	615 14 5						
1 12 11	Bad debts	..						
15 15 4	Miscellaneous trade expenses ..	6 10 4						
			4,369 16 6					
5,240 8 9								
			19,270 18 7					
25,910 15 1								
30,903 0 2	Balance to Net Revenue Account ..	..	49,881 11 7					
£56,813 15 3			£69,152 10 2		£56,813 15 3			£69,152 10 2

Net Revenue Account.

£ s. d.		£ s. d.	£ s. d.		£ s. d.		£ s. d.
8,423 10 0	To Depreciation at 2 per cent. per annum on completed work ..	9,307 0 0		30,903 0 2	By Balance from Gross Revenue Account		49,881 11 7
20,981 1 3	Interest for year ended 31st March	35,274 19 1					
1,498 8 11	Balance to Profit and Loss Appropriation Account ..	5,299 12 6					
£30,903 0 2		£49,881 11 7		£30,903 0 2			£49,881 11 7

TABLE No. 6—*continued.*

LAKE COLERIDGE HYDRO-ELECTRIC-POWER SUPPLY—*continued.*

Profit and Loss Appropriation Account.

1921–22.	——	1922–23.	1921–22.	——	1922–23.
£ s. d.		£ s. d.	£ s. d.		£ s. d.
30,673 18 4	To Balance from previous year's statement	29,175 9 5	1,498 8 11	By Balance from Net Revenue Account	5,299 12 6
			29,175 9 5	Balance to balance-sheet—Accumulated loss	23,875 16 11
£30,673 18 4		£29,175 9 5	£30,673 18 4		£29,175 9 5

Depreciation Reserve Account.

£ s. d.		£ s. d.	£ s. d.		£ s. d.
	To Amounts written off—		44,750 17 9	By Balance from previous year's statement	54,536 19 0
427 9 6	Motor vehicles and tools	..	1,790 0 9	Interest at 4 per cent. per annum	2,181 9 7
..	Transmission-line reconstruction	4,750 0 0	8,423 10 0	Amount set aside as per Profit and Loss Account	9,307 0 0
54,536 19 0	Balance to balance-sheet	61,275 8 7			
£54,964 8 6		£66,025 8 7	£54,964 8 6		£66,025 8 7

Note.—The State Supply of Electrical Energy Act provides for the establishment of a sinking fund of 1 per cent. per annum when profits are available for the purpose, and for the payment of arrears of sinking-fund contributions out of any future profits. The arrears of sinking fund (at 4 per cent. interest) since commencement of operations in 1915 total £37,765.

TABLE No. 6—*continued.*

LAKE COLERIDGE HYDRO-ELECTRIC-POWER SUPPLY—*continued.*

BALANCE-SHEET AT 31ST MARCH, 1923.

1921–22.	*Liabilities.*	1922–23.		1921–22.	*Assets.*	1922–23.	
£ s. d.		£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.
54,536 19 0	Depreciation Reserve Account	..	61,275 8 7	4,229 16 4	Works at Lake Coleridge— Land, including fencing and planting ..	..	4,229 16 4
				5,317 4 6	Coalgate Gorge Road	..	5,317 4 6
				7,566 3 8	Service roads	..	7,566 3 8
	Sundry creditors—			279 12 8	Service telephones	..	279 12 8
3,996 14 1	On open accounts	1,526 2 4		17,392 17 2			
6,496 15 9	On contracts	906 9 11			Headworks—		
1,217 2 0	Wages accrued	..		79,558 18 8	Tunnel, including inlet and outlet works	79,868 7 1	
308 6 8	Payment for current in advance	308 15 8		64,457 13 2	Pipe-lines	68,842 4 6	
130 0 0	Consumers guarantee deposits	..		1,996 16 2	Tram-line	1,996 16 2	
12,148 18 6			2,741 7 11	410 17 7	Weir at lake-outlet, gauges, and fencing	3,357 0 5	
				17,355 2 8	Harper River diversion works ..	21,413 8 11	
	Balance carried to general balance-sheet—			163,779 8 3			175,477 17 1
843,226 3 6	Total assets as *per contra*	930,797 9 1					
66,685 17 6	*Less* total liabilities as above	64,016 16 6			Power-house—		
776,540 6 0			866,780 12 7	24,854 2 6	Buildings, &c.	25,215 17 1	
				74,555 9 3	Machinery, &c.	100,149 5 9	
				231 2 1	Office furniture, fittings, &c... ..	231 2 1	
				99,640 13 10			125,596 4 11
					Accommodation for staff and workmen—		
				14,298 7 4	Buildings, fencing, &c.	..	14,560 5 5
					Transmission-line—		
				4,051 11 8	Land	4,051 11 8	
				85,249 6 6	Power-lines to Christchurch	176,264 2 1	
				33,270 18 7	Power-lines to South Canterbury ..	55,299 3 1	
				2,403 18 2	Telephone-system	2,403 18 2	
				3,118 12 10	Linemen's cottages, depots, tools, and equipment	3,165 5 5	
				6,588 12 4	Alterations to public telegraph-lines ..	6,588 12 4	
				2,060 8 7	Point Switching Station	4,017 7 10	
				136,743 8 8			251,790 0 7
					Addington Substation—		
				3,483 0 5	Land, including cottages	3,483 0 5	
				3,875 6 0	Substation buildings	3,875 6 0	
				27,954 19 0	Machinery, &c.	28,190 19 2	
				5,829 10 7	Store buildings and workshops	5,856 4 3	
				41,142 16 0			41,405 9 10
843,226 3 6	Carried forward	..	930,797 9 1	472,997 11 3	Carried forward	..	626,222 15 0

TABLE No. 6—*continued.*

LAKE COLERIDGE HYDRO-ELECTRIC-POWER SUPPLY—*continued.*

BALANCE-SHEET AT 31ST MARCH, 1923—*continued.*

1921–22.	*Liabilities.*	1922–23.	1921–22.	*Assets.*	1922–23.
£ s. d.		£ s. d. £ s. d.	£ s. d.		£ s. d. £ s. d.
843,226 3 6	Brought forward	.. 930,797 9 1	472,997 11 3	Brought forward	.. 626,222 15 0
				Primary distribution—	
			6,829 9 4	Supply cables—Christchurch City ..	6,963 9 0
			4,834 0 6	Christchurch Tramways ..	4,889 19 10
			7,013 3 9	Lyttelton	7,013 3 9
			16,513 15 8	Northern	18,893 9 8
			10,786 5 1	Southern	10,876 10 2
			3,515 12 4	Motukarara	3,994 11 1
			..	Hororata–Darfield ..	1,019 0 2
			622 9 9	Lightning-arresters	622 9 9
			300 4 5	Tools and equipment	300 4 5
			1,516 12 8	Alterations to public telegraph-lines ..	1,516 12 8
			51,931 13 6		56,089 10 6
				Secondary distribution—	
			22,024 17 3	Supply cables and reticulation	21,543 18 4
			20,395 4 11	Local substations	26,409 19 9
			42,420 2 2		47,953 18 1
			16,744 12 4	Service transformers and meters	.. 16,683 1 3
			8,171 12 0	Motor cars, lorries, and cycles, &c.	.. 6,646 18 2
			101 10 7	Test-room equipment	.. 88 14 6
			10,796 7 7	Loose plant, tools, and equipment	.. 11,957 15 10
			1,729 3 9	Public telephones to the lake	.. 1,729 3 9
			173 19 1	Telephones to Christchurch City Council and Tramway Board and local officers ..	.. 173 19 1
			247 3 2	Christchurch office—Furniture and fittings ..	.. 249 6 5
			23,969 18 8	Engineering, office, and general expenses on preliminary surveys and during construction ..	.. 26,749 13 9
			20,378 10 7	Salaries of Engineers and others on preliminary surveys and during construction	.. 23,692 9 10
			21,945 14 4	Interest during construction	.. 29,795 19 10
			671,607 19 0		848,033 6 0
			128,674 19 8	Stocks of material, &c., on hand at date ..	.. 41,095 0 1
			162 18 10	Telephone subscriptions and fire insurance paid in advance	.. 186 15 4
				Sundry debtors—	
			11,839 13 3	For current and rent	.. 17,606 10 9
			1,765 3 4	For work carried out, &c...	
			13,604 16 7		906,921 12 2
			814,050 14 1		
			29,175 9 5	Balance from Profit and Loss Appropriation Account	.. 23,875 16 11
£843,226 3 6		£930,797 9 1	£843,226 3 6		£930,797 9 1

The balance-sheet has been duly compared with the various supporting books, vouchers, and documents, and found to correspond therewith.

J. H. FOWLER, Deputy-Controller and Auditor-General.

TABLE No. 6—*continued.*

WAIKAREMOANA ELECTRIC-POWER SUPPLY.

Profit and Loss Account for Year ended 31st March, 1923.

1921–22.	——	1922–23.	1921–22.	——	1922–23.
		£ s. d.			£ s. d.
..	To Interest on capital from 1st January, 1923	915 5 0	..	By Rental of plant leased to Wairoa Power Board from 1st January, 1923	525 0 0
..			..	Loss on operations	390 5 0
		£915 5 0	..		£915 5 0

Balance-sheet at 31st March, 1923.

1921–22.	*Liabilities.*	1922–23.	1921–22.	*Assets.*	1922–23.
£ s. d.		£ s. d.	£ s. d.		£ s. d.
57,552 4 3	Balance carried to general balance-sheet	72,894 15 9	32,079 12 3	Access roads and bridges	11,920 11 4
5,014 0 0	Sundry creditors	4,146 6 11	12,525 5 0	Pipe-lines	18,550 17 3
			9,544 12 3	Power-house building and machinery	27,564 5 10
			5,327 10 0	Compensation for land	6,334 10 7
			..	Headworks	227 0 6
			..	Staff cottages	1,714 16 10
			..	Loose plant	335 10 0
			..	Telephone-line	1,000 0 0
			1,573 19 6	Survey, engineering, and office expenses	2,780 10 11
			1,515 5 3	Interest during construction	5,697 14 5
					76,125 17 8
			..	Sundry debtors	525 0 0
			..	Balance from Profit and Loss Account: Loss	390 5 0
£62,566 4 3		£77,041 2 8	£62,566 4 3		£77,041 2 8

TABLE No. 6—*continued.*

WAIKATO ELECTRIC-POWER SUPPLY.—HORAHORA SCHEME.

PROFIT AND LOSS ACCOUNT FOR YEAR ENDED 31ST MARCH, 1923, COMPARED WITH YEAR ENDED 31ST MARCH, 1922.

Gross Revenue Account.

1921–22.		1922–23.			1921–22.		1922–23.	
£ s. d.	To Generating expenses, headworks, and power-house—	£ s. d.	£ s. d.	£ s. d.	By Sales of electrical energy to wholesale consumers	£ s. d.	£ s. d.	£ s. d.
2,546 2 11	Salaries	2,478 3 3				27,105 2 7	40,467 15 8	
139 19 2	Wages	127 7 4				271 16 7	86 5 0	
326 19 8	Supplies	324 19 11				26,833 6 0		40,381 10 8
70 14 6	Transport	141 19 3						
	Maintenance and repairs—							
288 7 4	Headworks and buildings	305 12 10						
282 18 2	Power-house machinery	375 0 2						
79 14 10	Staff village	106 5 8						
			3,859 8 5			83 16 10	37 14 6	
3,734 16 7					Hire of plant	216 6 0	461 4 1	
					Rent of lines	348 7 0	506 17 5	
	Main transmission-lines (50,000-volt)—				Miscellaneous rents	..	14 16 9	
	Horahora to Waikino—				Discounts forfeited			1,020 12 9
691 1 8	Wages	628 16 0				648 9 10		
84 9 0	Repairs and supplies	331 18 2						
135 4 7	Transport	137 15 10						
			1,098 10 0			725 8 3		368 3 2
910 15 3					Testing, oil-drying, and repairs for consumers			
					Fees for inspection of lines and testing of instruments, &c.	..	..	48 6 0
	Horahora to Hamilton—					..		
..	Wages	123 18 9				725 8 3		
..	Repairs and supplies	120 8 9						
..	Transport	46 2 7						
			290 10 1					
	Mystery Creek to Te Awamutu—							
8 2 9	Wages	60 18 2						
..	Repairs and supplies	8 3 5						
..	Transport	21 9 0						
			90 10 7					
8 2 9								
	Main substations (50,000-volt)—							
	Waikino—							
561 5 0	Operating wages (half)	503 13 3						
178 17 6	Repairs to building, machinery, &c.	132 6 1						
			635 19 4					
740 2 6								
	Hamilton—							
61 11 8	Operating wages	151 11 9						
..	Repairs and supplies to building, machinery, &c.	33 3 1						
..	Maintenance yards, workshops, &c.	89 16 4						
..	Repairs, tools, and instruments	45 1 0						
			319 12 2					
61 11 8								
	Te Awamutu—							
..	Operating wages	58 9 3						
..	Repairs and supplies to building and machinery	1 13 11						
			60 3 2					
5,455 8 9	Carried forward	..	6,354 13 9		28,207 4 1	Carried forward	..	41,818 1 7

TABLE No. 6—*continued.*

WAIKATO ELECTRIC-POWER SUPPLY.—HORAHORA SCHEME—*continued.*

PROFIT AND LOSS ACCOUNT FOR YEAR ENDED 31ST MARCH, 1923, COMPARED WITH YEAR ENDED 31ST MARCH, 1922—*continued.*

Gross Revenue Account—continued.

1921-22.		1922-23.		1921-22.		1922-23.
£ s. d.	——	£ s. d.	£ s. d.	£ s. d.	——	£ s. d.
5,455 8 9	Brought forward	..	6,354 13 9	28,207 4 1	Brought forward	41,818 12 7
	Main substations (50,000 volt)—*contd.*—					
	Distribution substations—					
297 10 4	Waihi Grand Junction	2 12 1				
12 0 10	Various	31 1 10				
309 11 2			33 13 11			
	Distribution lines, (11,000 volt)—					
	Horahora–Hamilton–Frankton—					
97 8 7	Wages	109 16 1				
6 7 10	Repairs and supplies	61 9 0				
22 2 10	Transport	34 18 11				
..	Waikino–Waihi	5 11 10				
125 19 3			211 15 10			
	Management and general—					
769 13 2	Salaries, and wages	1,497 19 0				
180 2 2	Accident insurance, sick and holiday pay	339 8 6				
191 14 10	Travelling-expenses and motor-cars ..	430 1 8				
59 7 2	Postages, telegrams, and telephone ..	103 12 1				
24 16 11	Fire insurance	26 5 6				
7 7 0	Legal expenses	1 11 6				
48 11 9	Printing, stationery, and advertising..	74 5 7				
97 19 3	Office rent, cleaning, and lighting ..	179 9 0				
17 5 1	Experimental testing	56 7 11				
9 5 8	Miscellaneous expenses	15 5 5				
1,406 3 0			2,724 6 2			
8 15 6	Purchase of current	..	90 4 2			
680 10 7	Testing, oil-drying, repairs, &c., for consumers	..	306 13 11			
7,986 8 3			9,721 7 9			
20,220 15 10	Balance to Net Revenue Account ..	..	32,097 4 10			
£28,207 4 1			£41,818 12 7	£28,207 4 1		£41,818 12 7

Net Revenue Account.

£ s. d.		£ s. d.	£ s. d.		£ s. d.
	To Interest on purchase-money for plant purchased from Waihi Gold-mining Company, and on advances from Treasury..	19,208 7 8	20,220 15 10	By Balance from Gross Revenue Account	32,097 4 10
13,187 5 0					
4,262 3 4	Depreciation on completed works (2 per cent.)	6,236 9 3			
250 0 0	Special depreciation provision to cover cost of replacing temporary work	383 4 2			
2,521 7 6	Balance to Profit and Loss Appropriation Account ..	6,269 3 9			
£20,220 15 10		£32,097 4 10	£20,220 15 10		£32,097 4 10

TABLE No. 6—*continued*

WAIKATO ELECTRIC-POWER SUPPLY.—HORAHORA SCHEME—*continued*.

Profit and Loss Appropriation Account.

1921–22.	——	1922–23.	1921–22.	——	1922–23.
£ s. d.		£ s. d.	£ s. d.		£ s. d.
8,404 3 3	To Balance from previous year	5,882 15 9	2,521 7 6	By Balance from Net Revenue Account	6,269 3 9
..	Balance to balance-sheet	386 8 0	5,882 15 9	Balance to Balance-sheet—Accumulated loss to date ..	..
£8,404 3 3		£6,269 3 9	£8,404 3 3		£6,269 3 9

Depreciation Reserve Account.

£ s. d.		£ s. d.	£ s. d.		£ s. d.
..	To amount written off for temporary works	633 4 2	5,653 4 9	By Balance at close of previous year	10,210 10 7
	Amount written off for value of motor-cycle accidentally		225 2 6	Interest for year	408 8 0
180 0 0	destroyed	..	4,512 3 4	Amount set aside as per Net Revenue Account	6,619 13 5
10,210 10 7	Balance to balance-sheet	16,605 7 10			
£10,390 10 7		£17,238 12 0	£10,390 10 7		£17,238 12 0

Balance-sheet at 31st March, 1923.

1921–22.	*Liabilities.*	1922–23.		1921–22.	*Assets.*	1922–23.	
£ s. d.	Electric-supply Account—	£ s. d.	£ s. d.	£ s. d.	Works, &c., at Horahora—	£ s. d.	£ s. d.
393,194 5 1	Balance carried to general balance-sheet ..		418,734 9 1	2,168 5 9	Roads and bridges	2,168 5 9	
7,411 6 11	Sundry creditors		1,028 15 5	956 14 9	Land and fencing	956 14 9	
10,210 10 7	Depreciation reserve		16,605 7 10	9,537 15 5	Accommodation for staff and workmen ..	10,320 3 7	
				86,699 10 4	Headworks	88,666 5 1	
				26,682 15 8	Generating-station	41,414 9 0	
				28,561 4 1	Transformer building and machinery ..	30,894 13 7	
	Balance from Profit and Loss Appropriation Account—			2,821 16 4	Tools and equipment	81 6 5	
..	Net profit	..	386 8 0	157,428 2 4			174,501 18 2
					Transmission-lines (50,000 volts)—		
				44,425 1 6	Horahora–Waihi	44,573 13 9	
				18,090 10 5	Horahora–Hamilton	22,122 5 0	
				6,826 12 5	Mystery Creek – Te Awamutu	7,485 0 0	
				4,255 17 5	Waiorongomai–Waihou	4,524 7 4	
				..	Waihou–Hami ton	138 19 2	
				804 15 9	Linesmen's cottages	857 13 6	
				74,402 17 6			79,701 18 9
410,816 2 7	Carried forward	..	436,755 0 4	231,830 19 10	Carried forward	..	254,203 16 11

TABLE No. 6—*continued.*

WAIKATO ELECTRIC-POWER SUPPLY.—HORAHORA SCHEME—*continued.*

BALANCE-SHEET AT 31ST MARCH, 1923—*continued.*

1921–22.	*Liabilities.*	1922–23.	1921–22.	*Assets.*	1922–23.	
£ s. d.		£ s. d.	£ s. d.		£ s. d.	£ s. d.
410,816 2 7	Brought forward	436,755 0 4	231,830 19 10	Brought forward	..	254,203 16 11
				Main substations (50,000-volt)—		
			18,557 17 11	Waikino	20,352 15 2	
			4,124 3 10	Hamilton	7,754 2 7	
			2,279 6 0	Te Awamutu	5,455 14 4	
			5,884 19 10	Waihou	6,626 10 10	
			30,846 7 7			40,189 2 11
				Distribution-lines (11,000-volt)—		
			32,073 5 11	Horahora–Frankton	32,556 3 8	
			715 16 0	Waihi Grand Junction Company, line to ..	704 11 11	
			32,789 1 11			33,260 15 7
			6,077 19 2	Distribution substations (11,000-volt) ..	7,394 11 2	
			3,600 12 4	Land at Ruakura	3,975 11 9	
			6,315 15 2	Stores buildings and fittings and railway-siding, Ruakura	7,365 7 2	
			2,611 17 6	Staff residences, Ruakura	3,521 5 1	
			3,705 11 8	Loose tools and equipment	3,540 19 9	
			4,106 2 6	Motor lorries, cars, and cycles	4,317 17 6	
			427 6 10	Office furniture, Hamilton	440 6 1	
			5,744 19 9	Engineering, office, and general expenses on surveys and on construction	6,656 4 1	
			6,434 12 10	Salaries of officers on surveys and on construction	8,947 18 6	
			19,316 8 0	Interest during construction	21,207 15 4	
			353,807 15 1			67,367 16 5
						395,021 11 10
			45,398 14 8	General stocks of material on hand	..	31,620 4 7
				Debtors—		
			5,621 17 7	For electricity and sales of material ..	10,039 8 1	
			104 19 6	For insurance premiums, &c., paid in advance	73 15 10	10,113 3 11
			5,726 17 1			
			404,933 6 10			436,755 0 4
			5,882 15 9	Balance from Profit and Loss Appropriation Account—Accumulated loss to 31st March, 1922		..
£410,816 2 7		£436,755 0 4	£410,816 2 7			£436,755 0 4

The balance-sheet has been duly compared with the various supporting books, vouchers, and documents, and found to correspond therewith.

G. F. C. CAMPBELL, Controller and Auditor-General.

ABLE No. 7.

IRRIGATION AND WATER-SUPPLY.

SCHEDULE OF SCHEMES COMPLETED OR UNDER CONSTRUCTION.

Scheme.	Source of Supply.	River Discharge (Minimum).	Main Canal Discharge (Maximum).		Rainfall Average for Six Years.	Rainfall 1922.	Area commanded (Gross).	Area irrigated at Present.	Works authorized.		Works completed.		Expenditure to 31st March, 1923.	Estimate to complete.	Remarks.
			As per Design.	During 1922–23.					Main Canals.	Distributaries.	Main Canals.	Distributaries.			
		Cusecs.	Cusecs.	Cusecs.	Inches.	Inches.	Acres.	Acres.	M. ch.	M. ch.	M. ch.	M. ch.	£	£	
Steward Settlement	Waitaki River ..	..	110	..	19·72	17·42 (Steward Sett.)	18,000	..	14 60	50 31	14 60	50 31	12,115	..	Completed.
Otekaike	Otekaike River ..	9	15	..	19·89	20·21 (Duntroon)	1,500	800	14 37	3 47	14 37	3 47	3,631	..	Completed. Used only on west side of river.
Ida Valley ..	Manorburn, Poolburn, and Moa Creek (Storage Manorburn Dam)	..	109	84	15·48	18·17 (MoaCk.)	28,600	..	73 0	54 0	70 0	20 24	147,158	16,008	Sufficiently completed to supply water to any part of area for next summer. Further conservation required to provide complete irrigation of whole area which is not included in estimate.
Galloway	Manorburn Dam ..	..	15	12	13·77 (one year)	13·77	1,300	1,100	7 30	4 0	7 30	4 0	13,606	234	Completed and working. Further small works as required to adjust water-supply to land development.
Manuherikia - Alexandra–Clyde No. 1	Manuherikia River	77	100	40	14·90 14·82 12·79 (Alexandra, Clyde, and Ophir)	13·16 15·37 15·53	11,000	500	23 0	41 0	23 0	35 60	179,086	11,484	Sufficiently completed to supply water to any part of area for next summer.
Ardgour	Lindis River ..	50 (estim.)	20	..	16·24 (Luggate)	18·36	2,000	..	13 0	2 40	13 0	2 40	30,836	238	Completed during year. Further small expenditure to adjust water-supply to land development.
Earnscleugh (Fraser River)	Fraser River and storage dam	8	20	20	14·82 (Clyde)	15·37	4,000 (main) 1,580 (temp.)	1,000	4 30	12 10	4 30	12 10	3,037*	238	Temporary scheme. Completed and working. Main scheme for dam not started.
Olrig Terrace ..	Manorburn Dam ..	..	10	10	13·77 (Galloway) (one year)	13·77	1,600	400	0 20	..	0 20	..	7,285†	..	..
Last Chance Scheme (Fruitlands and Earnscleugh Tops)	Shingle, Gorge, and Coal Creeks	12	20	..	14·90 22·02 Alexandra and Roxburgh)	13·16 18·34	4,500	..	22 0	..	6 40	..	2,841‡	14,764	Water available for complete irrigation of 2,400 acres, and partial irrigation of a further 1,600 acres.
Tarras	Lindis River ..	50 (estim.)	63	..	16·24 (Luggate)	18·34	7,000	..	13 16	15 60	..	..	11	77,500	Work just started.
Teviot River ..	Teviot River and Lake Onslow dam	40 (estim.)	80	..	22·02 (Roxburgh)	18·34	3,000	..	..	..	..	..	1,597	22,051	..

* Includes £1,500 paid for Sandy Point mining races.

† Proportion of cost of Manorburn Dam and head races. Construction of races to serve remainder of irrigable land deferred till land settled.

‡ Includes £1,139 purchase of rights and races.

TABLE No. 7—*continued.*

SCHEDULE OF SCHEMES UNDER INVESTIGATION.

Scheme.	Source of Supply.	River Discharge (Minimum).	Main Canals Discharge (Maximum), as per Design.	Rainfall (Average for Six Years).	Rainfall, 1922.	Area commanded (Gross).	Length of Main Canal.	Length of Distributaries.	Expenditure to 31st March, 1923.	Estimate to complete.	Remarks.
		Cusecs.	Cusecs.	Inches.	Inches.	Acres.	Miles.	Miles.	£	£	
Maniototo (Upper Taieri)	Taieri River and storage dam	25	500	18·96 (Eweburn)	22·23	100,000	60	..	115	..	Modified scheme for complete irrigation of 5,000 acres is possible without storage or for reasonable partial irrigation of 15,000 acres.
Cromwell Flat and Lowburn (Roaring Meg)	Roaring Meg Stream (gravity), Kawarau River (pumping)	29 3,000	40	16·24 (Luggate)	18·36	15,000	10	30	8	39,700	Roaring Meg Stream: This will irrigate 3,750 acres and may be reduced in cost by charging £11,350 to possible hydro-electric-power development. Kawarau River: A private company is developing this portion of scheme.
Upper Manuherikia ..	Manuherikia and Dunstan Rivers, with two storage dams in Manuherikia River, one in Dunstan River, and one in Idaburn	77	several not fixed	14·82 12·79 21·13 (Clyde, Ophir, and Blackstone Hill)	18·37 15·53 24·29	90,000	130	..	1,982	..	This scheme includes the whole of irrigable lands in Manuherikia Valley, Idaburn and White Sow Valleys, and part of Maniototo Plains about Ranfurly. Complete irrigation requires storage dams, but a useful partial irrigation supply might be installed without dams for majority of areas. Dams to follow later. Survey and river-gauging proceeding.
Arrow River	Arrow River .. .. Timaru Creek (gravity)	100 (estim.)	..	30·42 (Queenstown)	25·42	6,536	17	24	14	93,598	To irrigate Arrow Flats, Miller's Flat, Speargrass Flat, and Frankton.
Hawea Flats (First Development)	Hawea River (pumping)	20 (estim.)	30	20·04 (Maungawera)	..	4,000	11	20	12	41,470	To irrigate Lower Flat only.
Hawea Flats (Later Development)		..	..	22·04 (Maungawera)	..	17,600	..	..	..	71,720	Estimate does not include cost of generating power for pumping, but scheme is dependent upon purchase of about 2,200 h.p. of cheap surplus power from any prospective hydro-electric development in the district.
Chapman's Gully ..	Butcher's Creek and storage dam	..	..	14·91 (Alexandra)	13·16	100	..	..	..	1,165	..
Bendigo Flat	Lindis River and storage dam	50	30	16·24 (Luggate)	18·36	3,000	7	..	..	..	..
Teviot River Extension..	Teviot River and Lake Onslow dam	40	80	22·02 (Roxburgh)	18·34	13,400	..	..	..	..	To irrigate Teviot and Miller's Flat and Ettrick. Involves enlargement of Lake Onslow dam.
Bengerburn	Bengerburn	..	4	22·02 (Roxburgh)	18·34	1,000	2	..	40	500	Preliminary scheme supplying domestic water and partial irrigation.

TABLE No. 8.

IRRIGATION AND WATER-SUPPLY.

IDA VALLEY, GALLOWAY FLAT, AND OLRIG TERRACE SCHEME.

PROFIT AND LOSS ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 1923.

Gross Revenue Account.

To Management and Operation—	£ s. d.	£ s. d.	By Sales of water—	£ s. d.
Ida Valley section—			Ida Valley section	2,207 7 4
Salaries	90 11 11		Galloway Flat section	187 8 7
Wages, horse allowances, and other costs of maintenance ..	1,077 3 10		Olrig Terrace section	83 16 0
		1,167 15 9		
Galloway Flat section—				
Salaries	9 4 7			
Wages, horse allowances, and other costs of maintenance ..	109 14 3			
		118 18 10		
Olrig Terrace section—				
Salaries	12 0 5			
Wages, horse allowances, and other costs of maintenance ..	142 19 4			
		154 19 9		
Office rent		10 0 0		
Maintenance of staff cottages ..		45 0 0		
Gross profit on working ..		981 17 7		
		£2,478 11 11		£2,478 11 11

Net Revenue Account.

To Interest on capital outlay—	£ s. d.	By Gross profit on working as per Gross Revenue Account	£ s. d. 981 17 7
4 per cent. per annum on £148,579 2s. 7d. (half charged against revenue)	2,971 11 8	Net loss for year	3,475 9 11
Amount required as contribution to Sinking Fund, 1 per cent. on capital outlay	1,485 15 10		
	£4,457 7 6		£4,457 7 6

Profit and Loss Appropriation Account.

To	£ s. d.	By	£ s. d.
Balance from previous year's statement	3,386 6 11	Balance to balance-sheet	6,861 16 10
Balance from Net Revenue Account ..	3,475 9 11		
	£6,861 16 10		£6,861 16 10

GENERAL BALANCE-SHEET AT 31ST MARCH, 1923.

Liabilities.	£ s. d.	*Assets.*	£ s. d.	£ s. d.
Public Works Fund—		Dams, weirs, water-races, &c.—		
Capital expenditure to 31st March, 1923	168,047 15 7	Ida Valley section—		
Consolidated Fund—		Proportion Manorburn dam and headraces	48,435 6 4	
Excess of maintenance and interest charges over receipts	11,877 8 10	Main water-races ..	91,937 3 8	
		Distribution water-races	10,472 1 9	
				150,844 11 9
Arrears of sinking-fund contribution ..	2,860 1 2	Galloway Flat section—		
Sundry creditors—		Proportion Manorburn dam	6,028 16 5	
Ida Valley section	1,183 11 6	Dip Creek diverting-weir	1,132 10 11	
Galloway Flat section	5 2 3	Main water-races ..	7,011 15 6	
				14,173 2 10
		Olrig Terrace section—		
		Proportion Manorburn dam and water-races	7,209 4 11	
		Main water-races ..	326 4 7	
				7,535 9 6
				172,553 4 1
		Staff accommodation		1,140 0 0
		Telephone system		800 0 0
		Stocks of material on hand ..		150 0 0
		Sundry debtors (sale of water)—		
		1920–21 and previous years ..	£ s. d. 7 19 10	
		1921–22 ..	9 13 2	
		1922–23 ..	2,451 5 5	
				2,468 18 5
		Profit and Loss Account—Accumulated loss to date		6,861 16 10
	£183,973 19 4			£183,973 19 4

Public Works Department,
Wellington, 19th July, 1923.

J. J. GIBSON,
Acting Accountant.

TABLE No. 9.

Schedule showing Particulars of Railway-lines under Construction at 1st April, 1923.

Railway.	Length of Section.	Length under Construction.	Handed over to Railway Department on 1st April, 1923.	Rails laid during Year.	Length over which Traffic is being run.	Length over which Goods Traffic only is being run.	Length ready for handing over to Railway Department.	Ready for handing over to Railway Department within Six Months.	Ready for handing over to Railway Department within One Year.	Ready for handing over to Railway Department within Two Years.	Amount spent to Date.	Estimated Amount to Complete.
	M. CH.	M. CH.	M. CH.	M. CH.	M. CH.	M. CH.	M. CH.	M. CH.	M. CH.	M. CH.	£	£
Kaihu Valley	4 54	..	4 54	..	..	..	..	..	..	..	87,650	5,000
North Auckland Main Trunk—												
Whangarei Branch	14 52	14 52	..	..	14 52	..	..	..	14 52	..	293,872	20,654
Waipu Branch	16 0	9 20	..	..	..	..	..	..	..	..	25,303	105,000
Okaihau Section	8 20	8 20	..	..	8 20	..	..	8 20	..	..	189,827	13,567
Okaihau–Te Tio	21 0	..	..	..	..	..	..	..	..	..	25,956	472,500
Huarau–Waiotira	15 70	15 70	..	9 0	15 70	..	..	..	15 70	..	618,561	90,000
Waiotira–Kirikopuni	15 0	10 0	..	..	..	..	..	..	..	12 0	84,243	386,000
Pukehuia–Dargaville	13 40	..	..	..	..	..	..	..	..	..	..	229,500
Huntly–Awaroa	1 60	1 60	..	1 60	..	1 60	..	1 60	..	..	64,984	16,729
East Coast Main Trunk—												
Waihi–Tauranga	41 5	19 63	..	..	..	..	..	..	..	9 68	187,500	683,000
Tauranga–Taneatua (including Mount Branch)	63 12	63 12	..	3 15	38 23	12 24	..	..	..	63 12	938,338	425,380
Taneatua–Opotiki	25 0	..	..	..	..	..	..	..	..	..	..	500,000
Gisborne–Wairoa	70 0	14 12	..	..	11 18	..	..	..	11 18	..	255,724	1,510,000
Wairoa–Napier	70 0	19 13	..	8 0	..	11 64	11 64	..	..	..	263,666	1,520,000
Waikokopu Branch	24 58	24 58	..	21 20	..	..	..	..	..	24 58	354,505	120,000
Stratford Main Trunk—												
Kohuratahi–Tahora	5 14	5 14	..	..	5 14	..	..	..	5 14	..	213,599	18,000
Tahora–Ohura	24 0	..	..	..	..	..	..	..	..	..	28,060	750,000
Ohura–Okahukura	19 0	19 0	..	10 23	10 23	..	..	..	10 23	8 60	390,738	305,000
Opunake Branch and Manaia Branch	28 49	28 49	..	8 40	..	..	..	..	12 49	16 0	174,385	220,000
Midland—												
Glenhope–Inangahua	55 0	3 71	..	..	..	..	..	..	3 71	..	63,341	1,300,000
Otira–Arthur's Pass	8 40	8 40	..	..	..	..	..	8 40	..	..	1,412,084	150,000
Westport–Inangahua	22 0	..	..	..	..	..	..	..	..	..	152,702	600,000
Greymouth–Port Elizabeth ..	2 45	2 45	..	..	..	..	2 45	..	..	..	70,963	2,827
South Island Main Trunk—												
Wharanui–Parnassus	83 0	..	..	..	..	..	..	..	..	..	..	2,000,000
Lawrence–Roxburgh—												
Beaumont–Miller's Flat ..	15 0	10 63	..	4 37	..	..	..	..	..	15 0	93,443	135,000
Miller's Flat–Roxburgh ..	10 0	..	..	..	..	..	..	..	..	..	..	130,000
Orepuki–Waiau	8 24	8 24	..	..	..	..	..	..	8 24	..	37,049	25,777
Balclutha–Tuapeka Mouth ..	22 50	..	..	..	..	..	..	..	..	..	..	250,000
Rimutaka Deviation	13 24	..	..	..	..	..	..	..	..	..	..	970,000
Wellington–Tawa Flat Deviation	8 0	..	..	..	..	..	..	..	..	..	..	950,000
Totals	..	287 46	4 54	66 35	103 60	25 68	14 29	18 40	82 1	149 38	6,026,493	13,903,934

APPENDICES TO THE PUBLIC WORKS STATEMENT, 1923.

APPENDIX A.

AUDITED STATEMENT OF EXPENDITURE ON PUBLIC WORKS OUT OF THE PUBLIC WORKS FUND FOR THE YEAR 1922–23.

Prepared in compliance with Section 8 of the Public Works Act, 1908.

SIR,— Public Works Department, Wellington, 12th July, 1923.

In compliance with the 8th section of the Public Works Act, 1908, I enclose a statement of the expenditure during the preceding financial year on all works and services chargeable to the Public Works Fund. I have, &c.,

J. G. COATES,
Minister of Public Works.

The Controller and Auditor-General, Wellington.

STATEMENT OF NET EXPENDITURE ON ALL WORKS AND SERVICES CHARGEABLE TO THE PUBLIC WORKS FUND (GENERAL PURPOSES ACCOUNT) FOR THE YEAR 1922–23.

Vote.	Summary.	Appropriation.	Expenditure.	Credits.	Net Expenditure.
	PUBLIC WORKS FUND (GENERAL PURPOSES ACCOUNT).	£	£ s. d.	£ s. d.	£ s. d.
40	Public Works, Departmental	145,893	164,442 4 7	53,116 7 2	111,325 17 5
41, 42	Railways	2,350,000	2,235,106 16 9	124,248 5 7	2,110,858 11 2
43–51	Public Buildings..	374,000	267,769 5 11	10,074 18 5	257,694 7 6
52	Timber-supply and Sawmills for Public Works Department	17,000	23,473 19 2	8,749 5 5	14,724 13 9
53, 54	Lighthouses, Harbour-works, and Harbour-defences	15,575	9,833 12 7	49 11 9	9,784 0 10
55	Tourist and Health Resorts	25,000	5,477 17 0	42 16 5	5,435 0 7
56	Immigration	241,043	163,791 13 3	73,180 2 3	90,611 11 0
57–58	Roads, Bridges, and other Public Works ..	890,672	676,617 16 0	28,612 4 10	648,005 11 2
59	Development of Mining	1,500	1 8 10	100 0 0	*Cr.* 98 11 2
60	Telegraph Extension	783,385	616,573 6 8	103,916 19 0	512,656 7 8
61	Motor Transport Service	33,100	31,487 9 11	8,808 0 0	22,679 9 11
62	Contingent Defence	25,000	2,315 8 4	613 14 0	1,701 14 4
63	Lands, Miscellaneous	38,380	28,142 4 1	1,937 17 6	26,204 6 7
64	Irrigation and Water-supply	70,000	59,579 6 2	1,448 2 11	58,131 3 3
65	Plant, Material, and Stores	75,250	77,183 16 2	96,891 14 3	*Cr.* 19,707 18 1
..	Unauthorized	..	850 11 6	809 7 4	41 4 2
	Total, Public Works Fund	5,085,798	4,362,646 16 11	512,599 6 10	3,850,047 10 1

J. J. GIBSON,
Acting-Accountant.

F. W. FURKERT,
Engineer-in-Chief and Under-Secretary.

Examined and found correct.

G. F. C. CAMPBELL,
Controller and Auditor-General.

APPENDIX A—*continued.*

	Name of Vote.	Appropriation.	Expenditure.	Credits.	Net Expenditure.
	PUBLIC WORKS FUND.	£	£ s. d.	£ s. d.	£ s. d.
40	Public Works, Departmental	145,893	164,442 4 7	53,116 7 2	111,325 17 5
	Railways—				
41	Railway-construction	1,500,000	1,436,109 11 2	77,178 14 3	1,358,930 16 11
42	Additions to Open Lines	850,000	798,997 5 7	47,069 11 4	751,927 14 3
	Public Buildings—				
43	General	126,000	121,082 18 11	7,530 9 1	113,552 9 10
44	Courthouses	5,000	2,561 18 3	543 17 7	2,018 0 8
45	Prisons	25,000	23,147 4 2	34 4 3	23,112 19 11
46	Police-stations	20,000	6,474 13 10	176 9 4	6,298 4 6
47	Postal and Telegraph	100,000	78,171 14 3	960 8 1	77,211 6 2
48	Agricultural	2,000	845 8 2	331 5 3	514 2 11
49	Mental Hospitals	50,000	14,028 2 8	175 13 1	13,852 9 7
50	Hospitals and Charitable Institutions	45,000	21,457 5 8	322 11 9	21,134 13 11
51	School Buildings	1,000	..	..	..
52	Timber-supply and Sawmills for Public Works Department	17,000	23,473 19 2	8,749 5 5	14,724 13 9
	Lighthouses, Harbour-works, and Harbour-defences—				
53	Lighthouses	5,550	3,304 17 3	44 18 5	3,259 18 10
54	Harbour-works	10,025	6,528 15 4	4 13 4	6,524 2 0
55	Tourist and Health Resorts	25,000	5,477 17 0	42 16 5	5,435 0 7
56	Immigration	241,043	163,791 13 3	73,180 2 3	90,611 11 0
	Construction and Maintenance of Roads, Bridges, and other Public Works—				
57	Roads, &c.	875,672	671,647 10 11	28,491 19 8	643,155 11 3
58	Road and other Works on Goldfields and Mineral Lands	15,000	4,970 5 1	120 5 2	4,849 19 11
59	Development of Mining	1,500	1 8 10	100 0 0	*Cr.* 98 11 2
60	Telegraph Extension	783,385	616,573 6 8	103,916 19 0	512,656 7 8
61	Motor Transport Service	33,100	31,487 9 11	8,808 0 0	22,679 9 11
62	Contingent Defence	25,000	2,315 8 4	613 14 0	1,701 14 4
63	Lands, Miscellaneous	38,380	28,142 4 1	1,937 17 6	26,204 6 7
64	Irrigation and Water-supply	70,000	59,579 6 2	1,448 2 11	58,131 3 3
65	Plant, Material, and Stores	75,250	77,183 16 2	96,891 14 3	*Cr.* 19,707 18 1
	Unauthorized—Services not provided for	..	850 11 6	809 7 4	41 4 2
	Total, Public Works Fund	5,085,798	4,362,646 16 11	512,599 6 10	3,850,047 10 1

APPENDIX B.

ANNUAL REPORT ON PUBLIC WORKS BY THE ENGINEER-IN-CHIEF.

The Engineer-in-Chief to the Hon. Minister of Public Works.

Sir,—

I have the honour to submit the following report upon the various works under my control completed and in progress throughout the Dominion during the period from the 1st June, 1922, to the 31st July, 1923.

RAILWAYS.

Abstract.

The following table shows the expenditure on Government railways in New Zealand up to the 31st March, 1923:—

Name of Railway.	Total Length of Railway or Section.	Open for Traffic.	Expenditure to 31st March, 1923.
	M. ch.	M. ch.	£
Kaihu Valley	24 30	19 58	175,110
Otiria–Hokianga	45 25	16 25	125,987
Opua Wharf – Onerahi	58 6	58 6	535,512
Kioreroa–Waiotira	19 79	5 23	396,175
North Auckland Main Trunk Railway (from Helensville)	84 24	54 27	1,871,406
Helensville – Te Awamutu, with Branches	163 48	159 08	3,113,354
Frankton Junction – Thames, with Branches	127 35	87 20	761,496
Thames Valley – Rotorua	69 33	69 33	382,080
Tauranga–Opotiki, with Branches	145 32	..	938,344
Gisborne–Opotiki	93 44	49 32	624,357
Napier–Gisborne	231 44	..	887,429
Wellington – Napier and Palmerston North (including Te Aro Extension and Greytown and Martinborough Branches)	249 44	233 12	2,737,380
Wellington–Waitara, with Branches	350 11	285 59	2,907,797
Stratford–Okahukura	112 47	42 26	1,173,290
North Island Main Trunk (Marton – Te Awamutu), including Raetihi Branch and Waipa Gravel-access Branch	225 79	218 39	2,959,662
Picton–Waipara (South Island Main Trunk Railway)—			
Picton southwards	92 38	56 6	656,086
Waipara northwards	90 45	44 14	377,253
Nelson–Greymouth	177 51	125 57	614,060
Stillwater – Arthur's Pass	51 41	42 27	1,842,047
Rolleston – Arthur's Pass (including Whitecliffs Branch)	92 59	84 45	914,576
Westport–Ngakawau	19 56	19 56	189,521
Westport – Ngakawau Extension to Mokihinui*	7 12	7 12	..
Mokihinui Colliery Line†	3 69	3 69	..
Westport–Inangahua	26 0	5 74	152,702
Ngahere–Blackball	3 40	3 40	147,532
Greymouth–Rewanui and Branches	11 34	8 70	326,609
Greymouth–Waitaha	50 32	38 68	342,314
Hurunui–Waitaki, with Branches	459 34	413 70	2,738,499
Canterbury Interior Main Line—Oxford–Temuka	83 0	11 44	59,942
Waitaki–Bluff, with Branches	600 21	546 12	5,097,650
Otago Central	182 51	147 27	1,435,496
Invercargill–Kingston, with Mararoa Branch	117 4	97 44	388,323
Forest Hill Railway—Winton–Hedgehope‡	12 40	12 40	23,337
Western Railways	94 8	70 31	368,376
Preliminary surveys	..	..	46,935
Miscellaneous	..	..	10,337
Stock of permanent-way on hand	..	..	224,122
Rolling-stock	..	..	9,075,048
Suspense Account, being proportion of cost of raising loan of £1,000,000 at 6 per cent. for Railways Improvement Authorization Act 1914 Account	..	..	63,192
Total	4,177 16	3,038 54	§44,683,336
Provincial Government Lines, etc.			
Canterbury (lengths included above)	..	..	731,759
Otago and Southland	..	..	372,522
Gisborne to Ormond Tramway	..	..	4,975
Midland Railway, valuation of works constructed by company	..	..	‖683,460
Grand total	4,177 16	3,038 54	46,476,052

* The funds for this extension—namely, £35,501 2s. 11d.—were provided by the Westport Harbour Board.
† The funds for purchase of this line, £15,745, were provided by the Westport Harbour Board.
‡ The expenditure on this line as a tramway was made by the Lands Department.
§ Includes expenditure on railways under Hutt Road and Railway Improvement, Railway Improvement Authorization Act nd Railway Improvement Authorization Act 1914 Accounts.
‖ Includes value for £150,000 paid to debenture-holders under the Midland Railway Petitions Settlement Act Amendment Act, 1903.

Kaihu Valley Railway Extension.

(19 m. 17 ch. to 23 m. 71 ch.; length, 4 miles 54 chains.)

All work in connection with this extension has been completed during the period, and the line was taken over by the Railway Department in February last. The most important work carried out during the year was the completion of the various bridges and the erection of station buildings at Aranga and Donnelly's Crossing. The timber for these buildings was supplied from the Department's mill at Whatoro. In order to facilitate the transport of timber from the new sawmill on the Katui Road to Donnelly's yard a tram-line was constructed, and has considerably cheapened the transport of timber.

North Auckland Main Trunk Railway.

Ngapuhi Northwards.

Okaihau Section (16 m. 25 ch. to 24 m. 45 ch.; length, 8 miles 20 chains).—The formation, platelaying, and ballasting on this line has been completed, but very heavy work has been required on the maintenance and formation owing to the large amount of slips which have taken place. 20,000 cubic yards of slip material has been removed. 6,300 yards of scoria has been utilized in the Okaihau station-yard, and the bank at 20 m. 17 ch. 24 chains of stone wall had to be built to maintain the cuttings at 19 m. 60 ch. and at 24 m. 14 ch. At the back of the Okaihau Station the line had to be deviated to reach solid country, between 23 m. 62 ch. and 24 m., and this has now proved satisfactory. The piers of the bridge over the Utukura Stream at 21 m. 67 ch. were erected and temporary stringers put in to take the traffic until the arrival of the steel girders, which have now been put into position. At the Okaihau station-yard platelaying, ballasting, and the erection of all buildings, engine-sheds, coal-stores, and all the necessary equipment of the station-yard has been completed. A water-service was provided, and has satisfactorily filled the requirements of the station. A goods and passenger service has been run between Kaikohe and Okaihau.

Extension Northwards of Okaihau.—No construction work has been carried out on this extension during the year.

Huarau Northwards.

Paparoa Section (90 m. 30 ch. to 92 m. 6 ch.; length, 1 mile 56 chains).—The principal work carried out during the period on this section has been the clearing of slips and maintenance. A considerable amount of new fencing has been erected, and it was necessary to dismantle and re-erect about 50 chains owing to the number of slips which have come down and broken the fences. One complete loop with points and crossings on the main line has been laid in the Paparoa station-yard, but no extensive work has been carried out here, as the lay-out of the yard has not been definitely decided. The siding has had one lift of ballast, and the station-yard in the vicinity of the goods-shed has been metalled.

Mareretu Section (92 m. 6 ch. to 96 m. 20 ch.; length, 4 miles 14 chains).—The formation on this section has been completed during the year. In addition to the general cutting and embankments throughout the section a number of large slips and subsidences have taken place. At 92 m. 21 ch. a slip of 2,500 cubic yards had to be cleared away, and at 93 m. 14 ch. a deviation had to be adopted owing to the bank having subsided very badly. The same course had to be adopted at 94 m. 57 ch., and at 95 m. 2 ch. it has been necessary to continually fill up the bank with rubble and rock in order to maintain traffic.

The most important work was, of course, the completing of the Golden Stairs Tunnel. All work in connection with this tunnel was finished by the middle of November, and this enabled arrangements for through traffic to be pushed on satisfactorily. The main-line bridge at 92 m. 15 ch., consisting of five spans of 25 ft. steel-plate girders on hardwood piles, was completed with the exception of the close sleepering, and the overbridge at 92 m. 73·30 ch., consisting of five timber spans and 17 chains of road approaches, was finished. The platelaying on this section was completed, 2 miles 26 chains of main-line rails having been laid and the sidings completed in the Mareretu station-yard. Two lifts of ballast have been laid on the main line from 93 m. 41 ch. to 96 m. 20 ch., and one lift has been laid under the siding at Mareretu station-yard. Approximately 6,375 cubic yards of ballast were crushed at the Hoteo quarry and transported, in addition to that supplied from the Tauraroa quarry.

Waikiekie Section (96 m. 20 ch. to 107 m. 28 ch.; length, 9 miles 66 chains).—The main objective in regard to this section was to complete the work sufficiently to enable a junction to be made with the northern end at the earliest possible date. This was accomplished and a through passenger service was inaugurated before Christmas, while there was still a gap of half a mile between the rails. Considerable difficulties were experienced owing to the bad weather and numerous slips, and it was mainly owing to the use of steam-shovels that sufficient progress was made to enable the lines to be joined up and through traffic instituted even earlier than promised.

The heavy formation of the Waiotira and Taipuha station-yards, which was in hand at the commencement of the period, is now practically complete. The formation of the overbridge approaches at 100 m. 35 ch., 101 m. 18 ch., 107 m. 3 ch., and 107 m. 27 ch. are in the same position.

Ten large concrete culverts were completed, as well as a number of concrete and earthenware pipes.

The southern portal of the Mareretu Tunnel has been built, and the left wing of the southern portal of the Waikiekie Tunnel. 40 chains of road-deviation was formed near the Mareretu Station.

Special measures were taken to drain the large banks. Between 96 m. 22 ch. and 96 m. 52 ch. stream-diversions and drains have been cut to enable the water to get away rapidly from the south-western side of the line and through the bridge-opening at 96 m. 47 ch.

Bridge-building has been very vigorously carried out during the year. Five railway-bridges have been completed, together with the railway overbridge at 107 m. 3 ch., 107 m. 27 ch., and the 100 ft. road-approach bridge at Waiotira station-yard. Considerable difficulty was experienced in the construction of the bridges at Mangawai (99 m. 2 ch.) and at the Kikowhiti Stream (99 m. 30 ch.) owing to the difficulty of getting a stable foundation. The ground being very soft and a solid bottom not being reached, it was necessary to resort to cradling and splicing the piles in order to give the necessary stability. The fabrication of the steelwork was carried out by contract, and immediately it was received the erection was pushed along, but in order to avoid interfering with traffic the placing of girders was restricted to week-ends.

The workshops at Waiotira have been kept very busily employed in maintaining and repairing the large amount of plant, machinery, &c., which is in use on this section. In addition to this, the housing of workmen and the shifting and re-erection of huts entailed a large amount of labour and material. The 240 ft. steel-joist road-approach bridge at the Taipuha Station is in hand. A telephone-line has been erected throughout. Platelaying on this section has now been completed.

Two lifts of ballast have been completed over the whole sections, and about 3 miles of the final lift and boxing-in has been completed.

Kirikopuni Section (107 m. 28 ch. to 121 m. 40 ch.; length, 14 miles 12 chains).—During the greater part of the period the Wairoa end of this section was pushed on more vigorously than the southern end, the principal work being the construction of the long tunnel at Omana. The northern end has been pierced for a distance of 6 chains, but progress has been slow and difficult owing to the very heavy nature of the country, which necessitated exceptionally heavy timber. It is hoped, however, that more stable country will shortly be reached. At the southern end of the tunnel some difficulty has been experienced, and in order to enable the approach cutting to be taken out and a start made on the commencement of the tunnel it was necessary to timber the whole cutting; four lengths of reinforced tunnel on the cut-and-cover system had to be built before the tunnel proper could be started. On the southern end of this section the work has been pushed on north of Waiotira in order that a start might be made with the Tokatoka Tunnel, a service tram-line having been built from Waiotira to this tunnel. In order to enable progress to be made with the northern end of this tunnel a jig line has been constructed over the hill, and it is intended to lay a tram-line from the northern end of this tunnel to the southern end of the Omana Tunnel in order to enable rail communication for service purposes to be maintained between Waiotira and the Wairoa River. This section is being heavily manned with steam-shovels and will be further strengthened shortly by more from some of the other sections which are now practically completed. Surveys are in hand for a deviation from the south of Pukehuia to the new crossing of the Wairoa River west of Pukehuia. This has been continued over the river towards Kirikopuni. The balance of the permanent-line survey to Kirikopuni is being started.

In order to provide a feeder road from the Mangakahia Valley a survey has been made of a direct motor road from Kirikopuni to Parakao. It has been found that very easy grades can be obtained, and the cost of construction should not be excessive. This road would save settlers in the vicinity of Parakao and northwards 13 miles of road and 8 miles of railway on the journey to Auckland, and would also be a great factor in opening up this big belt of country, thus providing considerable additional amount of traffic to the railway. Timber for the station buildings on this line is being cut at the Department's sawmill at Donnelly's, and is being barged to Ranganui. It will be possible, therefore, to proceed with the erection of the remaining station buildings very shortly.

Whangarei Branch Railway.

Oakleigh Section (5 m. 27 ch. to 7 m. 60 ch.; actual length, 2 miles 33 chains).—The principal work on this section has consisted of the completion of the Oakleigh Bridge at 7 m. 32 ch., together with the general maintenance. Some of the fillings showed indications of subsidence and slipping, and it was therefore found necessary to put in several drives to drain the seats of the fillings.

Tauraroa Section (7 m. 60 ch. to 14 m. 67 ch.; length, 7 miles 7 chains).—As this section has been under traffic a considerable amount of maintenance has been necessary. Several cuttings between 8 m. and 9 m. have slipped badly, and it has been necessary to employ a work-train to clear them up. The Mangapai Bridge at 10 m. 19 ch. and the Moewhare Bridge at 13 m. 30 ch. have been completed. The crushing plant on this section has given very good service, and established a record output of 31,700 cubic yards. This metal has been utilized mainly in ballasting, but a considerable amount of approach-road metalling has been carried out, and a certain amount has been supplied to local bodies. Owing to the large demand for metal in order to complete ballasting and to supply the requirements of the local bodies it has been decided to transfer the Omapere plant to Tauraroa to increase the supply. The sidings at Tauraroa have been completed, and the stockyard and loading-banks erected.

Waiotira Section (14 m. 67 ch. to 19 m. 75 ch.; length, 5 miles 18 chains).—Work on this section has been principally confined to maintenance, about 1,000 additional yards of ballast has been placed, and the steel girders have been erected on the bridge at 17 m. 73 ch.

Waipu Branch Railway.

Raukaka Section (0 m. to 9 m. 20 ch.; length, 9 miles 20 chains).—The only work carried out on this section during the year has been the building of the filling across the mud-flats from 0 m. to 2 m., and the erection of 3 miles of fencing where it was necessary to enter upon private property. The filling across the mud-flats was carried out by means of a steam-shovel.

Huntly–Awaroa Railway.

(7 m. 20 ch. to 9 m.; length, 1 mile 60 chains.)

Formation on this line has been completed from 7 m. 25 ch. to 8 m. 75 ch., including Glen Afton station-yard. Considerable trouble has been experienced in the last four months of the period owing to the almost continuous wet weather. It will be necessary to employ a steam-shovel here to deal with the slips, and arrangements are being made to that end. Platelaying and ballasting has been completed throughout. Owing to the large number of slips which occurred recently the final completion and handing-over to the Railways Department was delayed, but coal traffic has been run by the Department since the 17th June last, the daily output of the Glen Afton Colliery Company being 200 tons per day.

East Coast Main Trunk Railway.—Waihi Eastwards.

Athenree Section (0 m. to 8 m. 68 ch.; length, 8 miles 68 chains).—Practically all the earthwork on this section has now been completed with the exception of cutting from 8 m. 20 ch., and the necessary filling round several of the bridge abutments. A number of road-deviations, to avoid the railway formation and to allow for subways under various bridges, has been formed and metalled complete.

Good progress has been made on all the bridges on this section. In all a total of about 4,000 cubic yards of concrete has been placed, and 175 lineal feet of piling driven. At the Victoria Street Bridge (12 m. 33 ch., Paeroa chainage), two pile piers completed and seven spans of 22 ft. girders reinforced, and placed in position. Mangatoetoe Bridge (0 m. 3 ch.), twelve spans of 22 ft. girders reinforced, and one 55 ft. steel span and one stringer span have been erected. Adams Street subway (0 m. 36 ch.), two concrete piers have been completed, and timber has been delivered for two pile piers. Ohinemuri Bridge (0 m. 55 ch.), one concrete pier has been completed and coffer-dam built on the river to enable the foundations of the other concrete piers to be safely put in. The erection of this coffer-dam has been a difficult undertaking. It was constructed of sheet piling, and in all 300 piles had to be driven. Three shifts are being employed on this work, as its completion governs the continuance of platelaying. The cartage of material to the two Waimata bridges at 0 m. 67 ch. and 2 m. 62 ch. is in hand. The majority of the piers in the five Wairau bridges are completed, and the erection of the girders is being proceeded with. The subway at 8 m. 62·8 ch. has been completed. The fabrication of all steel for the bridge on this section has been carried on in the Mount Workshop at Tauranga. As it is anticipated that platelaying will be commenced very shortly, a stacking-ground for permanent-way material has been established in the Waihi yard, and a siding laid. Sufficient rails and sleepers to lay 8½ miles of line are in hand, all sleepers have been adzed, and formation has been trimmed to 1 m. 40 ch. in readiness to make a start.

The stone-crushing plant at 7 m. 23 ch. crushed 3,040 cubic yards of rock, the whole output being used for concrete aggregate and road-metal. A carpenter's shop and benzine-store was erected at Athenree, as well as a dam for water-supply.

Katikati Section (8 m. 68 ch. to 16 m. 28 ch.; length, 7 miles 40 chains).—All fencing has been completed to the 14-mile peg, and all formation is in hand to the same point, and is complete up to 10 m. 29 ch., with the exception of bank between 8 m. 68 ch. and 8 m. 71 ch. A steam-shovel has been transported to 8 m. 68 ch., and will be utilized for the completion of this bank. The deviation of the main road at 11 m. 59 ch. has been formed and metalled. A large amount of material, including bridge girders, cement, two locomotives, and a steam-shovel, has been landed at Tuapira from Tauranga, and the advantages of water transport have been fully utilized for the delivery of material on this section. A telephone-line has been built to the end of the section.

It is intended to call tenders for the construction of the railway from 16 m. 28 ch. to 35 m. 22 ch., comprising the Aongatete, Apata, and Te Puna Sections. A telephone-line has been erected throughout this length. Extensive surveys have been carried out, and complete plans, specifications, and all details have been prepared for contract purposes.

Tauranga Westwards, Tauranga Section (34 m. 78 ch. to 41 m. 5 ch.; length, 6 miles 7 chains).—The main formation work on this section during the period has been the excavation by steam-shovel of material between 40 m. 22 ch. and 40 m. 30 ch. for the reclamation of the Tauranga station-yard. The stone pitching along the waterfront has been completed from 40 m. 29 ch. to 40 m. 41 ch., and from 40 m. 60 ch. to 41 m. 4 ch. 833 ft. of earthenware pipe has been laid and filling put in between 40 m. 30 ch. and 40 m. 40 ch., and from 40 m. 60 ch. to 40 m. 78 ch. Permanent-way for this section has been delivered at the Mount, and sleepers adzed, &c.

Tauranga Eastwards, Matapeehi Section (41 m. 5 ch. to 45 m. 0 ch.; length, 3 miles 75 chains).—Good progress has been made at the Mount workshops on the fabrication of the steel for Tauranga Bridge. The seven straight spans are complete, six having been fabricated during the year. About 70 per cent. of the remaining seven curved spans is finished, and the whole fabrication for this bridge should be finished by October next. The preparation of reinforcement for the piers has also been completed. On the bridge itself all cylinder-sinking is completed, and all cylinders sealed and filled with concrete to 12 in. above low-water mark. Piers I to R are completed, in all about 1,000 cubic yards of concrete having been placed. Staging has been erected for four spans. Three of the 104 ft. spans are erected, and riveting is well forward. 400 tons of steel has now been placed and one span completed. Fencing has been completed from 41 m. 62 ch. to 42 m. 0 ch. Traffic has been carried from 42 m. to 45 m., and the section has been well maintained.

Mount Branch (0 m. to 4 m. 7 ch.; length, 4 miles 7 chains).—This section has been carrying traffic during the period, and, except for general maintenance and some small addition to the Mount yard, no actual construction has been carried out. The Mount workshop, however, which is situated on this section, has carried out a considerable amount of work not only for other sections of this railway, but for lines in other parts of the country. Additional machinery was installed in the mill

and car-shop department, consisting of four-sided planer, 12 in. buzzer, goose-saw, and shaving conveyer, and a new riveting-gantry was constructed and erected at the bridge-shop. Among the principal works carried out were the following: Two 60 ft. steel spans for Matiere Section, Stratford–Main Trunk; two 20 ft., nine 25 ft., and three 20 ft. spans fabricated for Whangarei; one 25 ft. span fabricated for Kawakawa–Hokianga Railway. All engines, locomotives, rolling-stock, &c., were overhauled, and fifteen M wagons converted to L-class wagons.

Te Puke Section (45 m. to 54 m.; length, 9 miles).—This section is open for traffic, and the usual maintenance has been carried out. Various banks throughout the section have been raised and widened where necessary. In April last very heavy floods were experienced, and this section suffered somewhat severely, so that an emergency time-table had to be organized. Te Puke ballast-quarry is situated on this section, and about 16,000 cubic yards of metal was crushed and delivered for ballast, concrete aggregate, and road-metal.

Paengaroa Section (54 m. 59 ch. to 59 m. 67 ch.; length, 5 miles 67 chains).—This section, which is open for traffic, was also affected by the April floods, but all damage has been repaired, and, in addition, private crossings have been provided at 56 m. 57 ch. and at 56 m. 79 ch.

Pongakawa Section (59 m. 67 ch. to 64 m. 15 ch.; length, 4 miles 28 chains).—The only new work carried out on this section has been the construction of an additional siding for the timber traffic, and the raising, metalling, and culverting of the approach road to the Pongakawa Station. The section has been fully maintained for traffic purposes during the period.

Otamarakau Section (64 m. 15 ch. to 71 m. 5 ch.; length, 6 miles 60 chains).—The usual maintenance necessary for carrying traffic has been attended to on this section, but in addition considerable formation work has been done at Pukehina Station at 68 m. 18 ch. The banks throughout the section have been raised and widened. Good work was performed at the widening of the Otamarakau Bluff by steam-navvy, a total of 23,000 yards being removed. This work has resulted in a very considerable improvement, and the line is now laid in its permanent position, including the siding at the Otamarakau Station. The reinforced-concrete bridge at 70 m. 77 ch., consisting of one 14 ft. and two 9 ft. 6 in. spans, is well in hand, the piles having been driven.

Matata Section (71 m. 5 ch. to 79 m. 16 ch.; length, 8 miles 11 chains).—Traffic has been carried over this section throughout the period, and a considerable amount of new work in the way of widening and lifting banks which were formerly left narrow has been attended to, about 14,000 cubic yards of filling having been borrowed from the Otamarakau Bluff and the Matata pit. All the temporary bridges which were erected to enable traffic to be carried on as soon as the formation was completed have now been replaced by permanent structures. Reinforced slab-top bridges have been built at 72 m. 43 ch., 74 m. 26 ch., 75 m. 54 ch., and at 76 m. 16 ch. Eight large concrete culverts have been constructed at various points. The Matata ballast-pit has been opened up, and the development work in connection with this, including bridging, stream-diversions, and siding, has been practically finished. 1,800 cubic yards of stripping was removed, and 1,150 cubic yards of metal taken out. It is anticipated that this pit should very shortly be working up to its full capacity.

Rangitaiki Section (79 m. 16 ch. to 87 m. 45 ch.; length, 8 miles 29 chains).—The rails have now been laid on this section, but goods traffic only is being carried. The work of widening and lifting the various banks throughout the section has been vigorously prosecuted, material having been obtained from the Awakaponga pit. A caterpillar-mounted steam-shovel has given very satisfactory service here, having removed 55,400 cubic yards in about nine months. The average for each working-day of eight hours, not counting stoppages and holidays, was 432 cubic yards. Of this amount 42,000 cubic yards was used on the Rangitaiki Section, and 13,000 cubic yards on the Tarawera road-bridge and approaches. Approach roads have been formed to the station-yards at Awakaponga, Tarawera and Rangitaiki, a considerable amount of site-drainage has been carried out, and six concrete culverts, ranging from 3-ft. arch to 10-ft. flat top, have been completed. The pile-driving in the Tarawera River Bridge, at 83 m. 50 ch., is in hand, and temporary bridges have been erected at all bridge-crossings on the section, in order that platelaying may be proceeded with and traffic arrangements made, so that the construction of the permanent bridges can be carried on without interfering with the temporary arrangements.

Awakeri Section (87 m. 45 ch. to 91 m. 40 ch.; length, 3 miles 75 chains).—In addition to the usual maintenance necessary in order to keep the section open for traffic, the widening of banks has been proceeded with, 12,000 yards having been transported from the Awakaponga pit. A considerable amount of work is in hand in the Awakeri yard, the platelaying, cattle-stops, crossings, and culverting being nearly completed. About half the concrete piles in the Rangitaiki Bridge at 87 m. 78 ch. are completed. Two platelayers' cottages have been erected at Awakeri.

Taneatua Section (91 m. 40 ch. to 100 m. 6 ch.; length, 8 miles 46 chains).—The earthwork on this section has been vigorously prosecuted during the period. The centre-line formation is now com-completed to the Waioho Stream Bridge, at 96 m. 72 ch. A large factor in the progress of this section has been the utilization of four steam-shovels. The caterpillar-type shovel, which was removed from Awakaponga to Kiwinui, has been engaged forming the station-yard, but work was much delayed owing to bad weather. Another shovel finished up the banks about 96 m. 50 ch., and was then removed to 97 m. 60 ch., where it is engaged taking out cuttings, the material being used to make up the Pekatahi station-yard. A third shovel completed the summit cutting 40 ft. wide up to 97 m. 22 ch., the material being carried to bank at 96 m. 74 ch. The fourth machine was employed working on the top length of the summit cutting, the material being run to the long bank between 97 m. 60 ch. and 98 m. 10 ch. Towards the end of the period this latter shovel was removed to the formation level of cutting at 97 m. 30 ch., and spoil from this place was run to bank at 97 m. 38 ch. Six concrete culverts have been built at various chainages, and the piles for the Mission Creek Bridge, at 95 m. 38 ch., have been made. The materials for the Waioho Bridge, at 96 m. 73 ch., have all been delivered. The testing of the Whakatane River Bridge site was carried out, and concrete piles for this structure are being cast. Fencing is completed to 98 m. 30 ch. and the permanent platelaying to 96 m. 50 ch.

Gisborne–Napier Railway (North End).

Ngatapa Section (0 m. to 10 m. 29 ch.; length, 11 miles 18 chains).—On this section the formation has been made up to the full width where necessary, especially in the Patutahi station-yard, where the filling was widened to provide a track for guards when shunting. At Repongaere the cutting at 6 m. 16 ch. was similarly widened, and the raising of the Ngatapa station-yard was completed. The approach road to the Repongaere Station has been cleaned up and remetalled after the recent heavy traffic, and the roads to Ngatapa passenger-platform, loading-bank, and goods-shed have been metalled. In addition to this all the road-crossings on the section have been cleaned up and remetalled, and the line at Bushmere Road, 1 m. 28 ch., has been raised slightly to give a better crossing. Various alterations to the fencing and general repairs have been attended to. General repairs were carried out to the bridges on the branch line from Repongaere to the quarry, new stringers and trestles being put in where necessary. Some of the girders for the permanent bridges have come to hand, but have not yet been installed, as it is considered desirable to wait until they are all available and go straight ahead with the work so as to minimize inconvenience to traffic. Additional ballasting has been carried out on the main line and in Patutahi and Repongaere station-yards. The raising and ballasting of Ngatapa station-yard has been completed, and also the metalling of the platforms and loading-bank. The station buildings on this section are now completed, and passenger and goods service has been run on one day per week, and additional goods service on such days as have been found convenient. General maintenance has been attended to, and owing to the very free growth of weeds, due to the mild climate and the character of the ballast from the Waipaoa River, a strong gang has been necessary to keep the section in order.

Wharekopae Section (10 m. 29 ch. to 16 m. 30 ch.; length, 6 miles 1 chain).—Considerable trouble has been experienced on this section with slips. The line between 11 m. 64 ch. and 11 m. 75 ch. has been temporarily abandoned, and a service deviation graded between these points. Another deviation has been completed, by means of steam-shovels, through the cutting 12 m. 0 ch. to 12 m. 8 ch., in an endeavour to avoid the slip in that locality. This slip is, however, still giving trouble. Another deviation has been found desirable between 13 m. 15 ch. and 13 m. 23 ch. to do away with a tunnel. This work has been commenced with a steam-shovel, and a service line is being constructed around the cutting for future operations. Difficulty is also being experienced with the filling from 12 m. 39 ch. to 12 m. 42 ch. and at 12 m. 50 ch. Preliminary work has been put in hand in connection with a number of culverts between 12 m. 50 ch. and 13 m. 10 ch. A considerable amount of fencing has been carried out at the various deviations and to enclose temporary work. A service deviation between 11 m. 64 ch. and 11 m. 75 ch. has been relaid in 40 lb. material, and the permanent line laid from thereon to 12 m. 57 ch. The first lift of ballast on this section is in hand. Water-supply for the steam-shovel which is working at 13 m. 15 ch. has been installed. The main feature about this installation is that it has been found necessary to deliver the water to four treating and settling tanks in order to make it suitable for boiler feed-water purposes. Considerable trouble has been experienced with all the water used in this district for boiler purposes unless treated.

Waikokopu Branch Railway.

Nuhaka Section (0 m. 0 ch. to 17 m. 12 ch.; actual length, 18 miles 65 chains).—Formation and platelaying on this section is, with the exception of the station-yards, practically complete. At 1 m. 19 ch. sidings have been laid to the freezing-works and flax-mill, and at 1 m. 0 ch. a 75-chain service-line has been laid into a ballast-pit, from which sufficient ballast for the first 5 miles will be obtained. Permanent understructures and temporary superstructures have been completed on the bridges at 1 m. 23 ch., 3 m. 76 ch., 8 m. 43 ch., 9 m. 42 ch., 11 m. 30 ch., and 13 m. 62 ch. A first lift of ballast out of the Wairoa pit has been laid up to 5 m. 40 ch., and from 7 m. to the end of the section practically the whole of the first lift and 2 miles of the second lift have been completed with ballast from the Nuhaka pit.

Waikokopu Section (17 m. 12 ch. to 23 m. 5 ch.; length, 5 miles 73 chains).—The construction of heavy formation on this section has been greatly aided by the employment of three steam-shovels, and is now practically completed, except for the formation of Waikokopu station-yard, which is in hand. The understructures for the following bridges are wholly or partly completed, and temporary superstructures have been erected: 17 m. 50 ch., 18 m. 0 ch., 19 m. 66 ch., 21 m. 23 ch., and 22 m. 54 ch. The permanent-way has been laid to 22 m. 24 ch., and a temporary track laid from there to the terminus at 23 m. 20 ch., giving a connection to the temporary wharf. The first lift of ballast has been laid from 18 m. 10 ch. to 19 m. 15 ch. Preliminary borings for an outer wharf at Waikokopu are in hand, and design has been prepared. The section has been opened for limited goods service since February last.

Gisborne–Napier Railway (South End).

Eskdale Section (0 m. to 10 m. 51 ch.; length, 11 miles 51 chains).—This section has now been completed, and is ready to hand over to the Railway Department. The embankment on the Napier–Port Ahuriri line and the dredging of the permanent channel to the Tutaekuri River are being carried out by the Napier Harbour Board and are not yet completed, but neither of these items will affect the working of the line between Napier and Eskdale. Goods traffic has been carried on during the past eight months, and the usual maintenance has been attended to. A field office, store, and carpenter's shop have been erected at Waipunga Station, and the erection of a fitting-shop and two platelayers' cottages is in hand. In all, three steam-shovels are at work on this section, and a fourth is being transferred from Wairoa and should be in action there shortly.

Tutira Section (10 m. 51 ch. to 28 m. 60 ch.; length, 18 miles 9 chains).—The formation, with the exception of the bridges at 11 m. 41 ch. and 13 m. 32 ch. has been completed to 14 m. 50 ch. Earthwork is in hand between 14 m. 50 ch. and 18 m. Thirteen miles of service road from 13 m. onwards has been

formed, and 8 miles metalled, the formation of the remaining portion being in hand. The earthwork on this section is particularly heavy, the bank at 15 m. 20 ch. having a maximum depth of 115 ft. and a cubical content of 120,000 cubic yards, and that at 15 m. 41 ch. has a maximum height of 110 ft. and a cubical content of 80,000 cubic yards. Two steam-shovels are at present engaged on the filling at 15 m. 41 ch., one of them working a double shift. The progress of this bank will be considerably facilitated when the material from the cutting at 16 m. 78 ch. becomes available, in about two months' time. The approach cuttings to the tunnel at 17 m. 35 ch. have been taken out, and a commencement has been made at the southern portal. Surveys have been made of a suggested deviation to avoid the tunnel at 16 m. 78 ch., and the proposal is at present under some consideration. In order to ensure minimum road transport, arrangements are being made to immediately proceed with the platelaying and ballasting to 13 m. 32 ch. The abutments of the bridge at 11 m. 41 ch. have been completed, and piles and piers driven. The remainder of the work in connection with these piers is in hand. The reinforced-concrete piles for the bridge at 13 m. 32 ch. have been cast.

Waikare, Kotemaori, Mohaka, Waihua, and Wairoa Sections (28 m. 60 ch. onwards).—The permanent survey has been completed to 43 m.

STRATFORD–MAIN TRUNK RAILWAY (EAST END).

Matiere Section (0 m. to 10 m. 23 ch.; length, 10 miles 23 chains).—The principal formation work on this section of the line has been the completion of the earthwork from 9 m. 50 ch. onwards, together with a considerable amount of slip-removal and the taking-down of several high papa batters which contain considerable quantities of lose and dangerous material. A road-deviation at 5 m. 65 ch. was necessary to avoid the Tahua station-yard. This deviation is sufficiently advanced to carry traffic, but is not yet completed. Another road-deviation was found necessary at 9 m. 64 ch. where the road crosses the railway. The road-formation at this spot was widened from 20 ft. to 40 ft. in order to obtain the necessary safety outlook in either direction. Earthwork at Tuhua station-yard, at 5 m. 65 ch., is well in hand. This station-yard called for extensive culverting. The formation of the Matiere station-yard has been completed, although a small amount of further work yet remains to be done to the approach road at 10 m., together with the filling of the stop-bank. It was found necessary to carry out certain protection-work at the Ongarue River Bridge at 0 m. 7 ch. Gabions were placed at the toe of the bank, and the face of the bank was then packed with stone and boulders. Excavations for the foundations of the overhead bridge at 5 m. 55·4 ch. on the Ohura road-deviation is well forward, and the timber and ironwork is on the site. The road-bridge at 6 m. 64 ch. is also well forward. The four Ohura River bridges at 7 m. 25 ch., 7 m. 56 ch., 8 m. 29 ch., and 8 m. 51 ch. respectively were completed during the period. These bridges each consisted of one central span of 60 ft. with end spans of 25 ft. and 30 ft. girders. Considerable difficulty was experienced in laying the foundations at 8 m. 29 ch. owing to the depth at pier D below the river-level, a 9 in. centrifugal pump having to be installed before the concrete could be placed in position. The girders for the bridges were fabricated in Tauranga workshops, and shipped in sections to these works, where they were assembled. During the period the concrete lining of the tunnel at 4 m. 65 ch. was carried to 4 m. 67·5 ch. The portal at 4 m. 63·80 ch. was excavated and concreted, and the portal at 4 m. 68·5 ch. was excavated, so that the remainder of the work on this tunnel should be completed very shortly. Field-pipes were laid in the water-tables throughout all the other completed tunnels for drainage purposes. The second lift of ballast was completed from 0 m. to 8 m. 40 ch., 20,000 cubic yards of ballast having been excavated, transported, and laid during the period. A regular time-table of goods and passenger trains has been run over the section, the goods traffic at times being very heavy. Twenty workmen's huts were erected, and a considerable amount of work in the reconditioning of plant, &c., was carried out.

Ohura Section (10 m. 23 ch. to 19 m. 10 ch.; length 8 miles 67 chains).—This section has been carried on as a relief work during the period, and the bulk of the formation between Matiere and Nihoniho, at 13 m., has been completed, whilst a considerable amount of work has been done between 17 m. 10 ch. and 19 m. 10 ch. Between 14 m. and 17 m. the only work carried out has been clearing and felling the bush. Twelve concrete culverts were constructed, and several stream-diverts were carried out. Fencing is in hand. The weather conditions during the period have hampered the work on this section very considerably, owing to the difficulty of transport. In spite of this, however, very considerable quantities of material, comprising service rails, sleepers, trucks, shingle, cement, buildings, &c., have been transported and utilized on the section.

STRATFORD–MAIN TRUNK RAILWAY (WEST END).

Tahora Section (42 m. 26 ch. to 47 m. 40 ch.; length, 5 miles 14 chains).—The principal work carried out on this section during the period was the ballasting of the line with metal procured from the Te Wera quarry. Since ballasting operations commenced a total of 12,540 cubic yards have been transported and laid, an average of 1,254 cubic yards per month. The first and second lifts have been completed throughout the section, and the third lift and the boxing-in is now completed from 43 m. 12 ch. to 47 m. 40 ch. The metalling in Tahora station-yard has been completed. A 6,000-gallon vat for water-supply purposes has been built, and a gravity water-supply laid on. A quantity of fencing in connection with the station-yard and the approach roads has been erected. A large quantity of material, including rails and sleepers, has been transferred to other works, portion of it having been reconditioned for forwarding. Fourteen workmen's huts were also built for other works. A passenger and goods service has been run over this section, connecting with the railway service at Kohuratahi.

Te Wera Quarry.—All the development work in connection with this quarry, including the formation platelaying, and the fencing of the access line, has been completed, and crushing has been in hand since August last. The stone has proved to be of first-class quality, and, although more

stripping has been met with than was anticipated, the stone is proving economical to work. 60,000 cubic yards of rock have been stripped ready for quarrying, as it is deemed advisable to always keep an adequate supply in view in case of slips occurring. The plant which has been installed has given good service, and the average quantity crushed to date per day is 85·8 yards. The output has been improving, and at the latter end of the period reached 100 cubic yards per day. The majority of the metal has been used for ballasting purposes on the Tahora Section of the railway, and about 4,000 cubic yards has been supplied to the various local bodies for road-metal.

Opunake Branch Railway.

Kapuni Section (0 m. to 7 m.; length, 7 miles).—The majority of the earthwork on this section was well in hand prior to last year, and the formation work for the period has consisted mainly of the completion of various sidings, Kapuni station-yard, and the various road-crossings and approach roads to overbridges. The Mangatoki Bridge, at 1 m. 49 ch., which consisted of two 25 ft., three 35 ft., and one 55 ft. steel-plate girder spans, was completed. The Kapuni River bridge, at 4 m. 69 ch., composed of one 25 ft., three 30 ft., and one 50 ft. plate girder spans, was also completed. The overbridge at 0 m. 42 ch., where the Skeet Road crosses the railway-line, is well in hand, 164 cubic yards of concrete having been placed in the wings and abutments, leaving 124 cubic yards to complete. Permanent-way was laid from 0 m. 28 ch. to 6 m. 75 ch., as well as the sidings at the Matapu, Duthie Road, and Palmer Road station-yards. The opening-up of the ballast-pit at the Kaupokanui River on the Manaia Branch line has been completed. The access to this pit comprises the laying of 30 chains of siding and branch line, together with a bridge across the Kaupokanui River. This pit is opening up well, and it is anticipated that it will contain sufficient ballast to complete the line to Opunake. At the end of the period the first lift of ballast had been completed from 0 m. to 66 m. 75 ch.

Auroa Section (7 m. to 12 m.; length, 5 miles).—The work on this section has been continued as a relief work. The formation is now completed with the exception of several banks which have been left for widening by work-train later on. Concrete piers have been erected for the bridges at 7 m. 8 ch., 7 m. 41 ch., and 7 m. 62 ch.

Pihama Section (12 m. to 16 m. 40 ch.; length, 4 miles 40 chains).—This section, which has also been carried on as relief, is well towards completion, and with the exception of two cuttings and embankments it is ready for platelaying. Approximately 5 miles of fencing has been erected on this section. Eight concrete culverts, mainly small ones, have been built, and only one or two minor ones yet remain to be done. The Oeo Road crossing at 13 m. 52 ch. is in hand, and the deviation of the Patiki Road at 16 m. 40 ch. has been formed, and boulders carted out for crushing and metalling. A platelayer's cottage, composed of concrete blocks, has been erected at 16 m. 40 ch.

Opunake Section (16 m. 40 ch. to 23 m.; length, 5 miles 70 chains).—This section has been carried on in the same manner as the previous ones. The fencing has been completed to 18 m. 60 ch. Fifteen concrete culverts and pipes have been put in, and the formation is in hand practically throughout. The heaviest work consists of the long cutting from 20 m. 78 ch. to 21 m. 72·50 ch. Arrangements have been made to utilize a steam-shovel and locomotives in dealing with this cutting, and it is anticipated that they will commence work there shortly. A temporary road has been built to enable the steam-shovel to be taken on to the works.

Manaia Branch (0 m. to 5 m. 49 ch.; length, 5 miles, 49 chains).—The formation and culverts on this section have been completed with the exception of several cuttings and banks which will be widened by work-train, and everything is in readiness to start platelaying.

Midland Railway.

Nelson–Westland (North End).

Kawatiri Section (59 m. 17 ch. to 63 m. 8 ch.; length, 3 miles 71 chains).—The principal work on this section has been the driving of the tunnel at 62 m. 43 ch. The bottom and top headings have been completed, and the tunnel has been excavated to full size and lined for a distance of 382 ft. The material from the tunnel has been utilized to form the embankment towards the Kawatiti station-yard. The Hope River Bridge, at 62 m. 54 ch. of four 51 ft. spans, with steel girders on concrete piers, has been completed. The girders for the bridge at 62 m. 42 ch. have been delivered, and a start is being made with the erection of the piers.

Gowan Section.—The pegging of the permanent line has been carried on, and though no construction has yet been started on this section, preliminary arrangements have been made for manning it.

Arthur's Pass Tunnel.

On this section of the Midland line, from 50 m. 58 ch. to 58 m. 58 ch., which includes the Otira Tunnel and Arthur's Pass station-yard, the platelaying with 100 lb. rails, ballasting, and lifting have been completed. At Arthur's Pass the Bealey Bridge, a seven-span steel-girder bridge, has been completed, and portion of the station-yard with platform and subway finished. The remainder of the platelaying in Arthur's Pass station-yard is being completed by the Railway Department. The Otira station-yard is also being formed by the Railway Department.

At Otira, a reinforced-concrete power-house, consisting of an engine-room, switch-room, boiler-room, locomotive-shed, battery-locomotive shed, coal-bunkers, basement, offices, and bathroom has been finished. Three Babcock and Wilcox marine-type boilers, two steam turbo-generators, each 2,000 h.p., and auxiliary equipment, have been erected for supplying electric power for the locomotives to operate the tunnel section. Duplicate lighting-sets driven by steam, a battery booster, and a track booster, have also been erected and are now in running order. All this machinery was hauled through the tunnel by the small narrow-gauge electric locomotives which were used on the construction. Five

main-line electric locomotives and one battery locomotive have been erected and delivered at sight, and trials of the plant have been commenced.

In order to obtain water for the condensers, extraction-pumps, and boilers for the power-house, and for the Otira Village and Station, a small dam was erected across Goat Creek, and the water has been taken from there in a 12 in. pipe-line to concrete reservoirs which feed the various installations. On its way the water is to be used for developing power. A start has been made with the water-driven electric generator of 125-kilowatt capacity, which will supply power for lighting and auxiliary services when the main power-house is shut down. Poles and overhead work for the electric-traction system have been completed between Otira and Arthur's Pass Station, and the station-yard at Otira is almost completed, while the overhead work in Arthur's Pass is under erection. A special concrete shed for the electric locomotives, and another for the steam locomotives, are under construction at Arthur's Pass, and are well advanced.

At Otira forty-three new cottages have been erected and connected up to a water-supply and sewerage system. These houses have all been wired for electric light, and the feeder lines for same have been erected. 29 chains of road through the village have been formed and metalled, and a considerable amount of clearing done on the sections, which were very rough.

Greymouth – Point Elizabeth Railway.

Extension to Seven-miles (3 m. 45 ch. to 6 m. 10 ch.; length, 2 miles 45 chains).—All construction work on this extension has been completed. The principal work carried out during the year consisted of the completion of forming and trimming throughout; the erection of the Seven-mile Creek Bridge with approaches and protection, and the completion of ballasting, platelaying, together with all sidings, private crossings, and level crossings, &c. A water-supply for the Rapahoe Station, consisting of two rams fed from the Rocky Creek Race, together with the storage reservoir of 25,000 gallons, was provided and connected to the station-yard. It has been arranged to supply the Mines Department's boilers from this installation. A considerable amount of work was caused during the period by the subsidence of a bank at 4 m. 33 ch., but this has been, it is hoped, overcome.

Lawrence–Roxburgh Railway.

Beaumont – Miller's Flat Section (34 m. 70 ch. to 49 m. 45 ch.; length, 14 miles 55 chains).—These works have been carried on vigorously as relief works, an average of over two hundred men having been employed continuously throughout. The formation has been completed to 42 m. 30 ch. except for the widening of several banks and cuttings, which will be dealt with later. From 42 m. 30 ch. to 44 m. 0 ch. formation is complete except for cuttings at 42 m. 31 ch., 42 m. 57 ch., 42 m. 73 ch., 43 m. 18 ch., 43 m. 40 ch. 43 m. 44 ch., and 43 m. 71 ch. From 44 m. work is in hand up to 46 m. 45 ch. During the year the piers of the Beaumont River Bridge at 35 m. 25 ch. were completed, and a temporary superstructure erected. The permanent girders are now arriving, and the bedding of sleepers, &c., is in hand. The piers of the Costorphine Stream Bridge at 39 m. 9 ch. have been erected, and temporary superstructure provided, while the permanent girders have been received and are now ready for riveting up and erection. The foundations of all piers for the Tallaburn at 40 m. 25 ch. have been completed to water-level, the balance of the concrete work is in hand, and the temporary bridge is in course of construction. At Jessie's Creek, 42 m. 62·5 ch., the excavation of the piers and a stream-diversion is proceeding. Platelaying is complete to 39 m. 54 ch., a temporary siding being constructed at 35 m. 40 ch. and a line laid into ballast-pit. A commencement has been made with the ballasting, and the first lift completed to 36 m. 6 ch. On these works the machinery in use is not so extensive as usual, but a steam-shovel has been in operation loading ballast, which is being hauled out by one of our smaller type of locomotives.

Orepuki–Waiau Railway.

Orawia Section (48 m. 23 ch. to 56 m. 47 ch.; length, 8 miles 24 chains).—The centre-line formation has been completed, the main work having been the finishing of the bank and cutting between 54 m. 60 ch., and 55 m. 38 ch. Formation work on the Pukemaori and Orawia Stations is well forward and will be completed very shortly. A telephone-line has been erected throughout and 150 chains of fencing completed. The bridge at 48 m. 29 ch. over the Boundary Creek, consisting of four 20 ft. steel joist girders on pile piers, has been completed. The concrete piers for bridge at 53 m. 27 ch. over Ellis Stream have been built, and the construction of the piers of the bridge over the Orawia Stream, consisting of eighteen 20 ft. steel-plate spans, are in hand. The overbridge at 55 m. 12 ch. is also in hand. The formation has been trimmed for platelaying from 48 m. 23 ch. to 50 m. 75 ch., and rails are laid to 50 m. 18 ch. Test-pits have been sunk over the area of proposed ballast-pit, adjoining 49 m. 19 ch. with satisfactory results.

SURVEYS OF RAILWAYS UNDER CONSTRUCTION, NEW LINES OF RAILWAYS, ETC.

East Coast Main Trunk Railway.

Tauranga Eastwards.—The permanent survey has been completed to 102 m., and the survey of the road on the left side of the Waimana Gorge, which will be necessitated by the proposal to form the railway on the right bank now occupied by the road, is in hand. The trial survey has been carried out to 117 m.

Rotorua–Taupo Railway.

A start has been made with the survey of this line. The work has been much delayed with the wet weather, 3 miles of trial line having been run.

Gisborne–Napier (South End).

The permanent survey has been completed to 43 m., and is in hand to 49 m., while the trial survey has been carried on to Wairoa, approximately 21 miles farther.

Rimutaka Incline.

The problem of the Rimutaka deviation involves something more than the improvement of what is known as "the Incline." The railway from Upper Hutt to a point in the vicinity of Featherston may practically all be considered as inferior to such a standard as should be characteristic of a main line of railway. The schemes of improvement that have been considered have therefore in practically all cases involved the abandonment of a very considerable length of the existing railway.

The line which the late P. S. Hay, formerly Engineer-in-Chief of this Department, recommended was one following what is known as Tauherenikau route. This line had a number of alternatives between Upper Hutt and Kaitoke, at which latter point it left the existing line, crossed the Pakuratahi Stream and the Rimutaka Creek, ascended the main range, passed through the summit with a considerable tunnel, and then followed at first a tributary and then the main stream of the Tauherenikau River down to a point where it became possible to steer directly for the nearest existing railway-station, which was Woodside. This meant that the whole existing line from Upper Hutt to Woodside—a distance of about 29½ miles—would be abandoned.

It is doubtful whether the Government would be justified in cutting off the Town of Featherston from railway communication. True, it would only be about 5 miles from Woodside, which is much more convenient than many other towns in New Zealand, but, having once had a railway, its claims to retain railway communication would be very hard to combat. In any case, it is possible that the trade coming from the lower part of the Wairarapa and joining the railway at Featherston would be sufficient to justify the keeping open of this section of the line. The necessity for running this 5-mile section as a branch line would prevent the total possible saving in working-expenses on the through line being made.

The question of the deviation has been in the background for a number of years, and when it became a burning question again a field party of Engineers were instructed to attack the problem with an entirely open mind, and search out every possible alternative which had been suggested or which seemed to offer any favourable features.

From an examination of the existing line it appeared that in the portion between Mungaroa and a point about 1½ miles north thereof the alignment and grade were entirely satisfactory, but the portion between Upper Hutt and Mungaroa, containing as it does very steep grades in combination with 5-chain curves, very materially limits the possible engine-load.

A number of lines were run between Mungaroa and Upper Hutt, and one was selected and closely examined, whereby it was found possible to develop the necessary distance with quite reasonable alignment and construction, and to obtain a grade of 1 in 60 on straights, with the necessary flattening on curves to compensate for the extra train-resistance due to curvature. From Mungaroa for about 1½ miles the existing line can be used, and from there on a grade of similar character to the new grade between Upper Hutt and Mungaroa can be obtained, passing through a tunnel between one of the branches of the Hutt River and a branch of the Pakuratahi. For some distance beyond this tunnel a reasonable line continually rising cannot be obtained, but the line will fall slightly to a crossing over the Pakuratahi River, and then rise towards the same summit as that originally surveyed in 1898. The summit-tunnel will be about 1¼ miles long. From this tunnel the grading down will entail very rough work, but will not involve any heavier construction than would have been found necessary with the steeper grades previously contemplated. It has been found possible to secure throughout a grade not exceeding 1 in 60 on straights, with the necessary compensation on curves.

Another line was tried, which was common to the one just described up to a point crossing the Pakuratahi River, at which point it turned off up the Rimutaka Creek on what is known as the coach-road route. The unfortunate part of this route is that the creek which it follows on the eastern side is falling throughout the whole of its course at a considerably faster rate than the grade which was aimed at for the railway, consequently the line had to follow the very steep hillsides, and had to cross the successive branch creeks at constantly increasing heights. This line would have passed Featherston at such an unfavourable location that a station on it would have been almost impracticable, although the line was almost in touch with the borough boundary. I consider that if this line had been suitable in other ways its adoption would not have obviated the necessity of keeping open the portion of the present line between Woodside and Featherston. In any case, its cost would have been greater than that of the line via Tauherenikau, and, as it had no compensating advantages, it was ruled out.

Another line which has been closely examined is that which is known as the Wainui-o-mata route This line involves a deviation extending from some point on the existing line between Petone and Belmont, climbing the hills to the north-east of the harbour, thence passing through a tunnel about ½ mile long inland from Lowry Bay, into a tributary of the Wainui-o-mata, following this tributary down to its junction with the Wainui-o-mata, then following the latter river up to a point some miles above the existing reservoir, where it would be carried through two high ranges of hills into the valley of the Waiorongomai by means of a tunnel nearly 3¾ miles long. It would then grade down the Waiorongomai River and along the eastern side of the ranges until it reached the shores of the Wairarapa Lake, which it would follow to a point near Pigeon Bush.

In the past it has been assumed by writers in the public Press, and also by persons who have frequently written to you, that the Wainui-o-mata route was a comparatively level route, and that therefore it should be adopted even though it might be dearer than some other routes which had been suggested, as, for instance, the Tauherenikau route. After a detailed survey had been made over the greater portion of this route it was found that the grades on the line were no better than those

referred to above as obtainable on the Tauherenikau route, tunnelling was very much greater, the total length of the deviation several miles longer than either the Tauherenikau or the coach-road route, and the earthworks generally, omitting consideration of the long tunnels, were as heavy as those via the Tauherenikau route.

There is another point in connection with the Wainui-o-mata route which, though not a fatal objection, is one which would raise strenuous opposition on the part of the Wellington City Corporation, and this is the fact that the line would run for a considerable distance through the country supplying water to the City of Wellington; in fact, in places the railway would run across bays in the reservoirs themselves. Normally this would lead to inevitable pollution of the water, though if the route in other respects possessed outstanding advantages I consider the difficulties could be overcome.

A point in favour of the Wainui-o-mata route which has not been greatly stressed in the past, but which is a very important advantage, is that it runs very much closer than either of the previous deviations mentioned, or the existing line, to the very extensive and extremely fertile flat land of the lower Wairarapa. At the present time the land in question, which consists of many thousands of acres of alluvial flats and swamps capable of draining, has its access via the Town of Martinborough to Featherston, involving very long carting. A station on the Wainui-o-mata route where it meets the Wairarapa Lake, in conjunction with a road-bridge across what is known as "The Narrows," would bring very many thousands of acres of land 10 miles nearer to the railway and more than twice that distance nearer to the City of Wellington.

A further suggestion has been made that the Wainui-o-mata route should run down the right-hand bank of the Waiorongomai Stream rather than the left-hand bank, and it should then run round the south side of the Wairarapa Lake and up the eastern side, thus running through the middle of the magnificent land previously referred to. Apart from the previous objection to the Wainui-o-mata route, this proposal, from the point of view of the through traffic, has a fatal objection, and that is that it very considerably lengthens the distance to Featherston and all stations to the north thereof. Whichever of the variations of the Wainui-o-mata route is preferred there will be required a total length of about 5½ miles of tunnel, as against 2¼ miles on the Tauherenikau route.

A further line was tried running south of the Wainui-o-mata route. This would naturally mean a still further detour in the through line; but, as our informants endeavoured to convey the impression that it was an easy line, it was investigated. This line runs from the vicinity of Petone round the foreshore to some distance south of Muritai, thence by a tunnel into Gollan's Valley, thence into the Wainui-o-mata, up the Catchpole into the Orongorongo, and then through the main divide. This line required at least 5¼ miles of tunnel and many miles of heavy work without any appreciable compensating advantages. It was therefore considered unsuitable.

Another suggested route, with a tunnel piercing the main dividing-range at a point known as Narrow Neck, has been investigated. This line would leave the existing line either at Petone or the Lower Hutt, and run up the eastern side of the Hutt Valley as far as Taita Cemetery, from that point tunnelling through the ridge into Stokes Valley, thence down the valley and up the right branch of Stokes Creek, tunnelling through the dividing-ridge into Whiteman's Valley, and from Whiteman's Valley by a long tunnel into Brockett's Creek, thence grading down the foothills on the western side of Lake Wairarapa to join the existing line near Pigeon Bush. This route was considered impracticable, as it involved between 7 and 8 miles of tunnelling, in addition to very heavy earthwork.

Taking the investigations up to this point, it appears that the Tauherenikau route is as good as any other route and is the cheapest. However, it is by no means cheap—the estimated cost being in the vicinity of a million and a quarter pounds,—when one takes into consideration the cost of dismantling the abandoned railway and the cost of the necessary improvement, alterations, and extensions at the Woodside Station. The interest on this, even at 5 per cent., would amount to approximately £60,000 per annum.

In view of the very expensive character of what appeared to be the best route, the matter was again investigated, as it appeared that if an expenditure in the order of a million pounds was to be incurred the tunnel route previously thrown out as too expensive might bear re-examination. It was found that a tunnel could be constructed from the permanently usable portion of the main line (at Mungaroa, previously referred to) to Cross Creek, and that the length of this tunnel would not exceed 5¼ miles—it would probably be slightly less than this. Such a tunnel would be on a very easy grade, so that no electrification would be required, as is necessary on account of the very steep grades, with the slightly longer tunnel at Arthur's Pass. Such a tunnel could be constructed for a sum not exceeding £900,000, and might even be done for £800,000. This tunnel would not, of course, eliminate all the heavy grades between Upper Hutt and Featherston, but it would cut out the worst portion of the line both as regards grades and curves. It would not result in the loss of any appreciable traffic, the only station cut off being Kaitoke, the business at which is of no consequence.

The tunnel has a further advantage in that immediately it was constructed the whole of the expensive staff, material, and attendant working-expenses at Cross Creek could be eliminated. The steep grade between Upper Hutt and Mungaroa, being only 2½ miles in length, could be easily coped with, even with a great deal more traffic on the line than at present exists, by means of an assistant engine, while the steep grade from Cross Creek to Featherston could be worked as at present until such time as increasing traffic justified the flattening of the grades, which can be done at very moderate expense. In fact, such portion of the spoil from the tunnel as is not required for lining could be utilized in constructing a considerable portion of the formation of a deviation on favourable grades. The total length of what I may call the tunnel deviation would be 5 miles 48 chains, of which 5 miles 18 chains would be in tunnel. The length of the existing line which would be cut out by this deviation is approximately 14 miles, so that there would be a shortening of nearly 8 miles. The grade would be 1 in 132—in other words, so flat that it would have no influence in limiting the loads which could be carried between Wellington and the Wairarapa, or *vice versa*. There would only be

two curves on it, which would be at least twice as favourable as the numerous sharp curves on the present line. The summit-level would be lower than that of any line which has yet been suggested, and would only be 500 ft. above sea-level. Such a line would enable the journey from Wellington to Masterton to be reduced by forty minutes, and the reverse journey from Masterton to Wellington by at least an hour. All the expense involved by the establishment of the Cross Creek Station would be avoided, and that station might be entirely closed. No deprivation of facilities would be suffered by Featherston or by the land to the south, now served either by the stations at Featherston or Pigeon Bush. No alterations would be required to the Woodside Station.

The distance from Wellington to Woodville by the deviation would be 108 miles, as against 114¾ at present, but from Woodville to Wellington via Palmerston North would still be considerably shorter, it being only 105 miles, and will eventually be even shorter; while the running-time, including a stop for a meal at Palmerston, is one hour and a quarter less than the present time via the Rimutaka, and less even than the shortened time which would become possible as a result of the Rimutaka deviation.

The shortening of the line is not an unmixed blessing on a system where all charges are based on the mileage over which the goods are hauled. On the basis of the present traffic over the line the loss under this head will be between £11,000 and £12,000, unless, in order to justify the making of a deviation, the Railway Department is empowered to continue to charge on the original mileage. I doubt whether such a suggestion could be put into practice on a State undertaking like the New Zealand railways.

It must be recollected that even though the loss in revenue may appear to put the railways into a position £12,000 per annum less favourable, New Zealand as a whole, of which the railway is only a part, would gain to the extent of £12,000.

With regard to the saving in working: The average cost of maintaining the line between Mungaroa and Cross Creek may be considered as slightly higher than the average for New Zealand, or £350 per mile per annum. This for 14 miles represents £4,900, while maintenance of the 5½ miles of deviation, being almost entirely in tunnel, should be very considerably below the average cost, in view of the fact that there would be no bridges or other structures, permanent or temporary, and the line would be protected against all the elements, either sun, wind, frost, or rain; there are no fences to keep up, no fire risks on wooden structures, no weeding to be done, and the track itself, having a solid rock bottom, should be more stable than the average track in the open air. As against this there is the disadvantage that men when working in a tunnel cannot be expected to be as efficient as they would be in the daylight. Still, their only work would be fettling the line, and with a solid foundation and rock ballast I think the maintenance cost may be estimated to be not greater than £200 per mile, or a clear saving of £4,000 under this heading.

Between the two ends of the deviation the present line is so tortuous that the wear-and-tear of the rolling-stock—locomotives, cars, and wagons—must be greater than would be the case on a piece of straight and almost level line. I understand, however, that the Railway Department have not figures which would enable this saving to be actually expressed in pounds, shillings, and pence. Taking figures from recognized authorities on railway location for the extra cost of maintenance due to curvature, which on the existing line is excessive, the saving under this heading is not likely to be less than £2,000.

There would be no appreciable saving in the cost of working from the traffic point of view, as regards through traffic, except that a Stationmaster and assistants would not be required at Cross Creek, which station could be closed up altogether, and all the charges in connection with the running of the present incline and amounting to £27,500 would be eliminated.

The position, therefore, with regard to the whole question is that if the tunnel line recommended as most favourable be constructed there will be an increase in interest charges of between £40,000 and £45,000 per annum, while there would be a saving to New Zealand of £45,000, made up as follows:—

	£
(1.) Abolition of all expenses in connection with the incline	27,500
(2.) Saving in maintenance of way	4,000
(3.) Saving due to eliminated curvature	2,000
(4.) Saving through lesser distance to haul	12,000
Total	£45,500

Of these items, (1), (2), and (3) would be a direct saving to the Railway Department, and although the £12,000 would be an apparent loss to them, it would be an actual saving to New Zealand. In addition to such savings as can be assessed in pounds, shillings, and pence, there is also the improvement in travelling conditions to the general public, and the live-stock carried on the line, and the saving of time, which cannot be assessed in money unless one knew the value of every person's time who travelled on the railway.

The conclusions to be drawn from the above report seem to me to be that while the deviation of the Rimutaka Railway may not be a crying necessity for financial reasons, yet when funds are available to put the work in hand it can be justified, and its benefit from a social point of view cannot be controverted.

It may be argued that the tunnel proposition does not meet the whole case, because the steep grades leaving Upper Hutt and just beyond Cross Creek have not been eliminated, but I maintain that these are minor matters until the traffic becomes much heavier than it is at present; and when the tunnel is finished, which will take many years, its effects upon the general business situation and the natural

growth in trade will have brought about such an increased traffic on the line that the small extra expense required for these deviations will be easily justified by the advantage gained. At any rate, there will be plenty of time to go fully into these problems before the tunnel is actually in operation.

The grades between Upper Hutt and Mungaroa can be brought to the same standard as the rest of the line with an expenditure of £78,680, and the grade between Cross Creek and Pigeon Bush can be eliminated at the cost of relaying and culverts, because the greater part of the formation will be done by distributing the spoil from the tunnel in such a way as to form a bank between the points indicated on a grade not steeper than 1 in 60 on the straights, and compensated proportionately on curves; and when it becomes necessary to relay the line through the wearing-out of present rails and rotting of sleepers the new work can be done on the new formation without any more cost, and probably without as much as would be necessitated by the ordinary relaying operations.

In conclusion, I consider that the solution of the Rimutaka crossing by railway will be best solved by—

Firstly, driving a tunnel on the lines indicated above, and utilizing the material to form a bank (the basis of a future deviation) between Cross Creek and Pigeon Bush. (Line 1.)

Secondly, as business develops, construct a deviation between Upper Hutt and Mungaroa according to line 2.

Thirdly, when ordinary maintenance requirements necessitate it, relay the line between Cross Creek and Pigeon Bush upon the formation previously referred to as having been made from the tunnel spoil. (Line 3.)

The accompanying map shows the various routes, with tabulation of estimates and distances.

Lawrence–Roxburgh Railway.

During the year the trial survey was continued to 50 m. 40 ch. A second trial line was surveyed behind Miller's Flat Township from 49 m. 0 ch. to its junction with the orginal trial at 50 m. 40 ch.: this deviation was adopted, and the permanent survey was completed to 49 m. 65 ch.

CONSTRUCTION AND MAINTENANCE OF ROADS AND BRIDGES.

The following are some of the principal works which have been completed during the year or which are still in hand:—

Mangamuka to Victoria Valley (Hokianga County).—An important road, shortening the distance between railway terminus at Okaihau and Kaitaia by 23 miles. Work done: 16 miles 32 chains first-class formation, 9 miles 10 chains second-class surfacing, together with 3,809 lineal feet culverts.

Wairoa River Bridge, Dargaville (Hobson County).—This bridge, of a total length of 1,380 lineal feet, is making satisfactory progress.

Rangiriri Hills Deviation (Waikato County).—The formation of a 20 ft. road is being carried on by relief work and by co-operative and small contracts. A length of 3½ miles now completed. It is anticipated that the balance of 2½ miles formation will be completed and metalling be started before next Christmas.

Rotokautuku Bridge (Waiapu River) (Waiapu County).—Progress in the construction of this bridge has been seriously delayed by floods. Both abutments completed, and the cylinders of central pier sunk.

Gisborne to Wairoa, via *Morere (Cook and Wairoa Counties).*—Improvements in alignment, grades, and widths over a length of 15 miles, including 1 mile 58 chains deviations, have been done. Four miles of metalling completed. The materials for the metalling were conveyed for distances varying from 5 to 7 miles, and to elevations of 1,600 ft. above source of supply, by means of a fleet of thirteen lorries.

Frasertown – Waikaremoana Road (Wairoa County).—14½ miles of road have been recoated; 13 miles of previously unmetalled road have been metalled, together with the reconstruction of five bridges. These works were necessary in order to convey materials for the hydro-electric works at Waikaremoana, and will also benefit settlements and tourists.

Awakino Valley (Lower) (Waitomo County).—The formation of this road, replacing the existing one over Taumatamaire Hill, has been practically completed, and traffic along it became possible last March. During the year 2 miles 56 chains have been widened to 18 ft., and 2 miles 22 chains of new formation to same width completed, together with 110 lineal feet bridges and 472 lineal feet culverts. There still remains 10½ miles to be metalled. A length of 3 miles 73 chains is now being tendered for.

Mimi to Mokau (Clifton County). Metalling on Mount Messenger has been completed. By means of motor-lorries 4 miles 9 chains of metalling has been completed.

Uruti–Tangitu Deviation (Clifton County).—A road-traffic tunnel, 610 ft. in length, together with 2 miles of dray-road approaches, have been completed.

Patea River Bridge, Stratford (Stratford County).—A ferro-concrete bridge, 64 ft. arch span, 97 ft. 6 in. wide, is about three-fourths completed.

Mohaka River Bridge, Waikare–Mohaka Deviation (Wairoa County).—This bridge, consisting of two 111 ft. and two 25 ft. spans in hardwood on mass-concrete abutments and concrete-cylinder piers, has been completed.

Dummy Hill Deviation (Akitio County).—1 mile 57 chains of 18 ft. road completed, together with 379 lineal feet of armco and concrete culverts.

Rimutaka Bridges (Featherston County).—Seven bridges in ferro-concrete, totalling 417 lineal feet have been completed.

Rimutaka Hill (Main Road), (Featherston and Hutt Counties).—Five miles of road have been regraded, realigned, and widened to a minimum of 18 ft., with minimum curves of 1½ chains, together with 2,045 lineal feet of culverts.

Waikanae–Upper Hutt Road (Hutt County).—Eight miles of existing road have been widened to 14 ft., 4 miles metalled, and sixty-eight culverts constructed.

Horokiwi Valley (Hutt County).—A further length of 1 mile 75 chains of road has been widened to minimum widths of 18 ft. and minimum curves of 1½ chains.

Matakitaki River Bridge (Upper), (Murchison County).—Arch, 60 ft. in concrete, together with approaches, completed.

Little Wanganui Bridge (Westland County).—This bridge, six 61 ft. spans, in hardwood, completed.

Cribb Creek Bridge (Kaikoura County).—Bridge consisting of eighteen 30 ft. spans completed.

HYDRO-ELECTRIC WORKS.

Arapuni.

The principal work carried out during the period in connection with the above power scheme has been the engineering survey, investigations, and plans. Surveys and soundings were completed at the power-house site, and below this to Waiteti Flat. Site plans were prepared for this weir and for the stilling-pond weirs below the power-house. A hydro survey of the river between the power-house and Brandon's Pool has been made. The necessary engineering surveys and investigations in order to determine the best method of transport from the limit of barge navigation to the dam-site were carried out, and explorations were made in order to locate stone suitable for concrete aggregate. A satisfactory deposit was located on the Waikato River, 12 miles up-stream from the dam. An investigation as to the best method of access was made, trial surveys for both railway and road being carried out. As a result of these it was decided to adopt a macadam road with metalling 16 ft. wide, a maximum grade of 1 in 30 against load, and curvature no sharper than 3 chains radius. A contract has been let for 3½ miles of formation, and a further contract will shortly be advertised for the balance of the road to the dam-site. A pit is being opened up for metalling the road. The location of the permanent village has been decided upon, and a start made with the buildings. A suitable bridge-site across the Waikato River has been adopted and the necessary data secured.

Tenders have been invited in America and England, as well as locally, for the construction of the dam and headworks which form the major portion of this development. Specifications are now being prepared, and will shortly be advertised in the same way, for the balance of works required, including the whole of the power-house building and its equipment. It is hoped to be in a position to accept a tender for the whole of the works in the first development of 45,000 kw. during the present year.

Mangahao.

During the year very satisfactory progress was made with the excavation of the tunnels, 2,005 ft. being driven in No. 1 tunnel, and 3,457 ft. in No. 2 tunnel. The headworks of No. 1 tunnel met in March, and the heading of No. 2 tunnel between the inlet end and No. 1 adit met at the beginning of June. In No. 1 tunnel 1,627 ft. of invert and 1,254 ft. of arch were concreted during the period. This makes a total of 2,618 ft. of invert and 1,983 ft. of arch completed, leaving 2,662 ft. of invert and 3,297 ft. of arch yet to complete. In No. 2 tunnel 1,625 ft. of invert and 1,253 ft. of arch were concreted during the period, making a total completed length of 3,247 ft. of invert and 2,291 ft. of arch, thus leaving 3,353 ft. of invert and 4,309 ft. of arch yet to complete. The excavation for the cut-off wall of the Mangahao dam was completed during May last, and a start was made with the concreting. Owing to the uneven nature of the foundation the excavation proved to be larger than anticipated, and had to be heavily timbered throughout. 1,673 yards of concrete have been placed in the foundations.

The construction of the by-pass tunnel was considerably retarded by floods in the river, but has just been completed, and the construction of the cribb dam is now in hand. Given reasonably favourable conditions as far as the river is concerned, it is hoped to have the cribb dam completed in July, and a start will then be made with the steel coffer-dam, and the excavation for the foundations of the main dam. Owing to the gate for the by-pass tunnel not yet having been delivered, it was necessary to proceed with the diversion of the water through the tunnel without it, in order that a start might be made with the coffer-dams. When this work has progressed sufficiently far it will be necessary to block the tunnel again and erect the gate.

The excavation for the foundations on the left-hand side has been practically completed to water-level.

Owing to difficulties in the foundation of the Tokomaru dam, its construction has been considerably delayed, but the excavation of the main portion is now completed, and 1,274 cubic yards of concrete have been placed in the cut-off wall.

Further investigation is still in hand to ascertain how far the core wall will require to be carried into the side of the valley to overcome percolation. It has been necessary to make a very thorough search to find a suitable rock for the concrete in this locality, and what is anticipated to be a fairly good quarry has been located and is being opened up. The excavation of the surge-chamber has been completed, and the concrete lining is in hand. The pipe-line excavation is now completed; practically all the pedestals have been concreted, as well as the majority of the anchor-blocks. The distributing-pipes have been erected, and are completed with the exception of the valves, which only came to hand recently. The contractor for the pipe-lines has not made as good progress as could be desired, and arrangements are being made to hasten this portion of the work.

The power-house building is now well in hand, and although it has been considerably delayed by a shortage of carpenters, every effort has been made to procure them, and it is hoped to have the building sufficiently advanced to enable the erection of the machinery to be commenced about November.

Three permanent staff cottages have been completed, and two are under erection, which will then give a total of eleven houses.

The very wet weather which was experienced during the months of January and February, during which one normally expects a dry spell, considerably added to the difficulties of carrying on the work. May and June were also very wet, and the heavy traffic has necessitated a considerable amount of work in keeping the roads up to the standard necessary for the transportation of the large quantities of material required. It is of interest to note the rainfall on these works, which is as follows: Mangahao—rainfall, 108·13 in.; days on which rain fell, 236. Arapeti—rainfall, 90·19 in.; days on which rain fell, 233.

HORAHORA.

The work of increasing the capacity of this power-station is well in hand, and during the period a considerable amount of work was carried out. The excavation for the two units above tail-race level is now approaching completion, the material having been removed by means of a flume and sluicing, and discharged into the river below the junction of the tail-race with the river. The excavation below the flume-level was taken out by trucks and a skid excavator, and a total of 660 cubic yards have been dealt with. The excavation for No. 8 draft tube will shortly be completed, and No. 7 is in hand.

The tail-race wall has been concreted to within 6 ft. of the power-house building, and the external walls of the old building and turbine-pit have been strengthened, 261 cubic yards of concrete having been placed. The work of preparing for the two new units at the power-station is proceeding, and it is anticipated that the excavation for the power-house and the head-race will be practically completed about the middle of August. The concreting of the power-house, turbine-pits, &c., can then be pushed on vigorously.

Temporary buildings, totalling over 5,000 square feet of floor-space, have been erected for the storage of cement, plant, &c., consisting of six A.C. motors, totalling 67 horse-power, one 5 horse-power oil-engine, and two motor-lorries for transport purposes. A great deal of temporary work has been necessary to avoid interfering with the operation of the present power-house, and to enable the staff to obtain the necessary access about the building.

The log crib weir which was previously erected by the Waihou Gold-mining Company across part of the stream has now been extended across the whole width of the river. The cribs composing this weir were constructed of *Pinus insignis* logs netted and loaded with boulders.

Between 7,000 and 8,000 square feet of accommodation has been provided for the housing of workmen, and this will accommodate approximately a hundred men. Substation buildings have been erected at Ruakura, Waikino, and Te Awamutu.

WAIKAREMOANA.

During the year two of the three unit exciter sets required for the main development have been installed in a temporary power-house, and are now supplying 1,000 horse-power to the Wairoa Borough and district. The installation of the plant was completed in October, and the supply of current to the Wairoa Electric-power Board was commenced in December. The Power Board has erected its own transmission-lines, and is renting and operating the power-house with its own staff. The transport of the 10,000 horse-power units for the larger scheme necessitated the re-formation, metalling, and strengthening or replacement of bridges on the Wairoa–Waikaremoana Road. This work was put in hand prior to commencing the headworks, in order to facilitate the cartage of materials for the preliminary scheme. The whole 32 miles from Wairoa to the power-house have now been re-formed and widened, and, with the exception of a short length, are metalled throughout. 14½ miles of existing metal have been given a maintenance coat of metal, while 13 miles of previously unmetalled road have been completed with crushed metal. Five old bridges have been replaced by new structures, and the work of replacing two others, together with the erection of two new truss bridges giving access to the headworks, is well in hand.

WAIHOU AND OHINEMURI RIVERS IMPROVEMENT.

The principal operations on the above works during the past year are as under:—

Waihou–Mangaiti–Tirohia Section.—The clearing of both banks has been completed from 0 m. 20 ch. to 3 m. 30 ch., and a preliminary stop-bank has been completed for a distance of 1 mile 45 chains. The No. 2 drag-line was engaged in completing the final stop-bank from 2 m. 43 ch. to 3 m. 50 ch., a length of 1 mile 7 chains, and containing 45,000 cubic yards.

Tirohia–Ngararahi Section (Right Bank).—On this section the Waihou dredge, working two shifts, has completed 1 mile 26·5 chains of permanent bank from 0 m. 53 ch. to 2 m. 49·5 ch. This involved the excavation of 106,000 yards of sand. This stop-bank has been covered with soil from 1 m. 23 ch. to 3 m. 27 ch.

Lower Waihou–Ngahina–Netherton.—On the left bank the interior drainage from Ngahina to just above Netherton has been completed, and the majority of the gaps have been filled in. A dipper dredge has been employed in drain H, which has now been completed. Its total length is 3 miles

64 chains, and the spoil removed by the dipper dredge was approximately 79,000 cubic yards. Two traffic-bridges have been erected over this drain, one on Wilson's Road and the other on the Paeroa–Netherton Road. Two culverts with automatic flood-gates have also been installed. On the right bank a four-barrel flood-gate has been completed at 2 m. 50 ch., and the Ngahina Bridge, which involved the building of a first-class traffic-bridge of thirty 25 ft. spans on 50 ft. piles, has now been finished.

Komata Creek.—During the year the No. 1 drag-line has completed 2¾ miles 43 chains of creek-diversion and channel-improvement. The approaches to the Komata Railway bridge have been stone-pitched.

Ohinemuri River (Right Bank).—The work on final stop-bank in this locality has so far been carried on with hand-labour, the bank having been completed from 0 m. 14 ch. to 0 m. 76 ch. Two large-capacity drag-lines have just been assembled and put into commission.

Rotokohu Drainage Area.—A drag-line is now engaged on the excavation of the main outfall drain. Two culverts, three and four-barrelled respectively, have been completed at Kaouiti Stream. Generally speaking, fairly heavy floods have been experienced since April last, and have hindered the progress of the work, but the benefits of the completed stop-banks have been very much felt by the settlers occupying the land thus protected. An automatic river-gauge has been installed at Mackaytown, and further flood data gathered.

MARINE.

Lighthouses.

Three Kings Islands.—The question of a light on the Three Kings Islands was again gone into very carefully. The Marine Engineer, accompanied by a survey party, paid a visit to the islands, spent some days there, and surveyed a tram route two miles in length from the only practicable landings on the main island to the site which was selected as most favourable for a lighthouse on the western corner, and this was also surveyed. The Western King, which has been suggested for the proper site for a light, was also closely examined, and as a result of this survey and examination alternative estimates were prepared either for a fully equipped watched light station with a radio beacon on the main island, or alternatively for a duplicate automatic unwatched light on the Western King. Later on the Telegraph Department carried out a number of experiments with a radio-beacon apparatus on the Great King, to ascertain whether there would be any undue interference with the wireless waves by reason of the shape or constitution of the ground. The results were quite satisfactory. In view of the very high cost of either of the alternatives, it is proposed to go further into the question of providing a radio beacon at the lighthouse on Cape Maria van Diemen.

Tiritiri.—Estimates were prepared for the conversion of this light from a watched oil-burner to an automatic acetylene light.

Ohena Island.—Plans have been prepared, and all plant and material supplied and delivered on the site, for the erection of an Aga automatic light on this island. The work of erection is well in hand, and will be completed early in the ensuing period. This light will be of particular benefit to coastal shipping proceeding to and from Auckland through the Mercury Bay passage.

East Cape Lighthouse.—The transferring of this light from the island on which it was originally situated has been completed. As this is a second-order watched light, it was necessary to arrange for a completely new station; the light and tower itself were transported in sections, but it was not practicable or economical to do so with the buildings, &c. Owing to the bad weather and the difficult situation, considerable difficulty was experienced in transporting the light apparatus and the tower-sections. Unfortunately, some of the prisms of the lanterns were damaged in transit, and, although it has been possible to erect the apparatus and arrange the position of the damaged prisms in such a way that the light is quite efficient, it has been necessary to order fresh prisms from England to replace the damaged ones. Meanwhile the light is giving good service in its new position, and the damages and expense connected with its maintenance on the crumbling island are now at an end.

Gable Island Foreland.—The erection of this light has now been completed, and consists of a concrete base, with a steel surmount, lantern-house, &c. The light is an automatic flashing one of 3,200 candle-power. A landing-crane was also erected, and a stairway to the top of the rock constructed. This light will have a range of seventeen miles.

Matakaoa Point (Proposed Light).—Investigations and surveys were made and estimates prepared for an automatic light to act as a subsidiary light to East Cape.

Tuhua (Cow Rock).—Estimates were prepared for the erection of an automatic light on this rock, which would serve the dual principle of a coastal light as well as defining the entrance to Coromandel Harbour.

Somes Island.—Arrangements have been made to hand this light over to the Wellington Harbour Board, but before doing so it is intended to convert it from a watched oil-burning light to an automatic acetone-acetylene light. Arrangements are in hand to give effect to this.

Stephen Island Lighthouse.—The existing incline and horse-operated whims have been very unsatisfactory for some time past, and consequently arrangements have been made to provide two 12-horse-power oil-driven winches. As all the supplies for this light and for the lightkeepers' families have to be transported over two separate inclines, it is anticipated that this work, which is in hand, will greatly improve conditions here as well as facilitating the despatch of the s.s. " Tutanekai " when tendering this station, and further save the expense of maintaining horse-power.

Godley Head Lighthouse.—Reports and estimates were prepared for the provision of an automatic compressed-air fog-signal, and for the improvement of the road to the signal-station.

Cape Foulwind.—It is now proposed to convert the existing oil-burning watched light to an automatic Dalen apparatus. Careful investigations have been made and detailed estimates prepared, showing that very considerable saving in upkeep can be made by this method without in any way interfering with the efficiency of the light.

Harbour-works.

The following harbour-works are in hand, but in addition a large number of reports and investigations have been made in matters covering applications for grants towards harbour-works, wharves, &c., as well as many other matters affecting navigation.

Westport Harbour.—During the year the general maintenance of the port has had careful attention. The dredger "Eileen Ward" has been kept constantly at work on the bar, and during the period lifted approximately 433,610 cubic yards. The dredger "Erskine" was utilized for a part of the year in dredging the berthage area, and removed approximately 7,386 cubic yards. It was found, however, that the latter was not sufficiently economical to justify keeping her in commission, and it was decided to dispose of her and make other arrangements. The railway-lines leading to the tip-heads at the eastern and western breakwaters, and to the Tauranga Bay quarries, were repaired and reballasted. The quarries were opened up again, and 7,000 tons of stone were deposited at the western breakwater and 500 tons at the eastern breakwater, as well as 1,700 tons along the Tauranga Bay line. Much more stone was required on the western breakwater than had been anticipated, owing to the prevalence of heavy weather. All building-tools, plant, &c., under the jurisdiction of the Department have been maintained in good order and repair.

Little Wanganui Harbour.—A survey was made of this harbour, and plans and estimates for its improvement have been prepared. New beacons were erected, flagstaff renewed, and tide-gauge erected.

Okuru Wharf.—Repairs were effected and new mooring-piles driven.

Bruce Bay.—Plans were prepared and work is in hand on the construction of a landing and goods-shed on the Flower Pot rock, together with approach bridge and road.

Karamea.—A considerable amount of repair work was carried out on the training-wall, a number of piles being driven and sheathed to strengthen the wall and to prevent wave erosion at the back.

Kaikoura Boat-harbour.—The various works which were in hand towards the improvement of the boat-harbour have been completed, the principal works being the provision of a new slip and repairs to the old one; repairs to the wharf; construction of dinghy-landing, skids, &c. The removal of rocks from the berthing-area was also contemplated, and the services of some of the Defence staff used to submarine mining were secured. Unfortunately, however, the results obtained have not been substantial.

Mokau Harbour.—The construction of a snagging-punt out of funds provided by the Government has been completed, and has been operating satisfactorily.

In addition to the above, general maintenance and repairs were carried out to the various light-house buildings and smaller wharves throughout the Dominion.

General.

As usual, a number of applications were received from local bodies and private individuals for approval of works involving marine interests. These have all been carefully investigated and, where desirable, approved, a few of the principal items being—

Wharves.—Princes Street, Auckland; Castlecliff, Wanganui; Hicks Bay; Holmes Wharf, Oamaru; Kaipara; Bradley's Landing; Kawakawa Bay; Kennedy Bay; Mangarewa, Wairoa River; Manukau Harbour; New Plymouth; Onekaka; One Tree Point; Whangarei; Opua; Tolaga Bay; Rona Bay; Akaaka landing and goods-shed; Kaikoura Wharf goods-shed.

Foreshore Leases.—Awanui River; Half-moon Bay; Mangamuka; Napier Harbour; Nelson Harbour power-house; Paremata; Paterson's Inlet; Picton; Purakanui; Waikiki Bay; Waikawa; Wairoa River; Wanganui power-house.

Reclamations.—Dargaville; Hutt River; Kawau Island; Moturoa, New Plymouth.

Harbour-works.—Gisborne Harbour; Napier; Castlecliff wall; Whangarei Harbour; Wade River.

IRRIGATION.

Ida Valley Scheme.

These works may now be considered to have reached such a stage as henceforth to make this scheme effective to a degree commensurate with the extensive conservation development and head-works. Whereas previously only 4,400 acres could be irrigated, the completion and extension of race-works during the year made it possible to now command the whole area included under the scheme—viz., 28,600 acres. It is anticipated that a very considerable proportion of this large area will be actually irrigated next season. When it is remembered what beneficial effects the irrigation of 4,400 acres has already had upon the production of the valley, the improved prosperity of the district which may be expected to accrue henceforth from the vastly increased irrigable area may readily be anticipated.

The works completed since beginning to convey water from Manorburn Dam to the farms now consist of 90¼ miles of water-race, four large flumes, two large diverting-weirs, besides numerous

smaller structures, measuring-weirs, &c. The chief works for the development of this scheme as far as at present recommended are now all constructed, except a concrete diverting-weir in the Poolburn to replace the present temporary arrangement. A large amount of detail works has still to be brought to completion, but these will not prevent the scheme from being effective meantime. The work done during the year comprises 9 miles main race and 17 miles of distributary races. During the past season twenty-eight irrigators were supplied with water, producing a gross revenue of £2,292, and a gross profit in working of £1,083. A marked improvement is expected next year.

Galloway Flat Scheme.

This scheme has continued to be run as a working scheme, twenty-four irrigators being served. The gross revenue has overtaken the working-expenses, leaving a small profit. Production on the flat is showing very marked improvement, the whole appearance being pleasing and giving promise of its rapidly becoming a successful settlement. Even now, in midwinter, butterfat is still being railed to the factories from dairy herds fed on lucerne hay, abundant supplies of which are stored on almost every farm. No construction work was done during the year.

Olrig Terrace Scheme.

As far as development works are concerned this scheme remains as before. Portion of the cost of Manorburn dam has been allocated against it for water-supply, but it has not yet been found expedient to develop the race system, beyond the supply of water to one irrigator on 300 acres, by means of an old existing mining race. A small loss was incurred during the year on the working of this scheme, owing to insufficient area being irrigated. However, as soon as arrangements can be made for more settlement, and the full area of 1,600 acres is brought under irrigation, this scheme, like Galloway Flat scheme, should become revenue-producing. No construction work was done during the year.

Manuherikia Scheme.

Irrigation was commenced from this scheme during the year in a small way. Forty irrigators were supplied with partial irrigation, but the scheme was not quite ready to be run effectively, the water being supplied intermittently during construction and seasoning of the newly constructed earth-channels. However, the object has been to complete the main works in order that the whole scheme may be effective, leaving some details to complete later. That position has now been attained, and next season very extensive irrigation may be anticipated. To expedite bringing the aims of the scheme to fruition, some areas of land which are too large for the present holders to completely irrigate require subdividing.

The works constructed since inception comprise the following: Intake tunnel, 23 chains long, with headworks and gravel-trap; main race in rock concrete-lined construction, 2½ miles; main race in earth, unlined, 20¼ miles; seven large siphons and flumes; numerous large concrete culverts, bridges, diverting gates and weirs; distributary races, 35¾ miles. Construction work done during the year comprises 40 chains main race and 22 miles 50 chains of distributary races.

Ardgour Settlement Scheme.

This scheme was just brought to completion at the end of the financial year, unfortunately too late to be effective for irrigation last summer. The newly constructed races are being seasoned—*i.e.*, tested out and weaknesses in earth remedied—so that all settlers may receive full benefits of irrigation next season. Immediate and satisfactory results may be expected from this scheme, where ideal conditions prevail—viz., moderate-sized farms, exceptionally fertile land, very favourable climatic conditions, and progressive settlers already on the land.

The works constructed since inception consist of—Intake and stop-gate; 13 miles of main race, including ¼ mile of concrete channel and ¾ mile of siphon pipes, besides many concrete culverts and flood-water chutes; 2¼ miles of distributary races. Construction work during the year comprises 7 miles 40 chains of main race, and 2 miles 32 chains of distributary races.

Earnscleugh Scheme.

Some small extensions and completion of details have been made on this scheme to meet increased settlement. Irrigation water was supplied efficiently to twenty-five settlers, and still more are anticipated during next season. 11 miles 30 chains of main and distributary races have been constructed since inception of scheme, of which 70 chains was done during the year.

Last Chance Scheme (Fruitlands).

This is a small scheme which was started during the year. It consists of the renovation of an old mining race, to make the waters of the Gorge Creek available to Fruitlands Settlement and some sections in that vicinity. During the year 6½ miles of race out of 8¾ miles have now been constructed, 2,000 ft. of steel siphon pipes which are required in the works have been purchased. It is hoped to have this development in working-order for the coming irrigation season. An extension of the head-race to divert more water from Shingle Creek, and an extension of the supply race to the land on the north side of Butcher's Creek, are being considered.

Tarras Scheme.

This scheme, which will irrigate 7,000 acres of excellent land, has just been started. Smaller private race-works were acquired by purchase, the intention being to enlarge and extend these. The completed works will involve the construction or enlargement of 13 miles 16 chains of main canals and 15 miles 60 chains of subsidiary ones. Construction work has only recently been started.

Teviot River Scheme.

This is another new scheme of the year. The present proposed development of this covers about 3,000 acres, but it offers possibilities of very considerable extension in future. From an irrigation point of view it presents a combination of all the most favourable requirements, and, in addition, has the unique feature of being the first combined irrigation and hydro-electric power scheme in the Dominion, with the still further interest of being founded upon the abandoned waterworks of one of the largest gold-mining claims of the district, the plant of which is being used in the scheme, part in its original position and part removed and re-erected on new site. Arrangements were made with the Teviot Electric-power Board to pool plant and make one headworks provide the dual requirements of power and irrigation. The headworks and races are so arranged as to permit the use of the tail-water for irrigation purposes. The results of the amalgamation are estimated to save about £9,000, which benefits will be shared between the Power Board and the Government. Work was started in January, and is proceeding so satisfactorily that the supply of water to the power-house is likely to be available in a few months' time, and a fair proportion of the irrigable area is expected to be served with water for the coming irrigation season.

The works completed to date are as follows: Concrete intake at Teviot River; tunnel, 11 chains long; pipe-line in head-race, 5,610 ft. of 36-in.-diameter steel pipes; 30 chains of large main head-race; all incorporated from the mining company's works.

New works: A concrete diverting and measuring weir; 42 chains of main head-race in rock; concrete forebay at power-siphon; 2,100 ft. of power pipe-line, 30 in. diameter, laid in position; 6,100 ft. irrigation-pipe extension, 18 in. diameter, laid in position; about 40 chains of irrigation race in rock.

General Surveys.

In addition to construction works which are now being pushed on rapidly in several parts of the district, surveys, including gaugings of the flows of all principal streams, and general investigations of the irrigation possibilities of all parts of the district, are being carried on, and the information so obtained has been tabulated for future use. The following are such schemes upon which survey and investigation is being steadily carried out: Roaring Meg, Cromwell Flat and Lowburn, Arrow River, Hawea Flat, Maniototo, Bendigo Flat, Bengerburn, Chapman's Gully, and Upper Manuherikia schemes. On the latter a survey party has been continuously engaged on trial location of races and investigation of dam-sites. Altogether the schemes under investigation cover some 232,000 acres of irrigable land.

TRAMWAYS.

Auckland.—The construction of the extension to the Great South Road, as well as alterations between tracks in Manukau Road and Queen Street, were inspected and passed.

Napier.—Several cars which were purchased elsewhere were examined and their reconstruction to comply with Napier conditions approved.

Wanganui.—Proposals were received for a proposed extension to St. John's; these were, after considerable investigation, finally approved. A balloon loop on the Aramoho extension was also dealt with, and several cars and trailers examined and tested.

New Plymouth.—Plans of the West-town were examined and approved.

Wellington.—Plans were examined and approved for the Island Bay duplication (three stages), Willis Street reconstruction, and sidings at Miramar. All these works were examined and passed on completion. A number of new cars were examined and tested.

Christchurch.—During the past year the new car-shed siding on Moorhouse Avenue and the Coronation Street extension have been completed and inspected. Plans have been approved for alterations to a loop on the Fendalton line, and a new loop at the corner of Carlton and Rhodes Streets. Several new cars were inspected and passed.

Dunedin.—Plans and specifications have been examined and approved for the Anderson Bay duplication. The question of tramway access to Maori Hill has been very fully considered, but so far no definite decision has been arrived at. A new rope has been installed on the Roslyn tramway, and provision is being made for a new motor in the Mornington power-house. Several cars were examined and tested.

Invercargill.—Proposals were forwarded by the City Council embodying the reconstruction of several of their existing cars to enable them to be used with one-man control. These proposals were approved subject to certain alterations.

F. W. Furkert, M.Inst.C.E., Assoc.M.I.Mech.E.,
Engineer-in-Chief.

Enclosure to Appendix B.

Table of Lengths of Government Lines Authorized, Constructed, and Surveyed up to 31st March, 1923.

NORTH ISLAND.

Note.—Column 11: For detail information as to dates of openings of such portions of lines as are not given in this table see tables of lengths of lines in Public Works Statements, 1904–19.

Appropriation.	Division.	Mileage.	Section.	Main Line.	Sidings.	Total.	State of Line.									
							Surveyed.	Under Formation.	Under Platelaying.	Opened.						
										Date.	To Mar. 31, 1919.	1919–20.	1920–21.	1921–22.	1922–23.	Total.
1	2	3	4	5	6		8	9	10	11	12	13	14	15	16	17
		M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.
Kawakawa-Grahamtown (Onerahi)	Kawakawa ..	7 16	Opua Wharf - Kawakawa	7 16	0 57	7 73	..	..	..	..	..	..	..	..	..	7 16
	Kawakawa-Kamo ..	41 48	Kawakawa-Towai ..	21 18	0 61	21 79	..	..	..	12 April,1911	..	..	..	..	..	21 18
			Towai-Hukerenui ..	4 30	0 33	4 63	..	..	..	2 May, 1910	..	..	..	..	..	27 2
			Hukerenui-Kamo ..	16 0	3 29	19 29	..	..	..	..	..	..	..	..	..	
	Kamo-Grahamtown	9 22	Kamo-Kioreroa ..	6 52	2 27	8 79	..	..	..	..	..	..	..	..	..	
			Kioreroa-Onerahi ..	2 50	1 16	3 66	..	..	..	2 Oct., 1911	..	..	..	..	..	2 50
	Kawakawa-Hokianga	45 25	Otiria-Kaikohe ..	16 25	1 45	17 70	..	..	..	1 May, 1914	..	..	..	..	..	16 25
			Kaikohe-Hokianga ..	29 0	2 40	31 40	18 0	3 11	7 69	..	..	..	..	..	..	..
Kaihu Valley	Kaihu Valley ..	24 30	Dargaville-Booms ..	17 21	0 75	18 16	..	..	..	..	..	..	..	..	..	19 58
			Booms-Tarawhati ..	2 37	0 25	2 62	..	..	..	1 June, 1914	..	..	..	..	..	
			Tarawhati-Donnelly's Crossing	4 52	0 38	5 10	..	..	4 52	..	..	..	..	..	..	..
North Auckland Main Trunk Railway	Kaipara Northwards	85 33	Extension	24 45	3 7	27 52	4 59	10 0	9 66	..	..	..	..	..	..	..
			McCarrol's - Paparoa	4 51	0 25	4 76	..	..	4 51	..	..	..	..	..	..	..
			Paparoa-Huarau ..	1 70	0 36	2 26	..	..	1 70	..	..	..	..	..	..	..
			Huarau-Maungaturoto	2 5	0 38	2 43	..	..	..	1 April, 1920	..	..	2 5	..	..	2 5
			Maungaturoto-Ranganui	4 25	0 61	5 6	..	..	..	1 April, 1920	..	..	4 25	..	..	4 25
			Ranganui-Kaiwaka ..	2 35	0 62	3 17	..	..	..	1 Aug., 1914	..	..	..	..	..	2 35
			Kaiwaka - Te Hana ..	8 65	1 3	9 68	..	..	..	18 Mar. 1913	..	..	..	..	..	
			Te Hana-Wellsford ..	3 27	0 58	4 5	..	..	..	16 May, 1910	..	..	..	..	..	
			Wellsford-Wayby ..	3 18	0 28	3 46	..	..	..	1 April, 1909	..	..	..	..	..	
			Wayby-Hoteo ..	3 40	0 13	3 53	..	..	..	13 May, 1908	..	..	..	..	..	
			Hoteo-Kaipara Flats	2 45	0 13	2 58	..	..	..	11 June, 1907	..	..	..	..	..	45 42
			Kaipara Flats-Woodcock's	3 5	0 16	3 21	..	..	..	17 Nov., 1905	..	..	..	..	..	
			Woodcock's-Ahuroa	2 41	0 16	2 57	..	..	..	18 May, 1905	..	..	..	..	..	
			Ahuroa-Helensville ..	18 41	1 75	20 36	..	..	..	..	..	..	..	..	..	

TABLE OF LENGTHS OF GOVERNMENT LINES AUTHORIZED, CONSTRUCTED, AND SURVEYED UP TO 31ST MARCH, 1923—*continued.*

NORTH ISLAND—*continued.*

Appropriation.	Division.	Mileage.	Section.	Main Line.	Sidings.	Total.	State of Line.									
							Surveyed.	Under Formation.	Under Platelaying.	Opened.						
										Date.	To Mar. 31, 1919.	1919–20.	1920–21.	1921–22.	1922–23.	Total.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.		M ch	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.
Whangarei Branch Railway	Whangarei Branch..	19 79	Kioreroa-Portland ..	5 23	0 37	5 60	..	..	..	3 April, 1920	..	..	5 23	..	..	5 23
			Portland-Waiotira ..	14 56	1 39	16 15	..	..	14 56	..	..	..	..	..	..	..
Waipu Branch	Waipu Branch Rly.	16 45	Oakleigh-Waipu ..	16 45	0 25	16 70	5 45	11 0	..	..	..	..	..	..	..	..
Kaipara-Waikato	Kaipara-Newmarket	35 73	Helensville-Newm'rk't	35 73	6 66	42 59	..	..	..	..	..	..	..	..	..	35 73
	Onehunga Branch ..	2 73	Penrose - Onehunga Wharf	2 73	1 70	4 63	..	..	..	..	..	..	..	..	..	2 73
	Auckland-Waikato ..	100 13	Auckland-Te Awamutu	100 13	16 66	116 79	..	..	..	..	..	..	..	..	..	100 13
	Auckland-Penrose—Deviation via Beach	6 50	Deviation via Beach	6 50	..	6 50	6 50	..	..	..	..	..	..	..	..	..
	Auckland City Branch—Kingsland Station to Auckland Station via Western Park and Freeman's Bay	2 60	Auckland City Branch	2 60	..	2 60	2 60	Prelim.	..	..	..	..	..	..	..	..
Waiuku Branch	Waiuku Branch Railway	12 69	Paerata-Patumahoe	5 4	0 78	6 2	..	..	..	10 Dec., 1917	..	..	..	..	..	5 4
			Patumahoe-Waiuku	7 65	1 3	8 68	..	..	..	10 May, 1922	..	..	..	..	7 65	7 65
Huntly-Awaroa	Huntly-Awaroa ..	9 0	Huntly-Awaroa ..	9 0	..	9 0	..	..	1 60	..	..	..	..	..	..	7 20
Survey, new lines	Waikokowai Branch Railway	8 25	Waikokowai ..	8 25	..	8 25	8 25	..	..	..	..	..	..	..	..	..
Surveys, new lines	Paeroa-Pokeno ..	40 15	Paeroa-Pokeno ..	40 15	..	40 15	40 15	..	..	..	..	..	..	..	..	..
Waikato-Thames	Waikato-Thames ..	62 58	Frankton Junction-Thames	62 58	10 17	72 75	..	..	..	..	..	..	..	..	..	62 58
Hamilton-Cambridge	Hamilton-Cambridge	12 2	Ruakura Junction-Cambridge	12 2	3 14	15 16	..	..	..	..	..	..	..	..	..	12 2
Paeroa-Waihi	Paeroa-Waihi ..	12 40	Paeroa-Waihi ..	12 40	1 30	13 70	..	..	..	9 Nov., 1905	..	..	..	..	..	12 40
East Coast Railway	Waihi - Opotiki, or East Coast Railway	142 43	Waihi-Tauranga ..	38 71	..	38 71	18 66	20 5	..	..	..	..	..	..	..	..
			Tauranga-Te Maunga Junction	3 75	..	3 75	..	0 56	3 19	..	..	..	..	..	..	..
			Te Maunga Junction-Te Puke	9 0	1 23	10 23	..	..	9 0	..	..	..	..	..	..	..
			Te Puke-Paengaroa..	5 67	1 16	7 3	..	..	5 67	..	..	..	..	..	..	..
			Paengaroa - Pongakawa	4 13	0 47	4 60	..	..	4 13	..	..	..	..	..	..	..
			Pongakawa-Otamarakau	7 5	0 26	7 31	..	..	7 5	..	..	..	..	..	..	..
			Otamarakau-Matata	8 11	0 43	8 54	..	..	8 11	..	..	..	..	..	..	..

TABLE OF LENGTHS OF GOVERNMENT LINES AUTHORIZED, CONSTRUCTED, AND SURVEYED UP TO 31ST MARCH, 1923—*continued.*

NORTH ISLAND—*continued.*

Appropriation.	Division.	Mileage.	Section.	Main Line.	Sidings.	Total.	State of Line.									
							Surveyed.	Under Formation.	Under Platelaying.	Opened.						
										Date.	To Mar. 31, 1919.	1919–20.	1920–21.	1921–22.	1922–23.	Total.
1	2	3	4	5	6		8	9	10	11	12	13	14	15	16	17
		M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.
East Coast Railway—*contd.*	Waihi-Opotiki—*ctd.* ..	..	Matata-Rangitaiki ..	8 55	..	8 55	..	..	8 55	..	..	..	..	..	..	..
			Rangitaiki-Awakeri	3 49	0 23	3 72	..	..	3 49	..	..	..	..	..	..	..
			Awakeri-Taneatua ..	8 47	..	8 47	..	6 0	2 47	..	..	..	..	..	..	..
			Taneatua-Opotiki ..	29 73	..	..	14 0	Prelim.	..	..	..	..	..	..	..	..
	Branch Lines ..	..	Mount Maunganui - Te Maunga Junction	4 27	0 67	5 14	..	..	4 27	..	..	..	..	..	..	..
			Te Puke Quarry ..	3 0	0 20	3 20	..	..	3 0	..	..	..	..	..	..	..
			Moturiki Quarry* ..	1 0	0 10	1 10	..	..	..	..	..	..	..	..	..	..
			Whakatane Branch	7 5	..	7 5	7 5†	..	..	..	..	..	..	..	..	..
Thames Valley - Rotorua	Thames Valley-Rotorua	69 33	Morrinsville-Rotorua	69 33	5 27	74 60	..	..	..	..	..	..	..	..	..	69 33
Gisborne-Rotorua	Gisborne-Opotiki ..	92 44	Gisborne Wharf-Kaiteratahi	13 10	2 45	15 55	..	..	..	..	..	..	..	..	..	
			Kaiteratahi-Karaka	5 5	0 71	5 76	..	..	..	13 April, 1905	..	..	..	..	..	
			Karaka-Puha ..	1 75	0 24	2 19	..	..	..	20 May, 1907	..	..	..	..	..	
			Puha-Waikohu Bridge	3 29	..	3 29	..	..	..	28 May, 1908	..	..	..	..	..	
			Waikohu Bridge-Waikohu	0 35	0 32	0 67	..	..	..	1 April, 1909	..	..	..	..	..	49 32
			Waikohu-Otoko ..	7 75	0 32	8 27	..	..	..	6 April, 1912	..	..	..	..	..	
			Otoko-Rakauroa ..	6 60	0 32	7 12	..	..	..	2 Nov., 1914	..	..	..	..	..	
			Rakauroa-Matawai ..	5 65	0 50	6 35	..	..	..	2 Nov., 1914	..	..	..	..	..	
			Matawai-Motuhora	4 78	0 61	5 59	..	..	..	26 Nov., 1917	..	..	..	..	..	
			Motuhora-Motu ..	2 10	..	2 10	2 10	..	..	..	..	..	..	..	..	
			Motu-Opotiki ..	41 2	..	41 2	41 2	Estim.	..	..	..	..	..	..	..	..
New survey	Napier-Gisborne ..	129 76	Napier - West Shore	3 7	0 58	3 65	..	..	3 7	..	..	..	..	..	..	..
			West Shore - Petane	3 63	..	3 63	..	..	3 63	..	..	..	..	..	..	..
			Petane-Eskdale ..	4 65	..	4 65	..	..	4 65	..	..	..	..	..	..	..
			Eskdale-Tutira ..	17 47	..	17 47	10 4	7 43	..	..	..	..	..	..	..	..
			Tutira-Wairoa ..	28 54	..	28 54	14 54 14 0	Prelim. Perm.	..	..	..	..	..	..	..	..
			Wairoa River-Gisborne	72 0	..	72 0	44 0	2 17	..	..	..	..	..	..	..	..
	Gisborne-Napier ..	72 42	Gisborne Station - Makaraka	3 5	..	3 5	..	..	..	..	..	..	..	..	..	..
			Makaraka-Ngatapa ..	11 51	1 29	13 0	..	..	11 51	..	..	..	..	..	..	..
			Ngatapa-Wharekopae	4 69	..	4 69	0 19	3 0	1 50	..	..	..	..	..	..	..
			Wharekopae-Waikura	5 40	..	5 40	5 40	..	..	..	..	..	..	..	..	..

* Rails taken up. † Preliminary.

TABLE OF LENGTHS OF GOVERNMENT LINES AUTHORIZED, CONSTRUCTED, AND SURVEYED UP TO 31ST MARCH, 1923—*continued.*

NORTH ISLAND—*continued.*

Appropriation.	Division.	Mileage.	Section.	Main Line.	Sidings.	Total.	State of Line.									
							Surveyed.	Under Formation.	Under Platelaying.	Opened.						
										Date.	To Mar. 31, 1919.	1919–20.	1920–21.	1921–22.	1922–23.	Total.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.
New survey —*contd.*	Napier-Gisborne—*ctd.*		Waikura-Waterfall ..	6 66	..	6 66	5 6	Perm.	..	..	..	..	..	..	..	..
							1 60	Prelim.	..	..	..	..	..	..	..	..
			Waterfall-Hangaroa	4 0	..	4 0	4 0	"	..	..	..	..	..	..	..	..
			Hangaroa-Te Reinga	17 11	..	17 11	17 11	"	..	..	..	..	..	..	..	..
			Te Reinga-Marumaru	9 40	..	9 40	9 40	"	..	..	..	..	..	..	..	..
			Marumaru-Wairoa ..	10 0	..	10 0	4 0	Perm.	..	..	..	..	..	..	..	..
							6 0	Prelim.	..	..	..	..	..	..	..	..
	Wairoa-Waikokopu..	24 72	Wairoa-Nuhaka ..	18 65	1 61	20 46	..	..	18 65	..	..	..	..	..	..	..
			Nuhaka-Waikokopu	6 7	..	6 7	..	..	6 7	..	..	..	..	..	..	..
Napier-Woodville and Palmerston North	Napier-Woodville ..	96 65	Napier Spit-Woodville	96 65	15 5	111 70	..	..	..	..	..	..	..	..	..	96 65
	Woodville-Palmerston North	17 21	Woodville-Palmerston North	17 21	0 51	17 72	..	..	..	..	..	..	..	..	..	17 21
Wellington-Woodville	Woodville-Wellington	115 79	Woodville-Wellington [Te Aro]	115 79	21 73	137 72	..	..	..	..	..	..	..	..	..	115 79
	Greytown Branch ..	3 7	Woodside-Greytown	3 7	0 64	3 71	..	..	..	..	..	..	..	..	..	3 7
	Featherston-Martinborough	11 50	Featherston-Martinborough	11 50	..	11 50	11 50	..	..	..	..	..	..	..	..	..
	Greytown-Martinborough	4 62	Greytown-Martinborough	4 62	..	4 62	4 62*	..	..	..	..	..	..	..	..	..
Rimutaka Incline Deviation Surveys	Coach-road Route ..	9 0	Kaitoke-Featherston	9 0	..	9 0	9 0	Prelim.	..	..	..	..	..	..	..	..
	Tauherenikau Route	21 30	Upper Hutt-Woodside	21 30	..	21 30	21 30	..	..	..	..	..	..	..	..	..
	Wainui-o-mata Route	31 40	Petone-Pigeon Bush	31 40	..	31 40	31 40	..	..	..	..	..	..	..	..	..
	Coast Route ..	52 0	Petone-Pigeon Bush	52 0	..	52 0	52 0	..	..	..	..	..	..	..	..	..
	Coast Route ..	70 0	Petone-Carterton, via Martinborough	70 0	..	70 0	70 0	..	..	..	..	..	..	..	..	..
Foxton-New Plymouth	Wellington-Manawatu	83 37	Wellington-Longburn	83 37	15 76	99 33	..	..	..	7 Dec., 1908†	..	..	..	..	..	83 37
	Foxton-Patea ..	120 44	Foxton-Patea ..	120 44	14 75	135 39	..	..	..	..	..	..	..	..	..	120 44
	Route Improvement Surveys	26 7	Turakina-Matarawa	11 67	..	11 67	11 67	..	..	..	..	..	..	..	..	..
			Aramoho-Goat Valley Tunnel	7 40	..	7 40	7 40	..	..	..	..	..	..	..	..	..
			Kai Iwi-Okehu ..	3 60	..	3 60	3 60	..	..	..	..	..	..	..	..	..
			Nukumaru-Waitotara	3 0	..	3 0	3 0	Prelim.	..	..	..	..	..	..	..	..

* Trial survey. † Date of purchase.

TABLE OF LENGTHS OF GOVERNMENT LINES AUTHORIZED, CONSTRUCTED, AND SURVEYED UP TO 31ST MARCH, 1923—*continued.*

NORTH ISLAND—*continued.*

Appropriation.	Division.	Mileage.	Section.	Main Line.	Sidings.	Total.	State of Line.									
							Surveyed.	Under Formation.	Under Platelaying.	Opened.						
										Date.	To Mar. 31, 1919.	1919–20.	1920–21.	1921–22.	1922–23.	Total.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.
Foxton-New Plymouth —*contd.*	Patea - Waitara and New Plymouth	72 29	Patea-New Plymouth Breakwater	72 29	11 52	84 1	..	..	..	..	..	..	..	..	..	72 29
	Bull's Branch ..	3 79	Bull's Branch ..	3 79	..	3 79	3 79	Prelim.	..	..	..	..	..	..	..	..
	Wanganui Branch ..	3 29	Aramoho-Wanganui	3 29	2 23	5 52	..	..	..	..	..	..	..	..	..	3 29
Stratford-Main Trunk	Stratford-Main Trunk	91 50	Stratford-Toko ..	6 26	0 40	6 66	..	..	..	..	..	..	..	..	..	
			Toko-Oruru ..	4 72	0 36	5 28	..	..	..	1 Mar., 1905	..	..	..	..	..	
			Oruru-Huiroa ..	4 50	0 35	5 5	..	..	..	1 April, 1908	..	..	..	..	..	
			Huiroa - Te Wera ..	6 77	1 16	8 13	..	..	..	20 June, 1910	..	..	..	..	..	42 26
			Te Wera - Pohokura	8 55	0 65	9 40	..	..	..	1 Aug., 1912	..	..	..	..	..	
			Pohokura - Whangamomona	6 13	0 45	6 58	..	..	..	1 July, 1914	..	..	..	..	..	
			Whangamomona - Kohurutahi	4 53	0 29	5 2	..	..	..	7 Jan., 1918	..	..	..	..	..	
			Kohurutahi-Tahora	5 14	0 37	5 51	..	..	5 14	..	..	..	..	..	..	..
			Tahora-Ohura ..	25 0	..	25 0	4 0	P m.	..	..	..	..	..	..	..	..
							13 0	Prelim.	..	..	..	..	..	..	..	..
			Ohura-Matiere ..	8 67	..	8 67	..	8 67	..	..	..	..	..	..	..	..
			Matiere-Okahukura..	10 23	0 75	11 18	..	..	10 23	..	..	..	..	..	..	..
	Stratford - Ongarue—Deviations	33 40	Mangaroa-Puketutu	33 40	..	33 40	33 40	Prelim.	..	..	..	..	..	..	..	..
		14 0	Aramatai-Hangatiki	14 0	..	14 0	14 0	Prelim.	..	..	..	..	..	..	..	..
	Puketutu - Mangaroa Deviation	30 0	..	30 0	..	30 0	30 0	Prelim.	..	..	..	..	..	..	..	..
	Opunake-Mountain Rd.	23 10	Opunake-Eltham ..	23 10	..	23 10	23 10	..	..	..	..	..	..	..	..	..
	Te Roti-Moturoa ..	55 65	Te Roti - Kapuni ..	7 0	1 19	8 19	..	6 25	6 55	..	..	..	..	..	..	..
			Kapuni-Auroa ..	5 0	0 33	5 33	..	5 0	..	..	..	..	..	..	..	..
			Auroa-Pihama ..	4 40	..	4 40	..	4 40	..	..	..	..	..	..	..	..
			Pihama-Opunake ..	5 70	..	5 70	..	5 70	..	..	..	..	..	..	..	..
			Opunake-Stony River	18 70	..	18 70	18 70	..	..	..	..	..	..	..	..	..
			Stony River-Moturoa	14 45	..	14 45	14 45	..	..	..	..	..	..	..	..	..
	Manaia Branch ..	5 50	Manaia-Kapuni ..	5 50	0 78	6 48	..	4 25	1 25	..	..	..	..	..	..	..
	Mount Egmont Branch	8 77	Manganui Section ..	5 74	2 3	7 77	..	..	..	1 April, 1908	..	..	..	..	..	6 0
			Quarry Section ..	3 3	0 60	3 63	..	1 58	1 25	..	..	..	..	..	..	..

TABLE OF LENGTHS OF GOVERNMENT LINES AUTHORIZED, CONSTRUCTED, AND SURVEYED UP TO 31ST MARCH, 1923—*continued.*

NORTH ISLAND—*continued.*

Appropriation.	Division.	Mileage.	Section.	Main Line.	Sidings.	Total.	State of Line.									
							Surveyed.	Under Formation.	Under Platelaying.	Opened.						
										Date.	To Mar. 31, 1919.	1919–20.	1920–21.	1921–22.	1922–23.	Total.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M.	M. ch.
North Island Main Trunk Railway	Marton-Te Awamutu	209 69	Marton Junction-Mangaweka	31 67	4 61	36 48	..	..	..	..	..	..	..	..	..	
			Mangaweka-Taihape	13 1	1 61	14 62	..	..	..	10 Sep., 1904	..	..	..	..	..	50 58
			Taihape-Mataroa ..	5 70	0 61	6 51	..	..	..	1 June, 1907	..	..	..	..	..	
			Mataroa-Waiouru ..	18 10	12 50	97 28	..	..	..	30 June, 1908	..	..	..	..	..	
			Waiouru-Erua ..	30 63			..	..	..	13 Feb., 1909	..	..	..	..	..	84 58
			Erua-Taumarunui ..	35 65			..	..	..	9 Nov., 1908	..	..	..	..	..	
			Taumarunui-Te Awamutu	74 33	6 20	80 53	..	..	..	..	..	..	..	..	..	74 33
	Waipa Gravel Access Branch	7 40	Otorohanga ..	7 40	..	7 40	..	..	..	..	..	..	..	..	..	..
	Raetihi Branch ..	8 50	Raetihi Section ..	8 50	1 7	9 57	..	..	..	18 Dec., 1917	..	..	..	..	..	8 50
	Central Route Deviation Surveys	30 0	Ohakune to Mokau-Retaruke Divide	30 0	..	30 0	30 0	Prelim.	..	..	..	..	..	..	..	..
		34 0	Makatote Gorge-Marae-Kowhai	34 0	..	34 0	34 0	Prelim.	..	..	..	..	..	..	..	..
		20 0	Marae-Kowhai-Ohura Valley	20 0	..	20 0	20 0	Explor.	..	..	..	..	..	..	..	..
	Ngaire-Ongarue ..	103 58	Ngaire Section ..	38 73	..	38 73	38 73	..	..	..	..	..	..	..	..	..
			Tangarakau Section	26 0	..	26 0	26 0	..	..	..	..	..	..	..	..	..
			Heao Section ..	10 70	..	10 70	10 70	..	..	..	..	..	..	..	..	..
			Ohura Section ..	27 75	..	27 75	27 75	..	..	..	..	..	..	..	..	..
	Waitara-Tangarakau	46 75	Waitara Section ..	46 75	..	46 75	46 75	..	..	..	..	..	..	..	..	..
	Urenui Route ..	12 0	Urenui to Tangitu River	12 0	..	12 0	12 0	Prelim.	..	..	..	..	..	..	..	..
	Hastings-Te Awamutu	170 0	Hastings-Te Awamutu	170 0	..	170 0	170 0	Prelim.	..	..	..	..	..	..	..	..
	Totals ..	2736 9	..	2736 9	212 29	2948 38	1108 17	97 50	179 47	..	1279 10	..	11 53	..	7 55	1298 48

NOTE.—Taonui and Lichfield Branches not mentioned above, as the rails have been taken up.

TABLE OF LENGTHS OF GOVERNMENT LINES AUTHORIZED, CONSTRUCTED, AND SURVEYED UP TO 31ST MARCH, 1923—*continued.*

SOUTH ISLAND.

NOTE.—Column 11: For detail information as to dates of openings of such portions of lines as are not given in this table see tables of lengths of lines in Public Works Statements, 1904–19.

Appropriation.	Division.	Mileage.	Section.	Main Line.	Sidings.	Total.	State of Line.									
							Surveyed.	Under Formation.	Under Platelaying.	Opened.						
										Date.	To Mar. 31, 1919.	1919–20.	1920–21.	1921–22.	1922–23.	Total.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.
Nelson-Roundell	Nelson-Belgrove ..	22 73	Nelson-Belgrove ..	22 73	2 52	25 45	..	..	..	..	..	..	..	..	..	22 73
Midland Railway	Stillwater - Belgrove (via Tadmor)	146 74	Stillwater-Reefton S.	37 30	4 79	42 29	..	..	..	..	..	..	..	..	..	
			Reefton S.-Reefton N.	1 30	1 0	2 30	..	..	..	31 Mar., 1907	..	..	..	..	..	
			Reefton N.-Cronadun	5 38	0 56	6 14	..	..	..	7 Aug., 1908	..	..	..	..	..	57 32
			Cronadun-Landing ..	8 40	0 45	9 5	..	..	..		..	..	..	..	..	
			Landing-Inangahua	6 0	0 10	6 10	1 26	..	..	June, 1914	..	..	..	..	..	
			Inangahua-Kawatiri	46 43	..	46 43	46 43	..	..		..	..	..	..	..	
			Glenhope-Kawatiri ..	3 72	0 15	4 7	0 18	3 54	..	..	..	..	..	..	..	..
			Glenhope-Tui ..	9 42	0 55	10 17	..	..	..	..	..	..	..	..	..	..
			Tui-Kiwi	3 17	0 34	3 51	..	..	..	2 Sep., 1912	..	..	..	..	..	
			Kiwi-Tadmor ..	5 9	0 29	5 38	..	..	..		..	..	..	..	..	
			Tadmor-Kohatu ..	10 29	0 69	11 18	..	..	..	18 Dec., 1908	..	..	..	..	..	37 61
			Kohatu-Belgrove ..	9 44	0 62	10 26	..	..	..	7 Aug., 1906	..	..	..	..	..	
	Brunner-Springfield	92 68	Brunner-Otira ..	42 27	2 68	45 15	..	..	..	..	..	..	..	..	..	42 27
			Otira-Arthur's Pass	8 14	..	8 14	..	..	8 14	..	..	..	..	..	..	..
			Arthur's Pass - Cass	14 67	0 20	15 7	..	..	..	1 July, 1914	..	..	..	..	..	
			Cass - Broken River ..	15 22	1 29	16 51	..	..	..	10 Dec., 1910	..	..	..	..	..	
			Broken River - Otarama	7 40	0 30	7 70	..	..	..	29 Oct., 1906	..	..	..	..	..	42 27
			Otarama-Springfield	4 58	0 16	4 74	..	..	..	29 Oct., 1906	..	..	..	..	..	
Blackball Railway	Ngahere-Blackball ..	3 40	Ngahere-Blackball ..	3 40	1 20	4 60	..	..	..	16 July, 1910	..	..	..	..	..	3 40
Greymouth-Nelson Creek	Greymouth - Nelson Creek	7 51	Greymouth-Brunnerton-Stillwater	7 51	6 18	13 69	..	..	..	..	..	..	..	..	..	7 51
Westport-Ngakawau	Westport-Ngakawau	19 56	Westport-Ngakawau	19 56	8 12	27 68	..	..	..	..	..	..	..	..	..	19 56
Westport-Ngakawau Extension	Ngakawau - Mokihinui	7 12	Ngakawau-Mokihinui	7 12	1 18	8 30	..	..	..	..	..	..	..	..	..	7 12
	Mokihinui Colliery Line	3 69	Mokihinui-Seddonville	3 69	0 25	4 14	..	..	..	..	..	..	..	..	..	3 69
Westport-Inangahua	Westport-Inangahua Junction	26 0	Westport-Te Kuha ..	5 74	0 10	6 4	..	..	..	1 April, 1912	..	..	..	..	..	5 74
			Te Kuha - Inangahua Junction	20 6	..	20 6	16 6	4 0	..	..	..	..	..	..	..	..

TABLE OF LENGTHS OF GOVERNMENT LINES AUTHORIZED, CONSTRUCTED, AND SURVEYED UP TO 31ST MARCH, 1923—*continued.*

SOUTH ISLAND—*continued.*

Appropriation.	Division.	Mileage.	Section.	Main Line.	Sidings.	Total.	State of Line.										
							Surveyed.	Under Formation.	Under Platelaying.	Opened.							
										Date.	To Mar. 31, 1919.	1919–20.	1920–21.	1921–22.	1922–23.	Total.
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.
State Colliery, or Coal Creek Railway	Greymouth - Point Elizabeth Collieries	5 1	Greymouth-Runanga Colliery	5 1	2 10	7 11	..	..	..	1 Dec., 1904	..	..	..	..	..	5 1
	Extension ..	3 69	Runanga Colliery-Point Elizabeth Collieries	3 69	2 20	6 9	..	..	..	21 Jan., 1914	..	..	..	..	..	3 69
	..	2 44	Runanga to Seven-mile	2 44	..	2 44	..	..	2 44	..	..	..	..	..	..	..
Greymouth-Hokitika	Greymouth-Hokitika	24 37	Greymouth-Hokitika	24 37	2 10	26 47	..	..	..	..	..	..	..	..	..	24 37
Kumara Branch	Kumara Branch ..	4 10	Kumara Branch ..	4 10	..	4 10	4 10	..	..	..	..	..	..	..	..	..
Hokitika-Ross	Hokitika-Ross ..	15 75	Hokitika-Ruatapu ..	7 10	0 61	7 71	..	..	..	9 Nov., 1906	..	..	..	..	..	7 10
			Ruatapu-Ross ..	7 21	0 69	8 10	..	..	..	1 April, 1909	..	..	..	..	..	7 21
			Survey to Ross Township	1 44	..	1 44	1 44	..	..	..	..	..	..	..	..	..
New survey	Ross-Waitaha ..	10 0	Ross-Waitaha ..	10 0	..	10 0	2 54	..	..	..	..	..	..	..	..	..
Picton-Waipara	Picton - Kaikoura ..	92 38	Picton-Seddon ..	33 45	3 26	36 71	..	..	..	..	..	..	..	..	..	
			Seddon-Kaparu ..	6 30	0 76	7 26	..	..	..	13 April, 1911	..	..	..	..	..	56 6
			Kaparu-Ward ..	8 15	1 20	9 35	..	..	..		..	..	..	..	..	
			Ward-Mirza ..	3 38	0 30	3 68	..	..	..	4 Dec., 1915	..	..	..	..	..	
			Mirza-Wharanui ..	4 38	0 34	4 72	..	..	..		..	..	..	..	..	
			Wharanui-Kekerangu	7 0	..	7 0	7 0	1 18	3 20	..	..	..	..	..	..	..
			Kekerangu - Hapuka River	29 32	..	29 32	29 32	..	..	..	..	..	..	..	..	..
	Hapuka River-Mendip Hills	40 50	Hapuka River-Limestone Creek	23 0	..	23 0	23 0	Prelim.	..	..	..	..	..	..	..	..
			Limestone Creek-Conway River	7 0	..	7 0	..	..	..	..	..	..	..	..	..	..
			Conway River - Mendip Hills	10 50	..	10 50	..	..	..	..	..	..	..	..	..	..
	Mendip Hills - Parnassus	5 61	Mendip Hills ..	5 61	..	5 61	2 0	3 61	..	..	..	..	..	..	..	..
	Parnassus-Waipara	44 14	Parnassus-Mina ..	8 43	1 14	9 57	..	..	..	1 Sept., 1912	..	..	..	..	..	
			Mina-Domett ..	3 63	0 70	4 53	..	..	..	1 Aug., 1910	..	..	..	..	..	
			Domett-Tormore ..	3 10	0 66	9 24	..	..	..	14 Nov., 1906	..	..	..	..	..	44 14
			Tormore-Ethelton ..	5 28			..	..	..	21 Mar., 1907	..	..	..	..	..	
			Ethelton-Scargill ..	8 51	0 51	9 22	..	..	..	3 Nov., 1905	..	..	..	..	..	
			Scargill-Waipara ..	14 59	1 2	15 61	..	..	..	..	..	..	..	..	..	
Hurunui-Waitaki	Main Line.. ..	206 7	Culverden-South Waitaki	206 7	64 68	270 75	..	..	..	..	..	..	..	..	..	206 7
		13 0	Culverden-Achray ..	5 23	0 10	5 33	..	..	..							
			Achray-Rotherham..	1 75	0 43	2 38	..	..	..	15 Dec., 1919	..	13 0	..	..	..	13 0
			Rotherham-Waiau ..	5 62	1 3	6 65	..	..	..							

TABLE OF LENGTHS OF GOVERNMENT LINES AUTHORIZED, CONSTRUCTED, AND SURVEYED UP TO 31ST MARCH, 1923—*continued.*

SOUTH ISLAND—*continued.*

Appropriation.	Division.	Mileage.	Section.	Main Line.	Sidings	Total.	State of Line.									
							Surveyed.	Under Formation.	Under Platelaying.	Opened.						
										Date	To Mar. 31, 1919.	1919–20.	1920–21.	1921–22.	1922–23.	Total.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.
Hurunui-Waitaki —*contd.*	*Branches,—*															
	Rangiora - Oxford	21 76	Rangiora-Oxford West	21 76	2 36	24 32	..	..	..	..	..	..	..	..	..	21 76
	Eyreton (from Main Line)	20 7	Main Line - West Eyreton-Bennett's	20 7	1 61	21 68	..	..	..	..	..	..	..	..	..	20 7
	Lyttelton ..	6 26	Lyttelton - Christchurch	6 26	..	6 26	..	..	..	..	..	..	..	..	..	6 26
	Southbridge ..	25 31	Hornby-Southbridge	25 31	3 17	28 48	..	..	..	..	..	..	..	..	..	25 31
	Little River-Akaroa	42 10	Lincoln - Little River	22 46	2 5	24 51	..	..	..	..	..	..	..	..	..	22 46
			Reconnaissance ..	19 44	..	19 44	19 44	Prelim.	..	..	..	..	..	..	..	..
	Springfield ..	30 60	Rolleston-Springfield	29 63	3 7	33 67	..	..	..	..	..	..	..	..	..	30 60
			Springfield-Coal-mine	0 77												
	Whitecliffs ..	11 38	Darfield-Whitecliffs	11 33	1 53	13 11	..	..	..	..	..	..	..	..	..	11 38
			Whitecliffs to Bridge	0 5												
	Rakaia - Ashburton Forks	22 20	Rakaia-Methven ..	22 20	2 65	25 5	..	..	..	..	..	..	..	..	..	22 20
	Ashburton ..	29 46	Tinwald-Springburn	27 29	1 52	29 1	..	..	..	..	..	..	..	..	..	27 29
			Extension ..	2 17	..	2 17	2 17	..	..	..	..	..	..	..	..	..
	Opawa and Albury to Fairlie Creek and Burke's Pass	55 8	Washdyke-Eversley	36 5	2 45	38 50	..	..	..	..	..	..	..	..	..	36 5
			Preliminary survey ..	19 3	..	19 3	19 3	Prelim.	..	..	..	..	..	..	..	..
	Waimate ..	17 43	Studholme-Waimate	4 42	1 3	5 45	..	..	..	..	..	..	..	..	..	12 63
			Waimate-Waihao Downs	8 21	0 54	8 75	..	..	..	..	..	..	..	..	..	
			Waihao Downs-Serpentine	2 65	..	2 65	..	2 65	..	..	..	..	..	..	..	..
			Serpentine-Kelcher's	1 75	..	1 75	..	1 75	..	..	..	..	..	..	..	..
Canterbury Interior Main Line	Oxford-Temuka ..	83 0	Oxford-Sheffield ..	11 44	0 27	11 71	..	..	..	..	..	..	..	..	..	11 44
			Surveyed ..	21 7	..	21 7	21 7	..	..	..	..	..	..	..	..	..
			Reconnaissance ..	50 29	..	50 29	50 29	Prelim.	..	..	..	..	..	..	..	..
Waitaki-Bluff and Branches	Main Line ..	246 69	South Waitaki-Bluff	246 69	59 13	306 2	..	..	..	..	..	..	..	..	..	246 69
	Branches,—															
	Duntroon - Hakateramea	37 33	Pukeuri-Duntroon ..	21 75	1 35	23 30	..	..	..	..	..	..	..	..	..	21 75
			Duntroon - Hakateramea	15 38	1 5	16 43	..	..	..	..	..	..	..	..	..	15 38
	Ngapara ..	14 76	Waiareka-Ngapara ..	14 76	1 31	16 27	..	..	..	..	..	..	..	..	..	14 76
	Livingstone ..	16 40	Windsor-Tokorahi ..	12 0	0 50	12 50	..	0 5	..	..	..	..	..	..	..	11 75
			Survey (trial) ..	4 40	..	4 40	4 40	Prelim.	..	..	..	..	..	..	..	..
	Palmerston - Waihemo	8 55	Palmerston-Dunback	8 55	0 54	9 29	..	..	..	..	..	..	..	..	..	8 55
		0 65	Surveyed ..	0 65	..	0 65	0 65	..	..	..	..	..	..	..	..	..

TABLE OF LENGTHS OF GOVERNMENT LINES AUTHORIZED, CONSTRUCTED, AND SURVEYED UP TO 31ST MARCH, 1923—*continued.*

SOUTH ISLAND—*continued.*

Appropriation.	Division.	Mileage.	Section.	Main Line.	Sidings.	Total.	Stat of Line.									
							Surveyed.	Under Formation.	Under Platelaying.	Opened.						
										Date.	To Mar. 31, 1919.	1919–20.	1920–21.	1921–22.	1922–23.	Total.
1	2	3		5	6	7	8	9	10	11	12	13	14	15	16	17
		M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.
Waitaki-Bluff and Branches—*contd.*	*Branches*—contd.															
	Inch Valley Railway	2 29	Inch Valley-Lime Kiln	2 29	0 23	2 52	..	..	..	..	..	..	..	..	..	2 29
	Port Chalmers ..	1 9	Glendermid - Port Chalmers	1 9	3 40	4 49	..	..	..	..	..	..	..	..	..	1 9
	Green Island ..	2 44	Burnside-Saddle Hill	2 44	0 52	3 16	..	..	..	..	..	..	..	..	..	2 44
	Green Island to Brighton	4 65	Surveyed	4 65	..	4 65	4 65	..	..	..	..	..	..	..	..	..
	Fernhill Colliery Line	1 60	Abbotsford to Fernhill Colliery	1 60	0 24	2 4	..	..	..	..	..	..	..	..	..	1 60
	Kaikorai Valley Railway	2 60	Surveyed	2 60	..	2 60	2 60	..	..	..	..	..	..	..	..	..
	Outram ..	8 78	Mosgiel-Outram ..	8 78	0 68	9 66	..	..	..	..	..	..	..	..	..	8 78
	Lawrence ..	21 76	Clarksville-Lawrence	21 76	2 2	23 78	..	..	..	..	..	..	..	..	..	
	Lawrence - Roxburgh	37 44	Lawrence - Big Hill	7 33	0 44	7 77	..	..	..	1 Aug., 1910	..	..	..	..	..	34 65
			Big Hill - Beaumont	5 36	0 45	6 1	..	..	..	15 Dec., 1914	..	..	..	..	..	
			Beaumont - Miller's Flat	14 55	0 38	15 13	1 45	10 63	2 30	..	..	..	..	..	..	..
			Miller's Flat - Roxburgh	10 0	..	10 0	10 0	Prelim.	..	..	..	..	..	..	..	..
	Lovell's Flat - Tuapeka Mouth	23 20	Surveyed	23 20	..	23 20	23 20	..	..	..	..	..	..	..	..	..
	Balclutha - Tuapeka Mouth	22 0	Surveyed	7 0	..	7 0	..	..	..	..	..	..	..	..	..	..
			Trial Survey ..	15 0	..	15 0	..	..	..	..	..	..	..	..	..	..
	Crichton-Tuapeka Mouth	11 60	Surveyed	11 60	..	11 60	11 60	..	..	..	..	..	..	..	..	..
	Stirling - Hill End (via Stoney Creek)	11 43	Trial Survey ..	11 43	11 43	11 43	11 43	..	..	..	..	..	..	..	..	..
	Balclutha - Appleby Junction or Catlin's - Seaward Bush	105 49	Balclutha-Owaka ..	19 20	1 63	21 3	..	..	..	..	..	..	..	..	..	
			Owaka-Catlin's ..	3 38	0 30	3 68	..	..	..	1 Aug., 1904	..	..	..	..	..	
			Catlin's-Houipapa ..	2 30	0 9	2 39	..	..	..	17 Dec., 1909	..	..	..	..	..	
			Houipapa-Puketiro ..	7 11	0 43	7 54	..	..	..	1 Feb., 1915	..	..	..	..	..	42 67
			Puketiro-McLennan	5 29	0 59	6 8	..	..	..	1 Feb., 1915	..	..	..	..	..	
			McLennan-Tahakopa	5 19	0 38	5 57	..	..	..	1 Feb., 1915	..	..	..	..	..	
			Tahakopa-Marinui ..	23 63	..	23 63	23 63	Prelim.	..	..	..	..	..	..	..	..
			Marinui-Tokanui ..	6 0	..	6 0	6 0	..	..	..	..	..	..	..	..	..
			Tokanui-Waimahaka	8 27	0 64	9 11	..	..	..	20 Sept. 1911	..	..	..	..	..	
			Waimahaka-Appleby	24 52	1 50	26 22	..	..	..	..	..	..	..	..	..	32 79
	Waipahi - Heriot Burn	26 23	Waipahi-Heriot ..	20 3	2 3	22 6	..	..	..	..	..	..	..	..	..	
			Heriot-Edievale ..	6 20	0 45	6 65	..	..	..	15 Feb., 1905	..	..	..	..	..	26 23
	Extension to Roxburgh, via Rae's Junction and Ettrick	28 10	Surveyed ..	28 10	..	28 10	28 10	Prelim.	..	..	..	..	..	..	..	..
	Via Spylaw ..	25 70	Surveyed ..	25 70	..	25 70	25 70	Prelim.	..	..	..	..	..	..	..	..

TABLE OF LENGTHS OF GOVERNMENT LINES AUTHORIZED, CONSTRUCTED, AND SURVEYED UP TO 31ST MARCH, 1923—*continued.*

SOUTH ISLAND—*continued.*

Appropriation.	Division.	Mileage.	Section.	Main Line.	Sidings.	Total.	State of Line.										
							Surveyed.	Under Formation.	Under Platelaying.	Opened.							
										Date	To Mar. 31, 1919.	1919–20.	1920–21.	1921–22.	1922–23.	Total.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.		M. ch.	M. ch.	M. ch.	M. ch.	M. ch.	M. ch.
Waitaki-Bluff and Branches —*contd.*	*Branches*—contd.															
	Waimea Plains District Ry.	36 39	Gore-Lumsden ..	36 39	1 34	37 73	..	..	..	..	..	..	..	..	..	36 39
	Kelso-Gore ..	24 0	Surveyed ..	9 58	..	9 58	9 58	..	..	..	..	..	..	..	..	..
			Preliminary survey ..	14 22	..	14 22	14 22	Prelim.	..	..	..	..	..	..	..	..
	Gore-Waikaka ..	12 65	Waikaka Section ..	12 65	1 51	14 36	..	..	..	26 Nov., 1908	..	..	..	..	..	12 65
	Riversdale-Switzers	13 70	Riversdale-Waikaia	13 70	1 40	15 30	..	..	..	1 Oct., 1909	..	..	..	..	..	13 70
	Edendale-Toitois ..	19 30	Edendale-Glenham	9 36	0 72	10 28	..	..	..	..	..	..	..	..	..	9 36
			Surveyed ..	9 74	..	9 74	9 74	..	..	..	..	..	..	..	..	..
Otago Central	Waitaki Bluff Main Line to Lake Hawea	182 45	Wingatui-Ida Valley	98 18	5 62	104 0	..	..	..	..	..	..	..	..	..	147 27
			Ida Valley-Omakau	13 20	1 16	14 36	..	..	..	1 Sept., 1904	..	..	..	..	..	
			Omakau-Chatto Creek	7 36	0 34	7 70	..	..	..	14 July, 1906	..	..	..	..	..	
			Chatto Ck.-Alexandra	10 39	1 6	11 45	..	..	..	15 Dec., 1906	..	..	..	..	..	
			Alexandra-Clyde ..	5 45	0 77	6 42	..	..	..	27 Mar., 1907	..	..	..	..	..	
			Clyde-Cromwell ..	12 29	0 69	13 18	..	..	..	10 July, 1921	..	..	..	12 29	..	
			Surveyed ..	35 18	..	35 18	..	..	..	..	..	..	..	..	..	..
Invercargill-Kingston and Branch, Lumsden-Mararoa	Invercargill-Kingston	87 4	Invercargill-Kingston Wharf	87 4	5 15	92 19	..	..	..	..	..	..	..	..	..	87 4
	Lumsden-Mararoa ..	30 0	Lumsden-Mossburn	10 40	1 0	11 40	..	..	..	..	..	..	..	..	..	10 40
			Surveyed	8 20	..	8 20	8 20	..	..	..	..	..	..	..	..	..
			Reconnaissance ..	11 20	..	11 20	11 20	Prelim.	..	..	..	..	..	..	..	..
	Winton-Heddon Bush	11 0	Surveyed	11 0	..	11 0	11 0	..	..	..	..	..	..	..	..	..
Forest Hill Railway	Winton to Hedgehope	12 40	Winton-Hedgehope	12 40	0 65	13 25	..	..	..	..	..	..	..	..	..	12 40
Western Railways, Orepuki-Waiau River	Orepuki-Waiau ..	60 64	Makarewa-Orepuki ..	35 41	6 37	41 78	..	..	..	..	..	..	..	..	..	48 16
			Orepuki-Waihoaka ..	4 48	0 58	5 26	..	..	..	..	..	..	..	..	..	
			Waihoaka-Tuatapere	8 7	1 10	9 17	..	..	..	1 Oct., 1909	..	..	..	..	..	
			Tuatapere-Orawia ..	8 8	..	8 17	..	8 8	..	..	..	..	..	..	..	
			Orawia-Clifden ..	4 40	..	4 40	4 40	..	..	..	..	..	..	..	..	
	Otautau Branch ..	22 15	Thornbury-Wairio ..	22 15	..	22 15	..	..	..	..	..	..	..	..	..	22 15
	Orawia Branch ..	11 0	Surveyed	11 0	..	11 0	11 0	..	..	..	..	..	..	..	..	..
	Totals ..	2351 44	..	2351 44	258 14	2609 20	480 65	36 29	16 28	..	1714 57	13 0	..	12 29	..	1740 6

APPENDIX C.

ANNUAL REPORT ON BUILDINGS, BY THE GOVERNMENT ARCHITECT.

The GOVERNMENT ARCHITECT to the Hon. MINISTER OF PUBLIC WORKS.

SIR,—

I have the honour to submit the following report on the various building operations of the Department for the year ending 30th June, 1923.

GOVERNMENT HOUSES.

Auckland.—A considerable amount of work has been carried out on the various buildings attached to the house. A new poultry-house and run have been erected, and a new tennis-court laid out.

Wellington.—Usual maintenance has been carried out during the year.

PARLIAMENT BUILDINGS.

The erection of the first portion of the new Parliament Buildings was completed early in the year.

The installation of electric light, domestic telephones, and electric bells was undertaken by the Department. The balance of furniture required was manufactured by the Public Works workshops, Wellington, and proved to be of better quality than that supplied by outside firms, while actually costing less.

Storage accommodation has been provided in the cellars of Parliament Buildings for various Departments by subdividing and erecting shelving as required.

History of First Portion of Parliament Buildings.—Competitive designs were called for this building early in 1911, and in September, 1911, the assessor (Colonel Vernon, Government Architect, New South Wales) awarded the first prize of £1,000 to Messrs. John Campbell and Claud E. Paton, of Wellington. The building erected is, however, a composite of the first and fourth prize designs, prepared by Mr. John Campbell, Government Architect, in May, 1913.

The foundations and basement of the first portion of the building, put in by the Public Works Department by day labour, were started in March, 1912, and tenders called for the superstructure in May of the following year. The tender of Messrs Hansford, Mills, and Hardie was accepted, and the contract signed on the 12th December, 1913.

The contract called for a building consisting of brick, reinforced concrete, and structural steel-work, the lower story being faced externally with Coromandel granite, and the upper stories with marble from Sandy Bay, Nelson. A considerable amount of polished marble was required for interior decoration, the remainder being plastered.

During the first twelve months the work progressed splendidly, but then a difficulty with respect to the supply of stone occurred, the quarry from which it was expected to obtain the marble proving a failure, necessitating the opening of a new quarry and the construction of a long and costly tramway to transport the blocks of marble to the sea. Nearly two years was thus lost, and by that time the war had upset the markets of the world, prices had soared, tradesmen and labourers had gone to fight for their country; with the result that the contract took many years to complete, and the final cost was greatly in excess of the original tender. It was not until the middle of 1922 that the contractors were ready to hand over the building to the Government, although a considerable portion had been in use for some years.

The building, which consists, generally, of a basement and three stories, is designed in the classic Renaissance style of architecture. The portion now completed contains the main-entrance hall, Legislative Council Chamber, and House of Representatives, lounge-lobby, Cabinet-room, and various Ministers' offices, Committee-rooms, &c.

The remainder of the building, to be erected at some future date, will comprise the Library, Bellamy's, Ministers' rooms, and Committee-rooms; also the big central tower and dome, which will dominate the whole building.

DEPARTMENTAL BUILDINGS.

The maintenance and general upkeep of public buildings has been carried out as funds permitted, including renovations, repairs, fittings, &c., to departmental buildings in most of the larger towns. The painting of the large Departmental Buildings, Wellington, is well in hand, and during the year extensive alterations were made to the sanitary conveniences in this building.

POST-OFFICES, ETC.

Additions, repairs, &c., were carried out to fourteen post-offices in the Whangarei district.

Ngatea, Patetonga, and Mangawai.—New buildings in wood were completed during the year, and necessary fittings supplied.

Whakapirau.—A small wooden building has been erected.

Additions, repairs, supply of fittings, &c., were carried out to forty-four post-offices in the Auckland district, to eight in the Taumarunui district, to eight in the Tauranga district, and to sixteen in the Gisborne district.

Stratford.—A contract was let for a new post-office of two stories and memorial clock-tower, and a large garage and engineer's store, &c. Work was commenced on the 1st November. Brickwork is up to main cornice, concrete floors laid, and steelwork in position.

Patea.—A contract was let for a new post-office in brick, two stories, and the building is nearing completion. The old building was removed to another site.

Hunterville.—Large addition to existing building almost completed.

Wanganui.—A contract has just been let for the erection of a new Post and Telegraph store and garage in wood and iron.

Additions, repairs, &c., carried out to eight post-offices in Napier district.

Dannevirke.—A contract was let for the erection of a two-story brick building, very similar to Stratford Post-office, but without a tower. Good progress is being made with the work. The furniture, fittings, &c., are being manufactured in the Public Works workshops, Wellington.

Featherston.—A new room was added to provide a telephone exchange.

Masterton.—Engineer's workshop, garage, and store were erected in wood and iron during the year.

Palmerston North.—A brick building is being erected for Engineer's store and garage, and good progress is being made.

Wellington.—Automatic-telephone exchange: The foundations were put in by the Department by day-labour, and a contract let for the erection of the superstructure. The work is progressing satisfactorily. The building will consist of a basement and three stories, built of reinforced concrete and brick on a steel frame. Wiring for lighting and power will be done by the Department.

Wellington.—Stores building and yard has been under construction by Postal Department for some time, but was taken over by Public Works Department early in 1922. The building is of four floors, in reinforced concrete. The ground floor consists of motor-garage, &c., with car-store on first floor and body-building department on second floor. Wiring for lighting and power is being done by this Department, but a contract has been let for a goods lift. A smith's shop, adjoining, has also been erected, and part of the yard roofed in (with steel roof-trusses) as extra cover for cars.

Motueka.—A contract was let for extensive additions and alterations.

Additions, repairs, &c., were carried out to twenty-one post-offices in Nelson district; to five post-offices in Greymouth district.

Christchurch.—The extensive additions to the Chief Post-office were completed during the year.

Timaru.—The additions were completed.

Cave.—The building was removed to a new site and renovated.

Additions, repairs, &c., were carried out to many post-offices in the Christchurch district.

Dunedin.—Contract was let for central automatic-telephone exchange, two stories, in brick. Contract nearing completion. Tunnel and shaft in connection with same not yet started.

Additions, repairs, &c., carried out to various post-offices in the Dunedin and Invercargill districts.

Courthouses, etc.

Auckland.—Supreme Court: Considerable alterations have been carried out, providing new Court-room, &c.

Morrinsville.—New building erected during the year and fittings provided.

No other new buildings were erected. Additions, repairs, &c., were carried out to various Court-houses throughout the Dominion.

Police-stations and Gaols.

Repairs, additions, &c., were carried out to eight police-stations in Whangarei district.

Auckland.—Central station: New garage in brick was erected. Electric light was installed in cells, and general renovations carried out.

Mount Eden.—The erection of the female division is in hand. A considerable amount of material has been supplied for work to be carried out by inmates. The new crushing plant is nearing completion. Various alterations have been carried out.

Inglewood.—New building, in wood, completed during the year.

Hawera.—New police-station and sergeant's residence in brick completed during the year.

Mohaka.—New building, in wood, completed.

Wi Tako Prison.—Brickworks: Boiler and engine house have been erected; also a brickmaking-machine house, in two stories, with machinery on ground floor and clay-store on upper floor. Machinery has been installed and is working satisfactorily. A tram-line has been started to connect with the railway. A cottage, removed from Mount Cook, Wellington, has been re-erected at Wi Tako. Ablution-sheds have been erected, and a septic tank started.

Point Halswell.—The dairy buildings were completed during the year, a septic tank constructed, and drainage laid.

Paparua Prison.—New cottage (No. 13) and East Cell-range are nearing completion. Kitchen block, bathroom, and laundry are now in use. Various renovations, &c., were carried out to buildings and cottages.

St. Albans.—A new residence, in wood, is being erected.

Invercargill Borstal Institution.—New stable and barn erected in concrete blocks. Interior sub-division walls, in concrete blocks, and exterior boundary walls have been completed, and various smaller works carried out.

Alterations, repairs, &c., have been carried out to many police-stations, &c., throughout the Dominion.

Mental Hospitals.

Avondale.—Renovations and repairs have been carried out. Painting of building is in hand.

Tokanui.—Water-supply is in hand, and materials have been supplied for work to be done by inmates.

Porirua.—Necessary repairs and renovations have been carried out.

Nelson.—New reception block was completed and electric light installed.

Hokitika.—A wooden building, containing dining-room, kitchen, bakehouse, and billiard-room, has been erected; also nurses' quarters. New drainage to the sea has been laid. Installation of electric light is in hand. Plans have been prepared for unit No. 1 of new scheme, and tenders are being invited. One wing is to be carried out by day labour.

Sunnyside.—Extensive additions to No. 2 ward have been completed and a large amount of renovations, &c., carried out. Site for male staff's new quarters has been cleared.

Seacliff.—Repairs and renovations have been carried out.

Waitati.—New unit for females was completed and is in use.

Education.

Whangarei District.—Various alterations, repairs, &c., were carried out to twelve Native schools.

Waiohau.—New Native school and teacher's residence erected, and additions, renovations, &c., carried out to six others.

Gisborne District.—Additions, renovations, &c., carried out to four Native schools.

Greenmeadows.—Repairs, &c., carried out to receiving-home.

Invercargill.—Southland Boys' High School: A contract was let and work commenced in May. This extensive building consists of two stories in brick (central block, three stories), and comprises a large assembly-hall, class-rooms, offices, &c.

Public Health Department.

Auckland.—St. Helens Hospital: The erection of new building, in brick, has been completed, furniture and fittings supplied, and electric light and elevator installed.

Motuiti Quarantine Island.—Repairs to buildings and wharf have been carried out and alterations to crane completed.

Rotorua.—King George V Hospital: General maintenance of building attended to.

Gisborne.—Townley St. Helens: Necessary repairs and renovations were carried out.

Pukeora Sanatorium.—Additions made to poultry-farm buildings, and extensions made to water-service. Various repairs carried out.

Otaki Sanatorium.—A residence, in wood, was erected for the Medical Superintendent, and electric light installed.

Hanmer.—Queen Mary Hospital: All buildings were repaired and painted, and electric lighting installed. Various additions and alterations were carried out.

Quail Island Quarantine Station.—Recreation-room and general sanitary block, &c., were erected.

Christchurch.—St. Helens Hospital: Additions to laundry have been built.

Dunedin.—St. Helens Hospital: New store and examination-room, &c., provided.

Invercargill.—St. Helens Hospital: General repairs.

Internal Affairs Department.

Featherston.—Soldiers' graves: The levelling of the ground, construction of footpaths, &c., and erection of permanent headstones was completed during the year. The headstones, numbering 159, are of Coromandel granite. Each grave is enclosed in concrete.

General.

In addition to the foregoing, various works, alterations, repairs, &c., were carried out in a large number of offices for different Departments, including Defence, Public Trust, Marine, Tourist, Valuation, Agriculture, Customs, Electoral, Internal Affairs, Government Life, and Mines; also to Ministerial residences.

Fourteen workers' dwellings, in concrete blocks, were erected in the Stratford district, and fifty-five dwellings in Christchurch.

A large quantity of furniture and fittings was made at the Public Works workshops and supplied to various offices.

John T. Mair, A.R.I.B.A.,
Government Architect.

ILLUSTRATIONS.

Parliament Buildings: Front Elevation, facing Molesworth Street.

Parliament Buildings: Main-entrance Hall.
Floor consists of black and white marble slabs; columns, dado, &c., of polished marble; and staircase is of white marble—all from Sandy Bay, Nelson.

Parliament Buildings: Chamber of House of Representatives.
View of portion of chamber, showing Speaker's chair.

APPENDIX D.

ANNUAL REPORT OF CHIEF ELECTRICAL ENGINEER.

The CHIEF ELECTRICAL ENGINEER to the Hon. MINISTER OF PUBLIC WORKS.

SIR,—

I beg to report on the position of electric-power development in the Dominion for the past year as follows :—

Since my last annual report the most important developments that have taken place are the extension of the Lake Coleridge plant from 6,000 kw. to 12,000 kw. capacity ; the opening of the small local plant at Waikaremoana, of 700 kw. capacity, for the supply of Wairoa and district ; the extension of the Auckland Power Board's steam plant by the addition of a 3,000 kw. unit ; the decisions of the Taranaki Electric-power Board to develop the Tariki scheme of 1,500 kw. ; and of the Tauranga Borough to develop the Wairoa River, 2,000 kw. ; and the constitution of nine additional electric-power districts, bringing the total up to thirty-one constituted districts.

In addition the new installations and extensions set out in my previous report are still in hand, or approaching completion, as follows :—

	Kilowatts.
Horahora (Public Works Department), water-power	4,000
Mangahao (Public Works Department), water-power	20,000
Monowai (Power Board), water-power	4,000
Dunedin (City Council), water-power	3,000
New Plymouth (Borough Council), water-power	1,000
Teviot River (Power Board), water-power	500
Wairarapa (Power Board), water-power	350
Opunake (Power Board), water-power	120
Auckland (Power Board), steam	10,000
Wellington (City Council), steam	5,000
Palmerston North (Borough Council), gas	900
Napier (Borough Council), oil	500

Plans are also in hand for the construction of the following additional installations :—

	Kilowatts.
Arapuni (Public Works Department), water-power	45,000
Lake Coleridge (Public Works Department), water-power	15,000
Tariki (Taranaki Power Board), water-power	1,500

The actual power installed has been increased during the year from 51,749 kw. to 57,589 kw., an increase of 11 per cent., and now amounts to 0·075 kw., or 0·1 h.p. per head of population.

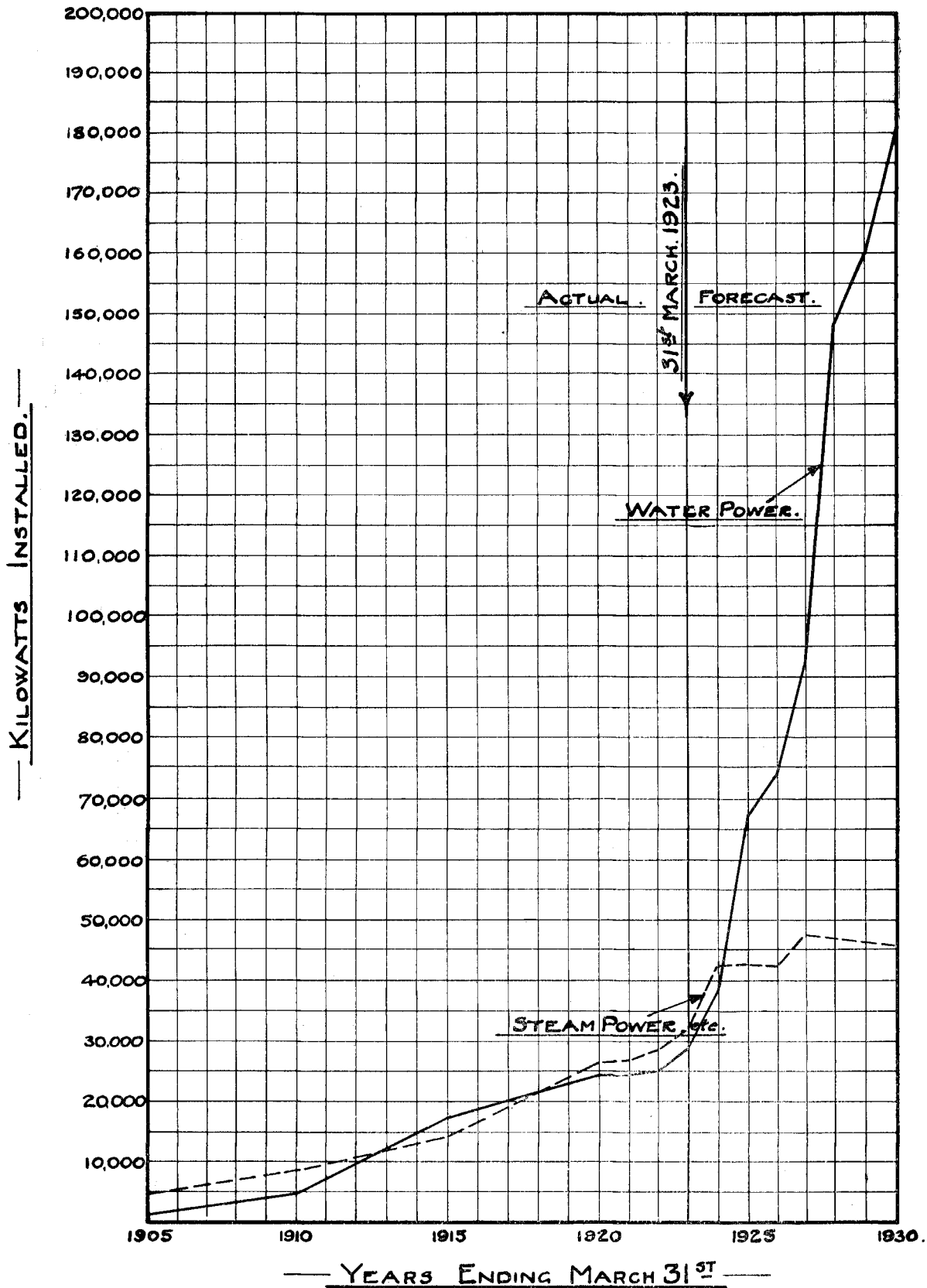
Of the 57,589 kw. installed on the 31st March last 29,386 kw. were in fuel plants and 28,203 kw. in water-power plants. But it will be noted that the proposed extensions will consist almost entirely of water-power installations.

The attached curves (Fig. 1) give a history of the growth of the output of the fuel and water-power stations in the Dominion since 1905, and a forecast up to 1930, based on installations actually decided upon.

It will be noted that the only appreciable increases in the fuel plants in hand or proposed are the consolidation of the Auckland and Wellington power and tramways plants into a single modern and efficient station in each city. This will involve the ultimate dismantling of the old tramway stations, and with the removal of the other small and obsolete fuel plants the total capacity of the fuel stations will decrease rather than increase.

The installed capacity of the water-power stations, on the other hand, will increase rapidly in accordance with the above programme. The installations already planned will give a capacity of 182,000 kw. of water-power and 45,750 kw. of steam-power in 1930, a total of 227,750 kw.—*i.e.*, 0·144 kw. or practically 0·2 h.p. per head of the estimated population in that year—viz., 1,573,000.

FIG. 1.—GROWTH OF THE OUTPUT OF THE FUEL AND WATER-POWER STATIONS IN THE DOMINION SINCE 1905.



INDUSTRIAL DEVELOPMENTS.

Owing to the continued shortage of power during the year throughout the Dominion, no notable developments have been possible in the application of electric power to industrial purposes. The most important is the operation of the new gold-dredge at Rimu Flat, which has proved very successful, and may result in a revival of gold-dredging on a large scale in the Dominion following on the development of the necessary cheap hydro-electric power.

Electric milking plants, which will necessarily form a large proportion of the country load of the Electric-power Boards, have increased by over 100 per cent. during the year. There are now over 1,100 such plants in operation in the Dominion, as compared with 548 last year. The following indicates the distribution of these plants :—

Thames Valley Power Board	384
Central Power Board	247
Te Awamutu Power Board	152
Cambridge Power Board	100
Banks Peninsula Power Board	67
Springs-Ellesmere Power Board	28
Southland Power Board	29
Tai Tapu Dairy Company	36
Hawera Electric Supply Company	50
Other installations	50
Total	1,143

The total number of milking machines in the Dominion operated for the greater part by benzine engines is 12,468, and is increasing at a rate of over 2,000 per year. There is thus ample scope for the development of electric-power supply in this direction.

In addition to the milking plants, the dairy factories are proving a useful load, particularly the large butter and dried-milk factories, of which six are now supplied from Horahora.

Of the fifty-one killing and freezing works in the Dominion, four were previously operated by hydro-electric power from Lake Coleridge, and one from the Waipori plant. One additional works —viz., that at Wairoa, Hawke's Bay—has been supplied with power from the Waikaremoana plant, and two more are making preparation to take supply from the new transmission-line recently constructed from Lake Coleridge to Timaru. These works constitute a useful load. An average freezing-works with a killing-capacity of five thousand sheep per day requires 250 kw. to 300 kw. during the season, and consumes 500,000 to 800,000 units per year. For this purpose hydro-electric power has the advantage that it is not only cheaper than coal but is independent of the mining and transport industries, and it is anticipated that within a couple of years the number of freezing-works supplied will be much larger.

Government Developments.

The statutory authorizations to date for the development of hydro-electric power in the Dominion are as follows :—

	£
Aid to Water-power Act, 1910—	
Lake Coleridge electric-power works	500,000
Electric-power Works Loan Act, 1919—	
Arapuni electric-power works	4,500,000
Mangahao electric-power works	1,600,000
Lake Coleridge extensions	257,500
Horahora electric-power works	412,500
Waikaremoana—Surveys, &c.	30,000
Otago—Surveys, &c.	30,000
Finance Act, 1920—	
Waikaremoana electric-power works	2,600,000
Kaituna River	150,000
Lake Coleridge extensions	720,000
Surveys and investigations	30,000
	£10,330,000

The total expenditure at the end of the past financial year, including capital outlay, stocks, and debit balances on the trading accounts, is as follows :—

	£
Lake Coleridge	930,797
Horahora	436,755
Waikaremoana	77,041
Mangahao	632,963
Arapuni	78,839
Hutt River	2,750
Kaituna River	1,355
Other surveys	5,187
General expenditure	4,413
	£2,170,100

Of the above, the Lake Coleridge, Horahora, and Waikaremoana systems are in commercial operation, and Mangahao and Arapuni are under construction.

These schemes are designed to feed into complete interconnected transmission-systems operating at 110,000 volts in the North Island and 66,000 volts in the South Island, for feeding the substations, as set out in the attached maps, supplying the various Power Boards and other reticulating authorities throughout the Dominion.

Lake Coleridge Hydro-electric Supply.

The year ending 31st March, 1923, represents the eighth year of operation, and, after paying operating costs, interest and depreciation charges, shows a credit balance considerably in excess of the previous years. Tables A, B, and C give a complete analysis of the results of operation of the Lake Coleridge plant, Table D gives a record of the connected load showing a diversity factor of 5·85, and Table E gives a complete summary of the financial results shown by the Department and the fourteen other distributing authorities which deal with the power from Lake Coleridge. It will be noted that all these distributing authorities have made a profit except the two Power Boards which only commenced operations during the year. Figure 2 shows the development in plant capacity and the growth of output since the commencement of operations in 1915. No serious troubles were experienced with the generating plant, and for the first time the steam standby plant was not called into operation during the year.

With the installation of No. 5 generating unit at the beginning of the year the increased capacity of the station (9,000 kw.) enabled restrictions on the demand to be removed. An additional unit of 3,000 kw. has since been installed. Line and insulator troubles showed a marked decrease owing to the changing of the transmission-lines from aluminium to copper and the substitution of a better class of insulators.

Financial Results.—The capital outlay at the end of the year was £848,033, as against £671,608 at the beginning of the year. Details of the additional capital expenditure are shown on Table B attached. The revenue for the year was £69,153, being £5,300 in excess of all charges, including interest at 5·4 per cent. and depreciation at 2 per cent., but not including sinking fund. This surplus has been employed to reduce the accumulated deficiency on the Profit and Loss Account for previous years from £29,175 to £23,876. Particulars of the financial results of operation and load records are given in the attached Table A. The power-house maximum load reached 9,390 kw. on the rated plant capacity of 9,000 kw.: this represents an increase in the maximum output of 10 per cent. over that of the previous year. The units generated reached 43,451,660, an increase of 14 per cent. on the corresponding figures for the year previous. The annual load-factor was 52·9, being a reduction from previous figures, due principally to the removal of restrictions and the consequent increase in the day load.

The total costs per unit are slightly higher, being 0·002d. per unit in excess of the previous year. This is accounted for by the increase in the rate of interest charged, being 5·4 per cent. as against 4·75 per cent. in the previous year. Working-costs, however, show a distinct decrease over those of the past two years. Table C attached shows details of operating-costs as compared with those of the previous year.

The erection of the No. 4 pipe-line and the installation of No. 6 generating-unit were practically complete at the end of the year, and No. 6 set is now in regular operation. The completion of this unit brings the normal output up to 12,000 kw., the ultimate capacity of the present tunnel and power-house.

Work on the switching-station at Windwhistle has been completed, and the Hororata switching- and sub-station is also in service, and will enable a supply to be given at 3,300 volts for the Railway Department's signalling-system on the Midland Railway and to the new Malvern Electric-power District.

The north transmission-line has been completely overhauled, retaining the 7/·135 aluminium wire, and the south line reconstructed with 19/13 copper wire and new insulators. In addition, in anticipation of the duplication of the Lake Coleridge plant, a third line has been constructed with 19/13 copper wire, and equipped with the latest type of insulators. With the three lines there is sufficient transmission-capacity to carry over 24,000 kw., the ultimate output of the present station and the proposed extensions.

The construction of the transmission-line to Timaru was completed during the year. This includes a special crossing over the Rangitata River, consisting of eight steel towers, each 84 ft. high, enabling spans of 18 chains to be used.

A contract was let in October for the erection of the substation at Timaru, and in March for the substation at Ashburton. Supply to these two places will be available during the current year.

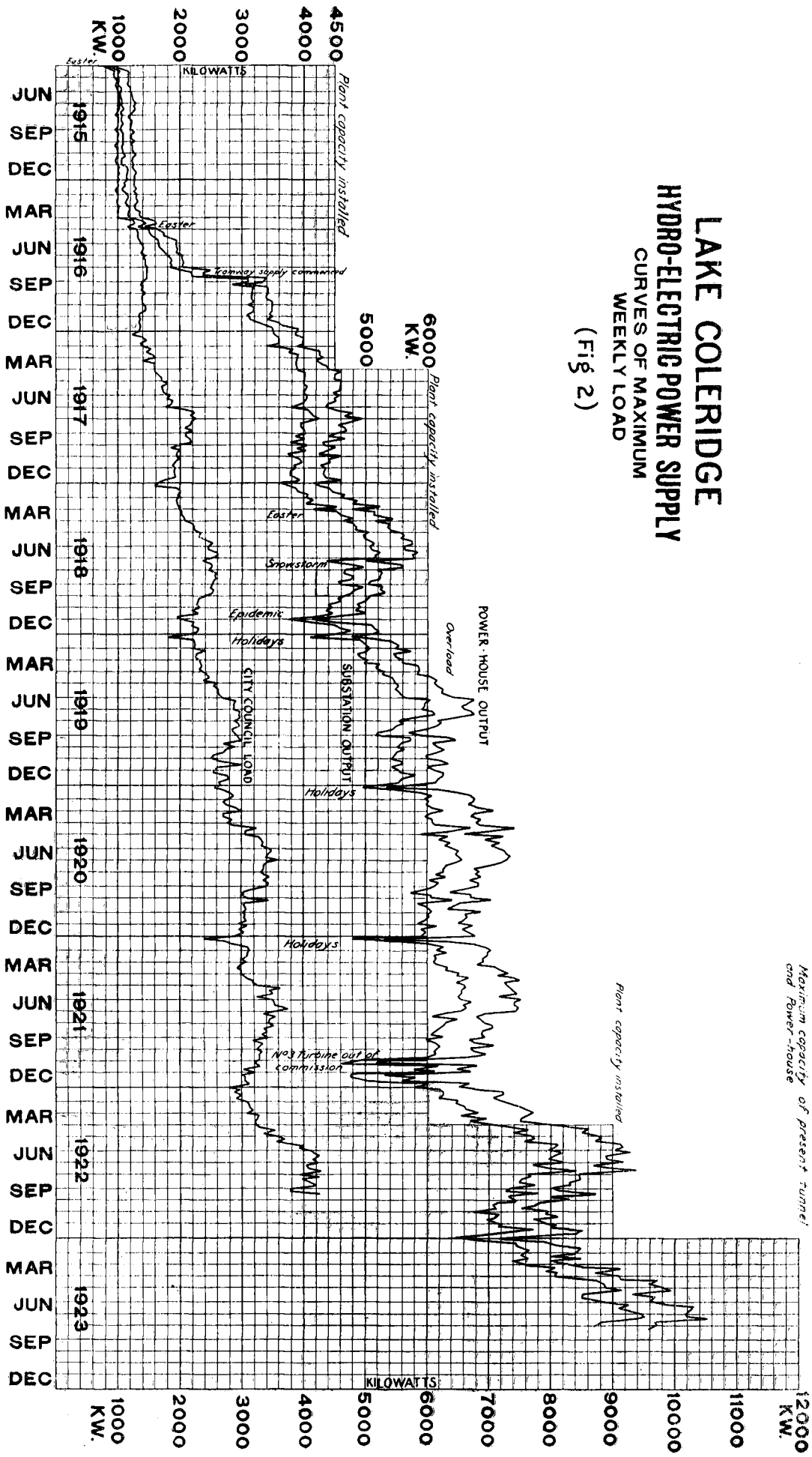
The groin in connection with the diversion of the Harper River was completed in September, and the whole of the Harper is now diverted past the intake gates. At the same time it was decided to raise the normal level of the lake from 1,667·5 ft. to 1,670 ft., and the work of constructing a new outlet weir was commenced in October and completed in February. This gives a substantial increase in the storage-capacity of the lake as well as in the tunnel-capacity, owing to the additional head of water available to overcome tunnel friction.

During the year the supply to Banks Peninsula Power Board was changed over to 33,000 volts by the installation of step-up transformers at Stoddart's Corner, and the 11,000-volt feeder was extended from Waikuku to Sefton, giving a supply to Kowai County.

A special duplicate 11,000-volt line was run from Addington substation to Fendalton to supply the Christchurch Tramway Board's new automatic substation.

As the result of these extensions, the Department's 11,000-volt reticulation has been increased during the year from 82¼ miles to 90 miles.

The total connected load increased to 49,343 kw., as shown on Table D herewith; an increase of 23 per cent. over that of the previous year. The maximum demand was 9,390 kw., giving a diversity factor of 5·25.


LAKE COLERIDGE
HYDRO-ELECTRIC POWER SUPPLY
CURVES OF MAXIMUM WEEKLY LOAD
(Fig 2)
KILOWATTS
1000 KW.
2000
3000
4000
4500
Plant capacity installed
Easter
Easter
Kaimai supply commenced
Easter
Snowstorm
Epidemic
Holidays
CITY COUNCIL LOAD
SUBSTATION OUTPUT
Holidays
Holidays
No 3 Turbine out of commission
6000 KW.
5000
Plant capacity installed
POWER-HOUSE OUTPUT
Overload
Plant capacity installed
Maximum capacity of present tunnel and Power-house
JUN
SEP
DEC
MAR
1915
1916
1917
1918
1919
1920
1921
1922
1923
KILOWATTS
1000 KW.
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000 KW.

Saving of Coal.—The saving of coal to Canterbury by the use of the 37,561,627 units of hydro-electric power sold during the year as compared with the generation of a similar amount of power in the most efficient modern steam plant, consuming 3 lb. of coal per unit, amounts to 50,000 tons of coal per year. But the small isolated plants actually replaced by the Lake Coleridge supply were using in daily running from twice to four times this amount—say, 150,000 tons per year—equivalent to three full train-loads of 160 tons each per day, or three ship-loads of 1,000 tons each per week for the whole year.

Transmission-system.—During the year there were nine interruptions to service exceeding one minute's duration, the total sum of these interruptions being 51½ minutes. The longest period of interruption was fifteen minutes, occurring on Sunday afternoon, 21st January, from 3.38 p.m. to 3.53 p.m. This shut-down was prearranged to enable a loose wire, which was threatening trouble, to be removed. Of the other eight interruptions, two were due to trouble at the power-house, and the remainder to transmission-line trouble. In addition to the above there were thirty-seven interruptions of a momentary duration, mainly due to insulator troubles on the lines. The total number of insulators replaced on these interruptions was thirty, all of these being old-pattern.

Water-storage.—Advantage was taken of the completion of the diversion groin at the Harper and the raising of the overflow from the lake to 1,670 ft. to fill the lake, the result being that the level reached the 1,670 ft. mark by the end of the year, as against 1,661·5 ft. at the beginning of the year.

Future Extensions.—In addition to the extensions set out above, preparations are in hand for increasing the capacity of the present station from 12,000 kw. to 27,000 kw. providing for a 24,000 kw. maximum output and a 3,000 kw. standby unit. This will involve new intake works, tunnel, headworks, penstocks, power-house buildings, and generating plant, consisting of two 7,500 kw. (10,000 h.p.) units with provision for the ultimate installation of a third similar unit. The preliminary survey work has been completed, and plans and specifications have been prepared for the tunnel. The necessary transformers to cope with the increased capacity, two banks each of 12,000 K.V.A., have been installed and are in service.

In order to provide for the additional demand at Addington substation it will be necessary to instal there an additional bank of transformers and 11,000-volt switchgear. For this purpose one of the 4,500 kw. banks displaced at the power-house will be employed, the other being dedicated to the Timaru substation. Plans and specifications have been completed for the necessary extensions to the substation building, and the construction will be put in hand during the current year. The transmission-lines are already of sufficient capacity for the full output of 24,000 kw.

Waikato Electric-power Supply.

The Horahora power-station has operated satisfactorily during the year under review, and has supplied an important district with electric power, including two large mines at Waihi, four electric-power districts, the Hamilton Borough, and half a dozen wholesale consumers. Tables F, G, and H give a complete analysis of the results of operation of the Department's activities. Table J gives the total connected load showing a diversity factor of 2·84, and Table K gives a complete summary of the financial results of the Department and the other five distributing authorities.

Financial Results of Operation.—The capital outlay on this scheme at the end of the year was £395,022, as compared with £353,808 at the end of the previous year, an increase of £41,214. This is analysed in Table G herewith. The year ended with a profit, after paying working-costs, interest, and depreciation, of £6,269. This is sufficient to pay off the previously accumulated losses of £5,882 and leave a balance of £386 to go towards the provision of a sinking fund.

The revenue for the year was £41,818, as compared with £28,207 for the previous year, an increase of 48 per cent.—a very satisfactory result. This increase is due mainly to the extension of the demand from the Electric-power Boards, as indicated by the following analysis:—

	1922.	1923.
Revenue from—	£	£
Mining companies	19,457	20,177
Power Boards	4,310	14,728
Hamilton Borough	1,391	2,911
Wholesale consumers	1,675	2,565
Miscellaneous	1,374	1,437
	£28,207	£41,818

The sum of the maximum loads of the four Power Boards has increased during the year from 1,051 kw. (1,400 h.p.) to 1,845 kw. (2,460 h.p.), an increase of 800 kw. (1,060 h.p.) The increase in the present year can hardly be so high, but it should be approximately 600 h.p., with an increase in revenue from the Boards of over £5,000.

The mines still constitute the main source of revenue—almost half of the total—and the return from them should be a little higher during the present year. During the first few months of the year, owing to the stoppage of the Grand Junction Company's battery, the revenue from the mines was considerably reduced. However, the increased load required by the Waihi Gold-mining Company for pumping, together with the starting of the Junction Company's battery again in January, 1923, more than compensated for the low return at the commencement of the year.

As regards future prospects outside the original area of supply, arrangements are being made for the construction of the transmission-line to supply power to the Auckland Power Board at Penrose, and the proposed Franklin Power Board, near Pukekohe. The transmission-line survey is complete,

and the material is on hand to commence construction in the spring. Power will be available over this line, when the extensions at Horahora are completed, amounting to a maximum of about 3,000 kw. available for most of the time, falling to 2,000 kw. for a few months in exceptionally dry years. In view of the decision to proceed energetically with the Arapuni scheme, the main object in view in dealing with the Horahora plant is to build up as much load in advance as possible for the Arapuni plant.

Extensions made during the Year.—The Horahora–Hamilton–Te Awamutu 50,000-volt line was put into service at 50,000 volts on the 31st December, 1922. This line had previously been supplying Te Awamutu at 11,000 volts, and the change-over of the line to the Hamilton and Te Awamutu substations to 50,000 volts was carried out without any trouble except the inconvenience due to a stoppage of a couple of hours. The line has since given very satisfactory service at 50,000 volts, and no insulator breakdowns have occurred on it.

The 50,000-volt line connecting Horahora and Arapuni is approaching completion. This will be operated at 11,000 volts to supply power for construction at Arapuni, and later on to connect up the Arapuni and Horahora power-stations.

The total system supplied from Horahora consists of 86 miles of 50,000-volt lines and 38 miles of 11,000-volt lines belonging to the Department, and 300 miles of 11,000-volt lines, 389 miles of 3,300-volt lines, and 676 miles of low-tension lines belonging to the Power Boards.

The connected load has increased from 13,478 kw. to 19,565 kw., an increase of 6,100 kw. or 45 per cent., but the increase in power-house maximum load has been only 1,100 kw. and the diversity factor has increased during the year from 2·3 to 2·84. The diversity factor for the whole load—2·84—is low, owing to the low diversity of the two largest consumers in the mining companies. The diversity of the Power Board demands is in each case between 4 and 5.

Operation.—Headworks and power-house: The maximum load of 6,900 kw.—*i.e.*, 10 per cent. overload on the full rated capacity (6,300 kw.) of the plant installed—was carried without difficulty, but on several occasions it was considered necessary, in order to reduce the heating of the generators at heavy load in hot weather, to arrange for the Grand Junction Company's steam plant at Waihi to carry the wattless current. By means of co-operation between the Department and the Junction Company in this manner the necessity for cutting off any load was avoided, and the best possible use of the water-power plant has been made. In addition the Junction Company's steam plant was called on for emergency and overhaul purposes on twelve occasions during the year, for a total period of sixty-one hours, during which 43,300 units were supplied by steam-power with a maximum load of 1,200 kw., in addition to carrying the company's own load for these periods. Of this period, thirty-one hours and a half was for the annual line-overhaul during Christmas week. This co-operation has been of the utmost value in maintaining a continuous service. The power-house was shut down completely for six hours on the 29th December for examination and cleaning of the race.

50,000-volt transmission-line, Horahora–Waikino: There were seventeen accidental stoppages, for a total time of 9 hours 48 minutes, including two each over one hour, and the remainder from one to eleven minutes; also eleven prearranged stoppages for a total time of 56 hours 18 minutes, including 30 hours 15 minutes for annual overhaul. Of these interruptions, eight were due to insulator-failures, one to overload at Waihi, one to failure of an arrester-bushing, and seven to unknown causes, occurring during bad weather. As this is a single line, carried on pin insulators that have been in service for over ten years, this result must be considered very satisfactory, and indicates that the type of insulator originally installed by the Waihi Company was an excellent one.

50,000-volt transmission-line, Horahora–Hamilton–Te Awamutu: This is now in operation at 50,000 volts, after having been in service for over a year at 11,000 volts. The operation has been very satisfactory. Flashovers have been noticed, which did not damage the insulators. No insulators have been replaced, and there have been but momentary interruptions.

11,000-volt lines: No insulators have been replaced on the 11,000-volt lines, and the accidental interruptions have been only momentary. Some of the poles are showing sap-rot, as was anticipated. The sap on these has been removed, and the heart-wood painted with creosote. Most of the 11,000-volt lines in the area are operated by the Power Boards, and there have been some cases of faults difficult to locate and consequent interruptions. There is good reason to think that these faults will be eliminated, and that the reliability of the service, already good, will be improved in future.

Waikaremoana Electric-power Supply.

The demand for water-power at Wairoa, Hawke's Bay, has been very urgent for some years owing to the unreliability of the bar at the Wairoa River, which blocks the supply of coal to the town and freezing-works for long periods, and has more than once threatened a serious disaster. In order to meet this difficulty, arrangements were made to install in advance the exciter units for the ultimate large power plant, which consist of two 500 h.p. water-wheels, each coupled to a 350 kw. exciter and 350 kw. synchronous generator. These have been erected in a temporary building, and operate at a head of 680 ft. through a 24 in. pipe-line 4,600 ft. long. The electricity is generated at 400 volts, three-phase, and stepped up to 11,000 volts, at which pressure it is transmitted to Wairoa, a distance of twenty-three miles. The line has been made suitable for conversion later on to a 33,000-volt line.

In Wairoa supply is given to the freezing-works, the flax-mills, and to the borough to feed its existing reticulation. Supply was commenced on the 16th December, and by the 30th June, 1923, a maximum load of 536 kw. was reached.

The transmission-line was erected and is controlled by the Wairoa Power Board, and in order to keep the standing charges as low as possible the generating plant has been leased to the Board, the Department reserving the right to use power as required for the construction of the large plant when undertaken.

The capital outlay on the plant installed is £76,126, but this includes an item of £5,698 for interest during construction, and £11,920, being a proportion of the outlay on the permanent improvement and metalling of the main road, which has been undertaken at a total cost of £62,789 in anticipation of the construction of the main plant later on.

The rental for the plant to the Power Board has been fixed at £2,100 per year, which constitutes the sole revenue to the Department from this scheme at present.

The installation of this small plant is proving of great benefit to the town and district of Wairoa. Besides removing the anxiety as to the supply of fuel, the cost of retail supply to the borough consumers has been substantially reduced.

Mangahao Electric-power Supply.

Construction work on the headworks and transmission-lines for this scheme is well in hand. Delivery of some of the items of power-house plant has commenced, and the reports from the factories indicate that the whole of it will be ready for shipment before the end of the year. The delivery of the material for the transmission-lines is well ahead of the construction work. The transmission-line to Wellington (sixty-five miles) is being carried out by contract, and good progress is being made, the pole-erection having now (10/8/23) reached Paraparaumu, a distance of thirty-six miles of double line.

The erection of the transmission-lines to Bunnythorpe and the Wairarapa is being carried out by day labour, and is also making good progress, the erection now (10/8/23) having reached Linton, a distance of twelve miles of double line. In addition seven miles of single line has also been erected by a co-operative contract from Bunnythorpe to Ashhurst. A third party has started at Dannevirke, working towards Woodville. In addition the erection of the poles for the special telephone-line which runs alongside all high-tension transmission-lines has been practically completed for a total length of 160 miles.

The survey of the main transmission-lines to Wellington, Marton, Dannevirke, and Masterton is completed, and the survey parties are now engaged on the extension from Dannevirke to Napier and on the patrol roads and tracks.

The site of the main substation for Wellington City at Khandallah has been levelled and the necessary workshops erected. The designs of the substation plant building are completed, and a contract for the erection of the building will be placed very shortly. Delivery of the substation plant is expected early in 1924. The sites of the other five substations—Bunnythorpe, Marton, Dannevirke, Tararua, and Masterton—have been acquired; contracts have been placed for the necessary plant, and the erection of the substations will be commenced early next year.

The question of the sale of the power from Mangahao is, of course, vital to the success of the whole scheme. Owing to the high cost of construction, this scheme cannot pay its way at the standard selling-rates until a market has been found for practically the whole output, at least of 20,000 K.V.A. But, on the other hand, it is estimated that the demand will in a few years considerably exceed the maximum output of 24,000 h.p. or K.V.A. The original allocation of the output amongst the various distributing authorities, based on population at the ratio of one horse-power to each ten head of population, is as follows:—

	Horse-power.
Wellington City	12,000
Hutt Valley Electric-power Board	2,000
Horowhenua Electric-power Board	1,200
Manawatu Electric-power Board	3,300
Rangitikei Electric-power Board	1,800
Wairarapa Electric-power Board	2,000
Tararua Electric-power Board	1,000
Dannevirke Electric-power Board	1,300
Total	24,600

The city has already built up a load of over 8,000 kw. under conditions of severe restriction of demand, and it is anticipated that this will increase as soon as these restrictions are removed, even at present selling-rates, to 10,000 kw.; and that the full allocation will be taken up and probably exceeded within a couple of years.

The seven Power Boards are each making provision to take and distribute the power as soon as it is available. Six have already submitted loan proposals to the ratepayers, which have been approved by large majorities. These appropriations are as follows:—

	£
Wairarapa Electric-power Board	260,000
Manawatu Electric-power Board	500,000
Dannevirke Electric-power Board	175,000
Horowhenua Electric-power Board	260,000
Tararua Electric-power Board	200,000
Hutt Valley Electric-power Board	350,000
	£1,745,000

Of these, Wairarapa, Manawatu, Horowhenua, and Tararua have arranged delivery of the necessary material for the reticulation systems and commenced construction on a large scale. The other two, Dannevirke and Hutt Valley, are now preparing their plans.

It will be necessary in each case to do all that is possible to develop the load in advance in order to ensure the best possible financial returns in the first few years of supply, and special arrangements have been made with this object, as follows: The Wairarapa Power Board is developing 350 kw. from the Kourarau River, which is expected to be in operation early in 1924; the Manawatu Power Board has arranged to take power from the new Palmerston Borough suction-gas plant (900 kw.) as soon as it is completed, early in 1924; the Tararua Power Board has taken over the suction-gas plants at Eketahuna and Pahiatua previously operated by the borough in each place, and is extending the reticulation into the surrounding districts; for Horowhenua a temporary supply will probably be available from the Department's construction plant at the power-house site; and for the Hutt Valley, supply will probably be available from the Wellington City steam plant at Evans Bay.

These special arrangements for building up the load in advance should enable these districts to commence the supply from Mangahao with a substantial portion of their business already developed, and it is considered that they should have no difficulty in extending to reach their full allocations within five years. The demand from districts beyond those to which the power from Mangahao was originally allocated, particularly from Napier, is very urgent, and obviously, if the nearer districts are not prepared to contract to take the power allocated within five years, the more remote districts must be given an opportunity to share in the allocation, both with the object of extending the public convenience and of ensuring the financial return for the Mangahao scheme. On this account the various Boards are being asked to guarantee in the fifth year to take the amount allocated or to concur in the reduction of their allocation. At the same time it is quite recognized that it will take some years to build up their load to the full allocation, and the guarantees for the earlier years are therefore asked for only on a graduated proportion of the allocation, based on the following amounts for each of the five years of the contract period—viz., 40, 50, 60, 80, and 100 per cent. Most of the Boards have fallen in with the guarantee, in some cases on reduced allocations, and the revised allocation is now as follows:—

	K.V.A.
Wellington	12,000
Hutt Valley	1,200
Horowhenua	1,200
Wairarapa (not accepted)	..
Manawatu	1,500
Rangitikei	1,800
Tararua (not accepted)	..
Dannevirke	450
Total	18,150

This leaves 5,850 K.V.A. still to be allocated to those districts which are first ready to give the guarantees. It is anticipated that a substantial allocation of this surplus will be required in Hawke's Bay as soon as the necessary Power Board is formed to undertake its distribution.

Arapuni Electric-power Scheme.

Following on the contract entered into with the Auckland Electric-power Board, specifications have been issued during the year for the construction of the dam and headworks for the Arapuni scheme, and the specification for the power-house and plant will be issued shortly.

The load in the Auckland District is growing rapidly, and there is a very strong unsatisfied demand from the manufacturing industries, particularly round Otahuhu, where the introduction of cheap electric power will give a great stimulus to industrial developments.

The Power Board, in order to meet this growth, has decided to further extend its steam station now under construction at King's Wharf from 20,000 kw. to 25,000 kw., as it is anticipated that the demand will exceed the 20,000 kw. limit before Arapuni can be ready, and this increased load will be available as an initial load on the combined Arapuni and Horahora plants in 1928. In addition the output of Horahora will have reached about 10,000 kw., and there are 700 kw. of smaller fuel plants already operating in the district. These, with the additional demands from new industries, will, it is anticipated, enable Arapuni to start with a load largely in excess of the 30,000 kw., which it is estimated will enable the combined Arapuni and Horahora plant to pay from the start of operations, and the first installation previously proposed for Arapuni will require to be increased to meet the increased demand that the Auckland Power Board is providing for.

In addition, proposals are in hand for the formation of the Franklin Power Board, centring round Pukekohe, which, if formed, will further increase the initial load on Arapuni.

The construction of the Horahora–Auckland transmission-line now in hand, although until 1928 it will carry only 2,000 h.p. at 50,000-volts pressure, is designed for a capacity of 15,000 kw. at 110,000 volts, so as to form the first of the three lines which will be necessary to supply Auckland from Arapuni.

Available Water-power in New Zealand.

In addition to the water-power sources already developed or under consideration, there are a large number of available powers awaiting development when required, and amounting in all to about 750,000 h.p. in the North Island and 3,200,000 h.p. in the South Island. Table P herewith gives a list of these possible sources, giving the maximum power available in each, and the distance from the nearest deep-water port. Some of these are capable of development at a low cost up to the economical

stage, and may on detailed survey prove suitable in the future for the establishment of electro-chemical or other special industries using a large quantity of electric power. The distance from the European market precludes the possibility of an export trade in competition with the large Swedish and Norwegian power sources for that market; but, on the other hand, the proximity to the Eastern and Australian markets gives New Zealand a transport preference over European products, which should be exploited to the fullest possible extent.

Electric-power Boards.

The development of the reticulation by means of Electric-power Boards has made substantial progress during the year. Nine additional districts were formed, and there are now thirty-one districts constituted, and ten actually carrying out the distribution and sale of electrical energy. The total area covered is 46,818 square miles, or 45 per cent. of the total area of the Dominion. The total population concerned is 582,091, or 45·5 per cent. of the total population of the Dominion; and the unimproved value of the land included in the electric-power districts and outer areas is £159,439,000, or 50 per cent. of the total unimproved value of the Dominion. About one-half of the Dominion is thus covered, as compared with one-third last year.

In addition to the thirty-one districts already formed, steps are being taken to form districts in Otago, Waitaki, Hawke's Bay, Poverty Bay, Marlborough, and Hokianga, including large areas in each case.

So far only one of the four main cities—viz., Auckland—has yet been included in a power district, but of the secondary towns, Palmerston North, Invercargill, Timaru, and Wanganui are included, and Napier will probably be included shortly, leaving, of the towns with a population of ten thousand or over, only Hamilton, Gisborne, and New Plymouth outside. The advantage of Power Board organization is more obvious to country than to city ratepayers, and yet the above position indicates that the cities are realizing that it is to their advantage generally to be associated with the country in undertaking the work of reticulation of electric power on a comprehensive scale.

The Boards already formed are getting to work energetically in carrying out their functions. Six Boards—viz., Thames Valley, Cambridge, Central, Te Awamutu, Banks Peninsula, and Springs-Ellesmere—have carried out fairly complete reticulation of their areas, and are distributing power taken in bulk from the Department's hydro-electric power plants at Horahora and Lake Coleridge. The Auckland Board has taken over the city electric-power station, and is providing for large extensions both of plant and mains. Three—viz., Southland, Tararua, and Ashburton—while pushing on with their reticulation in anticipation of an early supply of hydro-electric power, are giving partial supply from existing stations in the town areas. Wairoa is taking power in bulk from Waikaremoana, and supplies the borough and a few large consumers in the neighbourhood. Three—viz., Wairarapa, Opunake, and Teviot—have small power-stations approaching completion, and will commence supply before the end of the year. Eight others—viz., Dannevirke, Horowhenua, Manawatu, Rangitikei, Hutt Valley, Central Hawke's Bay, Malvern, and South Canterbury—are arranging to take power in bulk from the Government hydro-electric sources, and are preparing their systems of reticulation with this end in view. The Buller District, though constituted, has not yet elected a Board. The other eight—viz., Westland, Reefton, Taranaki, Grey, Otago Central, Wairere, Hobson, and Tauranga—are making special arrangements in each case, which have not yet been finalized.

Table L herewith gives details of the dates of constitution, the area, population, and rateable value included in each of the thirty-one power districts already formed, also the amounts of the loans already authorized, and the voting on each poll taken. The total amount of the loans authorized by the nineteen districts which have already taken their polls is £5,636,500. The population of the inner areas concerned is 417,764, so that the loans authorized amount to £13·5 per head of population, as compared with £14 last year. The unimproved valuation of the inner areas is £107,902,231, so that the loans authorized amount to 5·2 per cent. of the unimproved rateable value of the lands pledged as security for the loans, as compared with 5·4 per cent. last year. The voting at the nineteen polls amounts to 23,610 to 1,816—*i.e.*, a majority of 93 per cent. In one case (Te Awamutu District) the poll was unanimous, and in the Taranaki poll, in which the opposition was the strongest, the majority was still 77 per cent.

Table M herewith shows the capital expenditure incurred by each Board up to the end of the financial year, the revenue and expenditure, and the amount of rates struck and collected. The total capital outlay by the twenty Boards which have started construction is £2,224,090, but a great part of this is on works not yet in service. The gross revenue from the sale of electricity by the nine Boards which had commenced supply was £206,909, of which three-quarters was received by the Auckland Board. The general result is a loss over the whole business of the Power Boards of £15,651; but, as a substantial portion of the interest on lines still under construction was charged to capital, the total amount that it was necessary to raise by rating in order to cover the losses was only £7,382. With so many of the schemes in the very early stages of supply this result is quite satisfactory. The rating for the next few years will have to be substantially heavier unless provision is made to enable Power Boards to carry forward losses in early stages of their operations, to be paid out of the profits which can be anticipated after the first few years, as the Department has done in connection with Lake Coleridge and Horahora. But, even so, such losses in the early stages do not indicate any want of security in the business as a whole, but are inherent in starting of any concern depending to such an extent on a large initial capital outlay to earn a revenue which takes time to develop.

During last year ten of the Boards struck a general rate, which was only collected in five cases and seven of the Boards struck special rates for the security for loans, none of which had to be collected.

Several of the Boards are passing through a critical stage owing to the high cost and high interest rates ruling in 1921 when they started construction work, and to the fact that they have undertaken the construction of many lines without requiring the guarantees from consumers authorized by clause 7 (*d*) of the regulations. But costs and rates of interest are now substantially lower, and the other Boards are profiting by such experiences, and much better results will be attained by the Power Boards generally in future as the result of the experience of these earlier districts.

Local Electric-supply Systems.

Including the Government plants, there are now sixty-three public electric-power stations in the Dominion, as detailed in Tables N and O herewith.

Four new water-power stations started operations during the year—viz., Waikaremoana (700 kw.), Whakatane (240 kw.), Fairlie (40 kw.), Havelock North (176 kw.)—and one steam station (Hamilton) was closed down and supplied from Horahora, and one gas station (Wairoa) is now supplied from Waikaremoana.

Extensions were made during the year to Lake Coleridge (3,000 kw., water-power) and Auckland (3,000 kw., steam). The changes during the coming year will also be in the direction of increasing the large stations and closing down the small ones, giving greater economy in operation.

The total installed capacity has increased during the year by 5,840 kw., or 11 per cent. (from 51,749 kw. to 57,589 kw.), and the maximum load by 5,636 kw., or 11½ per cent. (from 48,866 kw. to 54,502 kw.).

The proportion of installed plant is now as follows:—

	Station.	Kilowatts.	Proportion per Cent.
Water-power	31	29,386	51·1
Steam-power	9	23,925	41·5
Gas-power	21	3,492	6·1
Oil-power	2	786	1·3
	63	57,589	100·0

showing a steady increase in the proportion of water-power.

The number of consumers supplied has increased from 88,838 to 106,790, an increase of 17,952, or 20 per cent., for the year. The units per consumer, exclusive of tramways, were 1,280, as compared with 1,210 last year.

The total population included in the various areas of electric-power supply is 767,600, or over 60 per cent. of the total population of the Dominion; so that the ideal of a supply being available to every home in the Dominion is well on the way to realization.

The maximum demand per head of population in the areas supplied, including tramways, is 0·071 kw., practically one-half of the allocation of 0·15 kw. or 0·2 h.p. per head of population, which is the basis of the design of the Government schemes. The units sold per head of population supplied, exclusive of tramways, were 178, as compared with 146 last year.

The total length of distributing-line is 3,758 route-miles, as compared with 2,814 last year, an increase of 944 miles, or 33 per cent. The number of consumers per route-mile is 28·4, as compared with 31·4 last year, the reduction being due to the large mileage of new lines erected during the year to which the full number of services are not yet connected.

The power demand per route-mile of line is now 12 kw., the sales 36,200 units, and the revenue £288, exclusive of tramways in each case. These are substantially smaller than last year, for the same reason, but are still remunerative returns over the whole business. Light country lines, on the other hand, will pay with a return of £50 per mile.

The revenue per kilowatt of output of all stations, excluding tramways, was £24·2, as compared with £24 last year. The water-power stations show a revenue of £20 per kilowatt, steam stations of £30·1 per kilowatt, and gas stations of £40·4 per kilowatt. These are valuable figures for use in forecasting the revenue from systems of various descriptions. The water-power systems include the largest proportion of large consumers, and the gas-engine stations the largest proportion of small consumers.

Out of the eighty-one distributing authorities, fifty showed a profit for the year amounting to £137,989, and thirty-one showed a loss amounting to £28,988. The general result is a net profit for the whole Dominion of £109,000 after paying working-costs (£553,540) and capital charges (£420,207) at the rate of 6.6 per cent. on the total capital outlay of £6,408,492. This shows a net profit of 1·7 per cent., as compared with 1·6 per cent. last year. The business on the whole is thus a thoroughly sound and remunerative one, as well as supplying a public necessity to 60 per cent. of the population of the Dominion.

Electric-power Supply of New Zealand for the Year ended 31st March, 1923.

—	Water.	Steam.	Gas.	Oil.	Total.
Number of stations	31	9	21	2	63
Average capacity (kilowatts)	938	2,658	166	393	915
Number of consumers	60,037	33,562	10,132	3,059	106,790
Installed capacity (kilowatts), (main plant only)	29,386	23,925	3,492	786	57,589
Maximum load (kilowatts)—					
General supply stations	29,995	11,621	2,604	597	44,817
Special tramway stations	..	9,375	310	..	9,685
Units generated—General supply and tramways	127,727,820	31,295,820	6,739,256	1,609,381	167,372,277
Special tramway stations	..	28,225,265	..	..	28,225,265
Annual load-factor (per cent.)	48·6	32·4	26·4	30·8	41·0
Units sold—					
General supply	94,648,989	22,634,873	3,466,739	1,231,557	121,982,158
Tramways	11,325,769	2,228,775	1,015,849	..	14,570,393
Total units sold	105,974,758	24,863,648	4,482,588	1,231,557	136,552,551
Total capital outlay*	£4,340,177	£1,377,290	£617,196	£73,829	£6,408,492
Total capital per kilowatt installed*	£148	£94	£177	£94	£111
Total annual working-costs	£253,844	£208,8-9	£75,055	£15,812	£553,540
Total annual working-cost per unit sold	0·57d.	2·01d.	4·02d.	3·08d.	0·97d.
Total annual working-cost per kilowatt, maximum load	£8·5	£18·0	£28·8	£26·5	£12·3
Total annual capital charges	£271,553	£114,694	£27,931	£6,029	£420,207
Total annual capital charge per unit sold	0·6?d.	1·11d.	1·49d.	1·18d.	0·74d.
Total annual capital charge per kilowatt, maximum load	£9·0	£9·9	£10·7	£10·1	£9·4
Total annual percentage of capital outlay	6·3	8·3	4·5	8·2	6·6
Total annual costs	£525,397	£323,523	£102,986	£21,841	£973,747
Total annual cost per unit sold	1·19d.	3·12d.	5·51d.	4·26d.	1·71d.
Total annual cost per kilowatt, maximum load	£17·5	£27·9	£39·5	£36·6	£21·7
Total annual revenue	£602,069	£349,911	£104,876	£25,892	£1,082,748
Total annual revenue per unit sold	1·36d.	3·38d.	5·61	5·05d.	1·91d.
Total annual revenue per kilowatt, maximum load	£20·0	£30·1	£40·4	£43·4	£24·2
Net profit	£76,672	£26,388	£1,890	£4,051	£109,001

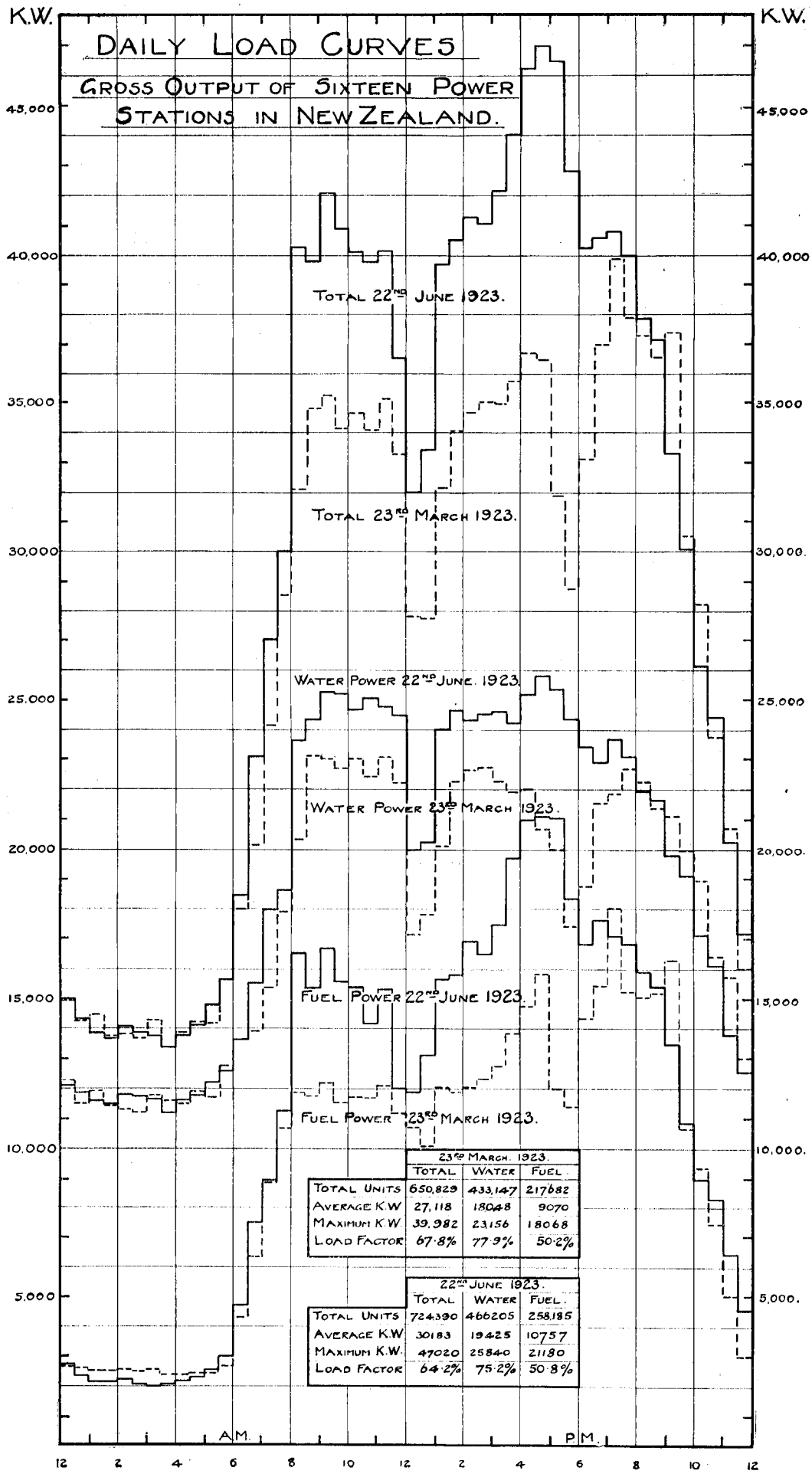
* Includes distribution.

NOTE.—Figures for special tramway stations are not included in capital outlay, working-costs, capital charges or revenue.

DAILY LOAD CURVES.

The question of the daily load curve and the ratio of the average load to the maximum load or the load-factor is an important one in determining the selling-price of electric power. Each station must ascertain its own load-factor and determine its selling policy accordingly. But as a general guide the daily load curves of sixteen of the larger stations of the Dominion have, by the kind co-operation of the engineers to these places, been obtained for two days of the current year—viz., Friday, 23rd March (representing equinoctial conditions), and Friday, 22nd June (representing midwinter conditions). Friday has been selected as the late-shopping night in most places, thus representing the most extreme conditions of loading. These sixteen stations have an installed capacity of 51,683 kw., or 90 per cent. of the total installed capacity of the Dominion, so that the resultant curves may be taken to represent quite accurately the shape of the load curve of the combined output of the whole Dominion. Water-power and fuel stations are proportionately represented, including all the large stations of each type, and the diagram includes not only the total output, but the water-power and fuel-power outputs separately. The summation curves are plotted in Fig. 3, and the results are as follow:—

—	Installed.	Maximum Load.	Units.	Daily Load-factor.
March 23rd, 1923—	Kilowatts.	Kilowatts.		
Water-power	24,950	23,156	433,147	77·9
Fuel-power	26,733	18,068	217,682	50·2
Totals	51,683	39,982	650,829	67·8
June 22nd, 1923—				
Water-power	24,950	25,840	466,205	75·2
Fuel-power	26,733	21,180	258,185	50·8
Totals	51,683	47,020	724,390	64·2



23rd March 1923.	Total	Water	Fuel
Total Units	650,829	433,147	217682
Average K.W	27,118	18048	9070
Maximum K.W	39,982	23156	18068
Load Factor	67·8%	77·9%	50·2%

22nd June 1923.	Total	Water	Fuel.
Total Units	724390	466205	258185
Average K.W	30183	19425	10757
Maximum K.W.	47020	25840	21180
Load Factor	64·2%	75·2%	50·8%

These are daily load-factors. The annual load-factors are of course substantially lower, being 48·6 per cent. for water-power, 32·4 per cent. for steam-power, and 41·0 per cent. for the whole output of the Dominion.

As shown by the curve, the load throughout the day hours, 8 a.m. to 5 p.m., is extraordinarily uniform. In summer there is a distinct drop at 5 p.m., before the lighting-load curves come on at 7 p.m. In winter, on the other hand, the peak occurs from 4 p.m. to 5 p.m., and is due to the overlapping of the lighting load with the industrial and tramway load for this period. It is largely with the object of reducing this overlapping peak that the adoption of a standard time—twelve hours instead of eleven and a half hours ahead of Greenwich mean time—has been proposed, and it would obviously reduce the cost of the electric-power supply accordingly.

There is an average difference between the total outputs for the 23rd March and the 22nd June during the daylight hours of 6,000 kw., which represents partly the normal growth in the period of three months, and the balance mainly the radiator or heating loads for practically the whole of the Dominion, which thus probably amounts to about 4,000 kw. The loading from midnight to 5 a.m. is surprisingly high—viz., 2,000 kw. on the steam-plants and 12,000 kw. on the water-power stations. This is mainly taken by the mining load, about 4,000 kw.; cement-works, about 2,000 kw.; freezing-works, about 2,000 kw.; flour-mills, about 1,000 kw.; and the balance by pumping, street-lighting, battery-charging, water-heating, and other all-night uses.

Inspection of Electric Lines.

The annual inspection of electric lines has been carried out during the year, and the condition of overhead-wiring work in the Dominion has been maintained at a very high standard, particularly in connection with the new Power Board installations.

Registration of Electric-wiremen.

This matter has been under consideration for some years, and a draft Bill has been drawn up with the object of bringing the qualifications and conditions of registration of electric-wiremen up to a uniform standard throughout the Dominion, and several consultations have been held with the authorities concerned during the year.

Staff.

During the year Mr. F. T. M. Kissel visited the main electrical installations and factories of America, Great Britain, and Europe, and gained much valuable information on recent development, which will be submitted in detail in a separate report.

The work of the branch is still hampered by frequent changes in the staff. The hydro-electric work of the Dominion has developed so rapidly that the utmost difficulty is found in getting the necessary trained staff at the salaries available. The staff already in the Department have done splendid service, and two or three very successful appointments have been made from outside. But several advertisements have resulted in no applicants with the necessary experience in the design and construction of such works as are in hand. The present staff deserves the highest commendation for the loyal and efficient manner in which they have coped with extra duties, and have maintained the efficiency that is imperative with the growth of this increasingly important work.

Lawrence Birks, B.Sc., M.Inst.C.E., &c.
Chief Electrical Engineer.

TABLE A.—LAKE COLERIDGE ELECTRIC-POWER SUPPLY.—RESULTS OF OPERATION.

—	Fifth Year, March, 1920.	Sixth Year, March, 1921.	Seventh Year, March, 1922.	Eighth Year, March, 1923.
	£	£	£	£
Capital outlay	422,076	499,957	671,608	848,033
Costs—				
Working-costs	17,759	21,341	25,911	19,271
Interest	16,863	18,639	20,981	35,275
Depreciation, 2 per cent.	7,624	7,946	8,424	9,307
Total costs	42,246	47,926	55,316	63,853
Revenue—				
City Council	16,029	17,700	18,890	21,641
Tramways	7,660	7,835	7,957	8,909
Wholesale consumers	18,735	22,339	26,019	34,344
Retail consumers	1,952	1,785	1,880	2,118
Miscellaneous	1,455	1,714	2,068	2,141
Total revenue	45,831	51,373	56,814	69,153
Profit	3,585	3,447	1,498	5,300
Accumulated deficiency	34,121	30,674	29,175	23,876
Accumulated Depreciation Fund	35,389	44,751	54,537	61,275
Maximum load (kilowatts)—				
Power-house	7,066	7,412	7,600	9,390
Substation	6,260	6,712	6,720	8,420
City Council	2,966	3,601	3,750	4,290
Tramways	1,760	1,840	2,120	2,480
Units output—				
Power-house	33,010,130	36,309,580	37,929,750	43,451,660
Substation	29,572,160	32,588,320	33,947,100	39,665,420
Units sold—				
City Council	12,936,340	14,700,000	15,419,100	17,575,610
Tramways	6,417,900	6,379,717	6,499,258	7,360,035
Wholesale consumers and local bodies	8,348,174	10,051,734	10,746,697	12,449,239
Retail consumers	315,562	270,900	278,897	176,743
Total units sold	28,017,976	31,402,351	32,943,934	37,561,627
Losses—				
Transmission losses	3,437,960	3,728,190	3,982,650	3,786,240
Percentage	10·1	10·27	10·5	8·72
Distribution losses	1,472,414	1,185,969	1,003,166	1,977,256
Percentage	4·4	3·64	3·0	5·2
Annual power-house load-factor (per cent.)	53·3	55·6	57·3	52·9
Average weekly load-factor (per cent.)—				
Power-house	59·9	61·4	62·9	53·5
Substation	58·6	60·5	62·0	53·6
City	53·1	53·8	53·6	47·0
Working-costs—				
Per kilowatt (power-house maximum)	£2·51	£2·87	£3·40	£2·05
Per kilowatt (substation maximum)	£2·83	£3·17	£3·85	£2·29
Per unit generated	0·129d.	0·140d.	0·161d.	0·106d.
Per unit sold	0·152d.	0·150d.	0·188d.	0·123d.
Capital charges—				
Per kilowatt (power-house maximum)	£3·46	£3·58	£3·87	£4·74
Per kilowatt (substation maximum)	£3·91	£3·96	£4·37	£5·29
Per unit generated	0·178d.	0·174d.	0·184d.	0·246d.
Per unit sold	0·209d.	0·203d.	0·214d.	0·284d.
Total cost—				
Per kilowatt (power-house maximum)	£5·98	£6·46	£7·27	£6·80
Per kilowatt (substation maximum)	£6·75	£7·14	£8·23	£7·58
Per unit generated	0·307d.	0·314d.	0·350d.	0·352d.
Per unit sold	0·361d.	0·366d.	0·403d.	0·408d.
Revenue—				
Per kilowatt (power-house maximum)	£6·48	£6·93	£7·47	£7·36
Per kilowatt (substation maximum)	£7·32	£7·65	£8·45	£8·21
Per unit generated	0·333d.	0·337d.	0·354d.	0·382d.
Per unit sold	0·393d.	0·392d.	0·414d.	0·441d.
Per unit sold (city)	0·297d.	0·288d.	0·295d.	0·295d.
Per unit sold (trams)	0·286d.	0·294d.	0·293d.	0·290d.
Per unit sold (wholesale consumers)	0·538d.	0·533d.	0·585d.	0·662d.
Per unit sold (retail consumers)	1·50d.	1·58d.	1·61d.	2·88d.

TABLE B.—LAKE COLERIDGE ELECTRIC-POWER SUPPLY.—ANALYSIS OF CAPITAL OUTLAY.

Item.	Capital Outlay.		Expenditure during Year.
	31st March, 1922.	31st March, 1923.	
	£	£	£
Land, roading and fencing	17,393	17,393	..
Harper River diversion	17,355	21,413	4,058
Tunnel and headworks	146,424	154,065	7,641
Power-house and machinery	99,641	125,596	25,955
Staff village	14,298	14,560	262
Transmission-lines	136,743	251,790	115,047
Addington substation	41,143	41,405	262
Primary distribution	51,932	56,089	4,157
Secondary distribution	42,420	47,954	5,534
Service transformers and meters	16,745	16,683	—62
Vehicles and loose equipment	19,070	18,694	—376
Telephone-lines	1,903	1,903	..
Office furniture	247	249	2
Surveys, preliminary expenses, &c.	44,348	50,442	6,094
Interest during construction	21,946	29,796	7,850
Totals	671,608	848,033	176,424

TABLE C.—LAKE COLERIDGE ELECTRIC-POWER SUPPLY.—OPERATING OR WORKING COSTS.

Expenditure.	1922.		1923.	
	Cost.	Per Unit sold.	Cost.	Per Unit sold.
	£	d.	£	d.
Harper diversion—Maintenance ..	1,002	0·007	568	0·003
Generation	6,299	0·046	5,796	0·037
Transmission	3,155	0·023	1,243	0·008
Main distribution station	2,282	0·017	2,164	0·014
H.T. distribution	2,040	0·015	2,166	0·014
L.T. distribution	1,306	0·010	1,596	0·010
Standby plant	4,586	0·033	1,368	0·009
Management and general expenses ..	5,241	0·038	4,370	0·028
Totals	25,911	0·189	19,271	0·123

TABLE D.—LAKE COLERIDGE ELECTRIC-POWER SUPPLY.—CONNECTED LOAD IN KILOWATTS AT 31ST MARCH, 1923.

—	Light.	Heat.	Power.	Total.
Local Bodies.				
Christchurch City Council	6,443	1,611	21,221	29,275
Riccarton Borough Council	93	195	108	396
Lyttelton Borough Council	187	84	215	486
Lyttelton Pumping Station	1	..	115	116
Sumner Borough Council	176	210	93	479
Kaiapoi Borough Council	109	157	47	313
Rangiora Borough Council	147	80	114	341
Heathcote County Council	187	391	42	620
Paparua County Council	128	432	113	673
Halswell County Council	50	58	65	173
Eyre County Council	34	57	85	176
Tai Tapu Dairy Company	66	106	217	389
Rangiora County Council	54	79	120	253
Waimairi (Hillmorten)	6	7	3	16
Springs Ellesmere Power Board ..	159	255	94	508
Lake Coleridge	29	162	63	254
Power Station and Substation ..	8	30	66	104
Banks Peninsula Power Board ..	207	344	160	711
Kowai County Council	9	11	22	42
Direct Wholesale Consumers.				
Tramways	85	..	6,575	6,660
Freezing-works (4)	122	20	2,275	2,417
Flour-mills (5)	5	1	301	307
Dairy factories (1)	3	..	56	59
Quarries (1)	1	..	45	46
Tanneries, &c. (6)	33	7	680	720
Seed-cleaning (4)	5	1	174	180
Brickyard (1)	..	..	91	91
Railway workshop (1)	31	..	210	241
Harbour Board (1)	55	..	660	715
Institutions (6)	124	320	166	610
Soapworks (1)	3	..	34	37
Steelworks (1)	2	1,200	22	1,224
Glueworks (1)	3	..	102	105
Sawmill (1)	..	1	22	23
Woollen-mill (2)	9	..	71	80
Aviation Company (1)	5	10	6	21
Twine-mill (1)	2	1	119	122
Railway-stations (2)	40	..	56	96
Chemical-works (1)	..	..	196	196
Racing club (1)	24	2	27	53
Electric Vehicle Charging-set (1) ..	..	..	15	15
Totals	8,645	5,832	34,866	49,343

Substation maximum output = 8,420 kw. Diversity factor = 5·85.

TABLE E.—LAKE COLERIDGE ELECTRIC-POWER SUPPLY.—GROSS FINANCIAL RESULTS OF DISTRIBUTION OF ENERGY FOR YEAR ENDED 31ST MARCH, 1923.

Distributing Authority.	Number of Consumers.	Capital Outlay.	Revenue from Consumers.	Paid for Electricity.	Maintenance Expenses.	Interest.	Sinking Fund.	Depreciation.	Balance. Profit.	Balance. Loss.
		£	£	£	£	£	£	£	£	£
Public Works Department	486	848,033	36,232*	..	19,270	35,275	..	9,307	5,300	..
†Christchurch City Council	17,448	441,962	107,097*	22,489	28,383	14,308	..	26,839	17,141	..
Halswell County Council	140	7,013	1,020	432	189	263	50	..	86	..
Heathcote County Council	743	17,124	4,415	1,909	1,034	450	34	..	988	..
Kaiapoi Borough Council	398	4,500	2,231	931	1,485	236	45	..	465	..
Lyttelton Borough Council	315	5,000	3,612	686	1,904	250	..	500	272	..
Riccarton Borough Council	556	7,809	3,549	P.W. 713 / C.C. 168	1,149	305	..	..	1,214	..
Rangiora Borough Council	280	7,551	2,135	532	272	345	148	291	547	..
Rangiora County Council	236	14,600	1,945	776	256	656	105	..	152	..
Sumner Borough Council	552	9,716	2,803	735	1,206	431	81	188	162	..
Tai Tapu Dairy Company	139	7,641	2,490	1,004	730	286	..	407	63	..
Waimairi County Council	2,319	49,641	12,173	P.W. 172 / C.C. 1,895	3,393	2,370	525	..	3,818	..
Eyre County Council ..	116	5,500	972	386	103	273	50	..	160	..
Banks Peninsula Power Board	758	81,300	3,874	1,221	589	3,577	650	..	..	2,163
Springs - Ellesmere Power Board	588	57,140	1,650	862	1,307	‡	‡	‡	..	519
Totals ..	25,074	1,515,830	286,198	34,911	61,270	59,025	1,688	37,532	30,368	2,682

* After deducting amount of sales to other distributing bodies, totalling £32,921 to Public Works Department, and £2,063 to Christchurch City Council. † Woolston Borough included in Christchurch City Council return. ‡ Included in capital expenditure. P.W. = Paid to Public Works Department. C.C. = Paid to Christchurch City Council.

Net profit of the whole Lake Coleridge system, £27,686.

TABLE F.—WAIKATO ELECTRIC-POWER SUPPLY.—RESULTS OF OPERATION.

	First Year, March, 1921.	Second Year, March, 1922.	Third Year, March, 1923.
	£	£	£
Capital outlay	249,499	353,808	395,022
Costs—			
Working-costs	6,452	7,986	9,721
Interest	10,675	13,187	19,208
Depreciation (2 per cent.)	3,960	4,512	6,620
Total costs	21,087	25,685	35,549
Revenue—			
Cambridge Power Board	..	541	1,837
Central Power Board	..	353	2,216
Te Awamutu Power Board	..	508	2,119
Thames Valley Power Board	..	2,908	8,556
Hamilton Borough Council	..	1,391	2,911
Waihi Gold-mining Company	13,698	13,748	15,927
Grand Junction Company	782	5,709	4,250
Other consumers	238	1,675	2,565
Miscellaneous (rents, &c.)	86	1,374	1,437
Total revenue	14,804	28,207	41,818
Profit (P.) or loss (L.)	(L.) 6,282	(P.) 2,522	(P.) 6,269
Accumulated deficiency	8,404	5,882	..
Accumulated surplus	..	..	386
Accumulated Depreciation Fund	5,653	10,210	16,605
Maximum load (kilowatts)—			
Power-house, for year	3,500	5,800	6,900
Power-house, average weekly	2,675	4,080	5,382
Units output—			
Power-house	16,729,050	25,659,550	33,732,150
Substations total	..	..	30,435,036
Units sold—			
Waihi Gold-mining Company	14,477,387	15,383,006	19,116,114
Grand Junction Company	738,613	5,449,870	4,079,700
Cambridge Power Board	..	..	519,450
Central Power Board	..	..	657,000
Te Awamutu Power Board	..	..	622,040
Thames Valley Power Board	..	..	3,776,065
Hamilton Borough Council	..	..	860,000
Other consumers	..	..	400,000
Total units sold	15,376,000	23,093,595	30,030,369
Losses—			
Transmission losses	..	..	3,297,114
Percentage	..	..	9·8
Distribution losses	1,338,450	2,565,955	3,701,781
Percentage	8	10	11
Load-factor—			
Power-house, annual (per cent.)	54·5	50·5	55·8
Power-house, average weekly (per cent.)	71·0	71·3	71·2
Working-costs—			
Per kilowatt (power-house annual maximum)	£1·84	£1·38	£1·41
Per kilowatt (power-house average weekly maximum)	£2·38	£1·95	£1·81
Per unit generated	0·093d.	0·075d.	0·069d.
Per unit sold	0·100d.	0·083d.	0·078d.
Capital charges—			
Per kilowatt (power-house annual maximum)	£4·18	£3·06	£3·76
Per kilowatt (power-house average weekly maximum)	£5·47	£4·34	£4·80
Per unit generated	0·210d.	0·166d.	0·184d.
Per unit sold	0·228d.	0·184d.	0·206d.
Total costs—			
Per kilowatt (power-house annual maximum)	£6·02	£4·43	£5·15
Per kilowatt (power-house average weekly maximum)	£7·85	£6·29	£6·61
Per unit generated	0·303d.	0·240d.	0·253d.
Per unit sold	0·327d.	0·267d.	0·284d.
Revenue—			
Per kilowatt (power-house annual maximum)	£4·23	£4·83	£6·07
Per kilowatt (power-house average weekly maximum)	£5·53	£6·91	£7·77
Per unit generated	0·212d.	0·264d.	0·300d.
Per unit sold	0·229d.	0·293d.	0·334d.
Per unit sold Cambridge Power Board	..	..	0·849d.
Per unit sold Central Power Board	..	..	0·810d.
Per unit sold Te Awamutu Power Board	..	..	0·818d.
Per unit sold Thames Valley Power Board	..	..	0·544d.
Per unit sold Hamilton Borough	..	..	0·812d.
Per unit sold Waihi Gold-mining Company	0·227d.	0·214d.	0·200d.
Per unit sold Grand Junction Company	0·254d.	0·252d.	0·250d.

TABLE G.—WAIKATO ELECTRIC-POWER SUPPLY.—ANALYSIS OF CAPITAL OUTLAY.

Item.	Capital Outlay.			Expenditure during Year.
	31st March, 1921.	31st March, 1922.	31st March, 1923.	
	£	£	£	£
Land, roading, and fencing at Horahora	2,968	3,125	3,125	..
Headworks	86,308	86,700	88,666	1,966
Generating-station, transformers, and machinery	46,988	58,065	72,390	14,325
Staff village, Horahora	7,436	9,538	10,320	782
Transmission-lines	59,077	106,476	112,258	5,782
Distribution-lines	536	716	705	—11
Main substations	17,940	30,846	40,189	9,343
Distribution substations	..	6,078	7,395	1,317
Vehicles and loose construction equipment	5,184	7,812	7,859	47
Land, stores, and siding, Ruakura	1,533	9,917	11,342	1,425
Staff residences, Ruakura	..	2,612	3,521	909
Office furniture, Hamilton	363	427	440	13
Surveys, supervision, preliminary expenses, &c.	5,546	12,180	15,604	3,424
Interest during construction	15,620	19,316	21,208	1,892
Totals	249,499	353,808	395,022	41,214

TABLE H.—WAIKATO ELECTRIC-POWER SUPPLY.—OPERATING OR WORKING COSTS.

Expenditure.	1922.		1923.	
	Cost.	Per Unit sold.	Cost.	Per Unit sold.
	£	d.	£	d.
Generation	3,735	0·039	3,859	0·031
Transmission	911	0·009	1,480	0·012
Main substations	740	0·008	1,0 6	0·008
H.T. distribution	504	0·005	245	0·002
Management and general	2,084	0·022	3,031	0·024
Miscellaneous and stand-by expenses	12	..	90	..
Totals	7,986	0·083	9,721	0·077

TABLE J.—WAIKATO ELECTRIC-POWER SUPPLY.—CONNECTED LOAD IN KILOWATTS (31ST MARCH, 1923).

——	Light.	Heat.	Power.	Total.
Waihi Gold-mining Company	164	100	4,461	4,725
Grand Junction Company	38	38	2,452	2,528
Cambridge Dairy Company	2	1	184	187
New Zealand Dairy Company, Frankton	15	3	757	775
State Farm, Ruakura	10	1	5	16
New Zealand Railways, Frankton	10	..	190	200
Cambridge Power Board	224	352	340	916
Central Power Board	276	407	530	1,213
Te Awamutu Power Board	240	367	414	1,021
Thames Valley Power Board	957	1,776	2,974	5,707
Hamilton Borough Council	940	330	829	2,099
Public Works Department, Horahora	8	77	48	133
Public Works Department, Hamilton	3	37	5	45
Total	2,887	3,489	13,189	19,565

Maximum load, 6,900 kw. Diversity factor = 2·84.

TABLE K.—WAIKATO ELECTRIC-POWER SUPPLY.—GROSS FINANCIAL RESULTS OF DISTRIBUTION OF ENERGY FOR THE YEAR ENDED 31ST MARCH, 1923.

Distributing Authority.	Number of Consumers.	Capital Outlay.	Revenue from Consumers.	Revenue from Rates.	Paid for Electricity.	Maintenance Expenses.	Interest and Sinking Fund.	Depreciation.	Balance.	
									Profit.	Loss.
		£	£	£	£	£	£	£	£	£
Public Works Department	11	395,022	24,179*	..	..	9,721	19,208	6,620	6,269	..
Thames Valley P.B.	1,950	333,587	30,632	..	8,569	5,576	20,618	..	..	4,131
Te Awamutu P.B.	666	119,814	7,145	2,118	2,125	4,151	2,849	..	138	..
Central P.B.	970	115,000	8,371	..	2,216	1,847	4,000	..	308	..
Cambridge P.B.	605	75,000	4,771	..	1,837	1,366	4,640	..	..	3,072
Hamilton Borough	1,574	44,034	19,439	..	2,951	6,378	3,802	..	6,308	..
Totals	5,776	1,082,457	94,537	2,118	17,698	29,039	55,117	6,620	13,023	7,203

* After deducting amount of sales to other distributing bodies, totalling £17,639.

Net profit for the whole Waikato system, £5,820.

TABLE L.—ELECTRIC-POWER BOARDS OF NEW ZEALAND AS CONSTITUTED ON 1ST JULY, 1923.

Name of Electric-power District.	Proclamation constituting District gazetted.	Number of Members on Board.	Approximate Area of District.		Population.		Value of Rateable Property (unimproved).		Amount of Loan.	Voting for Loan Poll.	
			Inner Area.	Outer Area.	Inner Area.	Outer Area.	Inner Area.	Outer Area.		For.	Against.
Southland	19/11/19	12	7,798	3,059	65,450	9	14,163,952	137,513	1,500,000	6,516	415
Thames Valley	8/1/20	12	2,304	..	28,721	..	6,967,483	..	550,000	1,503	28
Te Awamutu	8/1/20	10	261	46	8,000	1,200	1,559,588	200,000	120,000	359	..
Cambridge	8/1/20	8	104	..	5,000	..	1,683,632	..	60,000	198	3
Banks Peninsula	8/1/20	7	387	..	3,935	..	4,344,873	..	100,000	331	23
Wairarapa	25/3/20	9	302	1,694	17,500	1,752	3,913,232	5,457,271	260,000	1,704	225
Central	8/7/20	7	300	..	9,100	..	3,667,904	..	200,000	515	19
Wairoa	29/7/20	10	1,354	..	4,368	..	2,681,627	..	100,000	504	31
Springs-Ellesmere	8/7/20	7	272	..	5,527	..	3,401,187	..	60,000	302	16
Teviot	22/7/20	7	76	..	1,800	..	169,137	..	35,000	191	27
Opunake	18/8/21	7	122	117	2,744	500	716,111	200,000	70,000	170	20
Auckland	1/4/22	12	295	..	145,870	..	25,240,539	..	600,000	4,179	288
Ashburton	17/11/21	12	1,193	1,349	16,691	533	9,346,863	700,181	296,500	1,590	96
Manawatu-Oroua	1/12/21	12	1,301	..	37,518	..	14,021,064	..	500,000	1,144	96
Dannevirke	11/8/21	10	568	105	11,648	433	4,177,743	488,970	175,000	651	93
Horowhenua	1/12/21	9	630	..	11,795	..	3,403,255	..	260,000	973	26
Wanganui-Rangitikei	1/12/21	12	1,648	972	41,364	650	6,568,540	1,408,210	Poll not yet taken.		
Tararua	23/3/22	10	700	565	8,485	1,781	2,912,346	1,147,113	200,000	714	83
Taranaki	19/5/22	7	218	1,419	10,190	12,000	2,865,396	3,109,336	350,000	635	190
Hutt Valley	6/7/22	9	471	..	23,422	..	2,656,299	..	200,000	1,431	137
Buller	11/5/22	5	1,987	..	9,197	..	696,374	..	Poll not yet taken.		
Westland	28/10/20	9	750	..	3,272	..	196,268	..			
Reefton	30/6/21	5	24	..	1,850	..	64,476	..			
Central Hawke's Bay	19/10/22	9	1,226	..	8,980	..	6,653,485	..			
South Canterbury	26/10/22	12	1,673	3,429	35,618	6,000	12,946,839	2,536,815			
Grey	26/10/22	12	640	810	10,000	2,000	514,694	100,000			
Otago Central	26/10/22	7	27	2,657	1,500	2,989	52,313	982,621			
Wairere	18/1/23	7	147	260	1,500	1,000	392,434	480,000			
Hobson	29/3/23	8	778	..	7,017	..	1,389,487	..			
Tauranga	14/6/23	7	636	3	4,656	3,106	964,553	267,547			
Malvern	28/6/23	6	308	1,833	3,920	1,500	2,433,080	1,458,588			
Totals	..	..	28,500	18,318	546,638	35,453	140,764,774	18,674,165	5,636,500	23,610	1,816

TABLE M.—ELECTRIC-POWER BOARDS.—RETURNS FOR YEAR ENDED 31ST MARCH, 1923.

Board.	Main Supply commenced.	Capital Outlay.	Revenue.		Expenditure.			Profit.	Loss	General Rate.		Special Rates.		Valuation Basis.
			Sale of Electricity. (Gross.)	Sale of Materials. (Profit.)	Capital Charges.	Power.	General.			Levied.	Collected.	Levied.	Collected.	
		£	£	£	£	£	£	£	£	d.	£	d.	£	
Auckland	1908	914,024	154,758	130	79,033	..	76,654	..	799	..	..	0·925	Nil	Capital.
Southland	..	376,788	..	758	..	..	..	758	..	..	..	..	..	..
Thames Valley ..	1921	333,587	22,434	8,198	20,618*	8,569	5,576	..	4,131*	..	..	..	..	..
Te Awamutu ..	1921	119,325	7,145	..	2,849	2,125	4,151	..	1,980	0·14	2,081	..	..	Capital.
Cambridge ..	1921	75,000	4,771	..	4,640	1,837	1,366	..	3,072	..	..	0·05	Nil	Capital.
Banks Peninsula ..	1922	81,300	3,853	21	4,227	1,221	589	..	2,163	..	..	..	..	..
Wairarapa	..	22,032	..	..	..	..	..	..	..	..	..	..	..	..
Central	1921	122,000	8,267	104	4,000	2,216	1,847	308	..	..	..	..	..	..
Wairoa	1923	36,890	809	..	700	525	528	..	944	0·10	1,388	..	..	..
Springs-Ellesmere ..	1922	57,140	1,650	..	†	862	1,307	..	519	..	..	..	..	..
Teviot	..	10,565	..	..	..	..	..	..	..	..	..	4·00	Nil	Unimproved.
Opunake	..	22,000	..	..	..	..	..	..	..	..	..	..	..	..
Ashburton	..	1,360	..	..	..	..	..	..	..	0·65	Nil	..	..	Capital.
Manawatu	..	22,075	..	..	..	..	..	..	..	..	..	0·75	Nil	Unimproved.
Dannevirke ..	..	1,408	..	..	..	..	..	..	..	0·33	Nil	1·03	Nil	Unimproved.
Horowhenua ..	..	7,440	..	..	..	..	..	..	..	0·10	Nil	..	..	Capital.
Rangitikei	..	..	..	..	..	..	1,172	..	1,172	0·04	2,925	..	..	Capital.
Tararua	..	19,169	3,222	..	..	2,543	1,622	..	943	0·25	Nil	1·25	Nil	Unimproved.
Taranaki	..	847	..	..	..	..	847	..	847	0·14	609	..	..	Capital.
Hutt Valley ..	..	964	..	..	..	..	..	..	..	0·125	Nil	1·33	Nil	Unimproved.
Reefton	..	176	..	..	..	..	147	..	147	0·5	379	..	..	Capital.
Totals ..	..	2,224,090	206,909	9,211	116,067	19,898	95,806	1,066	16,717	..	7,382	..	..	..

* Interest and sinking fund for year were paid out of loan, leaving a profit of £16,487. † Interest and sinking fund were paid out of loan (£3,762).

Buller, Westland, Central Hawke's Bay, South Canterbury, Grey, Otago, Central, Wairere, Hobson, Tauranga, and Malvern Boards not yet in operation.

Table N.—Electric-supply Stations of New Zealand at 31st March, 1923.

(G = gas; O = oil; S = steam; W = water.)

Station.	Ownership.	Supply commenced.	Population supplied.	Number of Consumers.	Capacity, in Kilowatts.			Units.						Annual Load-factor Percentage.	System of Supply.	Supply Voltage.	Route-miles of Lines	Static Head, in Feet.
					Main Plant.	Standby Plant.	Maximum Load.	Connected Load.	Diversity Factor.	Generated or purchased.	Sold.	Non-productive.	Percentage Non-productive.					
Steam Stations.																		
1. Auckland (lighting)	City	1908	145,870	11,609	9,000	..	6,105	..	..	17,326,349	13,599,195	3,727,154	21·5	32·4	D.C./A.C.	460/400/230	180·0	..
(tramways)		1902	..	..	5,350	..	5,400	..	..	14,485,038	14,485,038	..	..	30·6	D.C.	550	..	..
2. Wellington (lighting)	City	1888	95,000	16,000	3,500	..	4,060	..	..	9,789,402	7,685,318	2,104,084	21·5	27·6	A.C.S.P.	105	190·0	..
(tramways)		1904	..	478	4,000	..	3,975	..	..	13,740,227	12,246,801	1,493,426	10·8	39·5	D.C.	550	..	..
3. Invercargill	Borough	1913	25,000	2,527	1,450	525	850	3,811	4·5	2,848,380*	2,516,792	331,588	11·6	38·2	A.C.	400/230	101·0	..
4. Gisborne	Borough	1912	10,930	2,205	350	300 (O.)	520	2,826	5·4	1,185,711*	939,085	246,626	20·8	26·1	D.C.	460/230	33·0	..
5. Huntly	Town Board	1916	2,500	351	225	..	46	620	13·5	83,886	63,878	20,008	23·8	20·8	D.C.	460/230	7·0	..
6. Bluff†	Borough	1903	1,600	292	50	..	40	..	..	62,092	59,380	2,712	4·4§	17·6	D.C.	460/230	7·0	..
7. Kaitangata	Borough	1917	1,768	100	Bulk	..	..	..	..	..	(6,048)‡	..	..	..	A.C.	230	7·0	..
Totals	..	..	282,668	33,562	23,925	825	20,996	..	..	59,521,085	51,595,487	7,925,598	13·3	32·4	..	..	525·0	..
Gas Stations.																		
1. Napier	Borough	1913	13,500	2,185	830	..	702	3,282	4·7	1,801,511*	1,578,158	223,354	12·4	29·3	D.C.	460/230	30·0	..
2. Wanganui	Borough	1908	16,900	28	485	..	510*	171	..	1,084,417*	161,718	216,883‡	20·0	..	D.C.	550	..	..
3. Ashburton†	Company	1908	6,172	693	186	165 (O.)	251	..	..	431,688	317,632	114,056	26·4	19·6	D.C./A.C.	460/400/230	62·0	..
4. Timaru	Borough	1908	14,500	1,465	420	..	375	1,716	4·6	1,170,176	723,036	447,144	38·2	35·6	D.C./A.C.	460/400/230	50·0	..
5. Devonport†	Borough	1915	9,304	1,070	200	..	204	..	..	592,960	434,246	158,714	26·5	33·0	D.C.	460/230	18·0	..
6. Feilding	Borough	1914	5,000	1,100	310	..	185	934	5·0	520,097	390,401	129,696	24·9	32·1	A.C./S.P.	230	26·0	..
7. Te Kuiti	Borough	1913	2,300	525	170	..	110	590	5·4	265,367	215,694	49,673	18·7	27·5	D.C.	460/230	11·0	..
8. Picton	Borough	1917	1,400	300	58	8 (W.)	60	368	6·1	197,000‡	157,680	39,320	20·0	37·6	D.C.	460/230	10·0	279
9. Pukekohe	Borough	1917	1,200	331	86	..	84	430	5·1	96,750	77,400	19,350	20·0	13·2	D.C.	460/230	9·5	..
10. Waitara	Borough	1907	1,500	312	62	23 (W.)	56	100	1·8	64,767	53,723	11,044	17·1	13·2	D.C.	460/230	9·0	293
11. Opotiki	Private	1914	1,100	273	99	..	65	114	1·8	85,562	71,302	14,260	16·7	15·0	D.C.	460/230	11·0	..
12. Winton	Borough	1914	800	165	37½	..	29	73	2·5	25,729	23,297	2,432	9·5	10·1	A.C.	400/230	3·5	..
13. Ngaruawahia¶	Borough	1913	1,200	215	70	..	..	..	..	59,268	34,459	24,809	41·9	..	D.C.	460/230	7·0	..
14. Martinborough	Town Board	1914	932	235	77	..	39	75	1·92	67,962	35,917	32,045	47·2	19·9	D.C.	230	8·0	..
15. Pahiatua	Borough	1918	1,360	234	85	..	52	214	4·1	68,665	56,616	12,049	17·6	15·1	D.C.	460/230	9·5	..
16. Eketahuna	Borough	1909	874	212	62	5 (W.)	30	..	..	36,795	29,436	7,359	20·0	14·0	D.C.	230	7·0	274
17. Bull's	Town Board	1915	505	152	27	..	22	95	4·3	23,249	18,939	4,310	18·5	12·1	D.C.	230	4.0	..
18. Waiuku	Company	1918	3,000	155	100	30 (G.)	39	192	5·0	33,154	26,522	6,632	20·0	9·8	A.C.	400/230	8.0	..
19. Kaikoura	County	1922	600	72	37½	..	20	47	2·3	34,520	16,755	17,765	51·4	19·7	A.C.	400/230	4·0	..
20. Motueka	Borough	1921	1,500	164	40	12 (O.)	33	74	2·2	33,280	23,475	9,805	29·5	11·5	A.C.	400/230	8·0	..
21. Tamaki West‖	Road Board	1922	1,800	246	50	..	48	192	4·0	46,345	36,193	10,152	21·9	11·0	A.C.	400/230	9·0	..
Totals	..	..	85,447	10,132	3,492	243	2,914	8,667	3·0	6,739,256	4,482,588	1,550,852	23·0	26·4	..	..	304·5	..
Oil Stations.																		
1. Hastings	Borough	1912	10,000	2,149	576	..	432	2,649	6·1	1,202,532	962,026‡	240,506	20·0	31·8	D.C.	460/230	31·0	..
2. Stratford	Borough	1898	9,000	910	210	70 (W.)	165	1,097	6·7	406,849	269,531	137,318	33·8	28·2	A.C.	250/110 S.P.	25·0	27
Totals	..	..	19,000	3,059	786	70	597	3,746	6·3	1,609,381	1,231,557	377,824	23·4	30·8	..	..	56·0	..

* Including tramways. † Last year's figures. ‡ Assessed from incomplete returns. § Assessed by local authority. ‖ In operation eleven months. ¶ Included in Central Power Board from 20th February, 1923.

Note.—Figures in parentheses not included in totals.

TABLE N (*continued*).—SUMMARY OF RETURNS OF OPERATING RESULTS FOR THE YEAR ENDED 31ST MARCH, 1923.

Station.	Capital Outlay at 31st March, 1923.	Gross Revenue.	Working-expenses.*	Capital Charges.†	Total Annual Costs.	Net Result.		Average Revenue.		Working-costs.		Capital Charges.		Total Costs.		Retail Selling-rates.		
						Profit.	Loss.	Per Unit sold.	Per Kw. P.H. Max.	Per Unit sold.	Per Kw. P.H. Max.	Per Unit sold.	Per Kw. P.H. Max.	Per Unit sold.	Per Kw P.H. Max	Lighting.	Heating.	Power.
Steam Stations.	£	£	£	£	£	£	£	d.	£	d.	£	d.	£	d.	£	s. d.	s. d.	s. d.
1. Auckland (lighting) ..	915,228	154,889	76,514	78,991	155,505	..	616	2·73	25·4	1·35	12·6	1·39	12·9	2·74	25·5	0 6	0 4	0 2¼
,, (tramways) ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2. Wellington (lighting) ..	260,466	134,326	96,636	24,860	121,496	12,830	..	4·19	33·1	3·02	23·8	0·77	6·1	3·79	29·9	0 6	0 2	0 3½
,, (tramways) ..	(219,432)	(107,669)	(78,614)	(20,513)	(99,127)	(8,542)	..	2·11	27·1	1·54	19·8	0·40	5 2	1·94	25·0	..	..	0 3½
3. Invercargill	134,470	32,401	16,760	7,561	24,321	8,080	..	3·10	38·1	1·60	19·7	0·72	8·9	2·32	28·6	0 7	0 3½	0 3½
4. Gisborne	53,482	23,430	13,998	2,455	16,453	6,977	..	6·00	45·1	3·58	26·9	0·62	4·7	4·20	31·6	0 9	0 5	0 4
5. Huntly	8,575	2,780	3,299	541	3,840	..	1,060	10·45	60·5	12·40	71·7	2·03	11·8	14·43	83·5	0 9	0 5	0 5
6. Bluff‡	4,449	1,981	1,585	286	1,871	110	..	8·00	49·5	6·40	39·5	1·16	7·2	7·56	46·7	0 7½	..	0 4
7. Kaitangata	620	104	37	..	37	67	..	4·13	..	1·47	..	..	..	1·47	..	0 9	..	..
Totals	1,377,290	349,911	208,829	114,694	323,523	28,064	1,676	3·38	30·1	2·01	18·0	1·11	9·9	3·12	27·9	..	..	..
Gas Stations.																		
1. Napier	91,594	28,289	14,965	6,577	21,542	6,747	..	4·31	40·3	2·27	21·3	1·00	9·4	3·27	30·7	0 7½	0 4	0 4
2. Wanganui	173,533	(2,164)	Included in Tramways Account			..	..	3·22	..	..	..	..	..	..	..	0 5	..	0 4½
3. Ashburton†	36,903	8,858	8,958	960	9,918	..	1,060	6·70	35·0	6·78	35·6	0·72	3·8	7·50	39·4	0 10	..	0 4
4. Timaru	73,740	19,509	12,356	5,728	18,084	1,425	..	6·48	52·0	4·10	32·9	1·90	15·3	6·00	48·2	1 0	0 5	0 5
5. Devonport†	34,376	8,655	8,814	2,408	11,222	..	2,567	4·80	42·4	4·88	43·2	1·34	11·8	6·22	55·0	0 6	..	0 3
6. Feilding	41,224	10,429	5,757	3,794	9,551	878	..	6·41	56·4	3·54	31·1	2·33	20·5	5·87	51·6	0 11	0 4	0 4
7. Te Kuiti	16,002	5,055	3,321	890	4,211	844	..	5·64	46·0	3·71	30·2	0·99	8·1	4·70	38·3	0 10	0 2	0 4
8. Picton	10,299	2,113	1,944	572	2,516	..	403	3·22	35·2	2·96	32·4	0·87	9·5	3·83	41·9	Flat rates.		
9. Pukekohe	26,145	2,254	1,849	1,037	2,886	..	632	6·99	26·8	5·73	22·0	3·22	12·3	8·95	34·3	0 8	0 3	0 3
10. Waitara	9,124	1,977	1,971	512	2,483	..	506	8·83	35·2	8·80	35·2	2·29	9·1	11·09	44·3	0 10	..	0 4
11. Opotiki	6,522	2,774	2,534	240	2,774	..	..	9·35	42·6	8·54	38·9	0·81	3·7	9·35	42·6	0 10	0 5	0 5
12. Winton	4,316	1,050	639	371	1,010	40	..	10·82	36·2	6·59	22·0	3·82	12·8	10·41	34·8	0 9	..	..
13. Ngaruawahia¶ ..	9,076	1,838	1,494	402	1,896	..	58	12·80	..	10·41	..	2·80	..	13·21	..	0 11	0 5	0 5
14. Martinborough ..	10,926	2,036	1,647	507	2,154	..	118	13·60	52·2	11·00	42·2	3·39	13·0	14·39	55·2	0 10	0 5	0 5
15. Pahiatua	10,292	2,026	1,437	1,038	2,475	..	449	8·60	39·0	6·10	27·6	4·40	20·0	10·50	47·6	0 10	0 5	0 4
16. Eketahuna	7,230	1,572	1,406	284	1,690	..	118	12·82	52·5	11·45	46·8	2·32	9·5	13·77	56·3	0 10	0 6	0 6
17. Bull's	6,000	1,325	825	390	1,215	110	..	16·80	60·2	10·45	37·5	4·95	17·7	15·40	55·2	1 3	0 9	0 9
18. Waiuku	15,432	1,243	1,245	257	1,502	..	259	11·25	31·9	11·28	31·9	2·33	6·6	13·61	38·5	0 8	0 4	0 4
19. Kaikoura	8,766	882	1,134	329	1,463	..	581	12·62	44·1	16·25	56·7	4·71	16·4	20·95	73·1	..	..	..
20. Motueka	14,256	1,750	1,703	1,025	2,728	..	978	17·90	53·0	17·40	51·6	10·49	31·1	27·89	82·7	0 10	..	..
21. Tamaki West‖	11,440	1,241	1,056	610	1,666	..	425	8·25	25·9	7·00	22·0	4·04	12·7	11·04	34·7	0 8	0 5	0 5
Totals	617,196	104,876	75,055	27,931	102,986	10,044	8,154	5·61	40·4	4·02	28·8	1·49	10·7	5·51	39·5	..	..	..
Oil Stations.																		
1. Hastings	48,276	19,047	10,821	3,253	14,074	4,973	..	4·75	44·1	2·70	25·05	0·81§	7·53	3·51§	32·58	0 8	0 4	0 3
2. Stratford	25,553	6,845	4,991	2,776	7,767	..	922	6·10	41·5	4·45	30·20	2·47	16·8	6·92	47·10	0 8	0 4	0 5
Totals	73,829	25,892	15,812	6,029	21,841	4,973	922	5·05	43·4	3·08	26·50	1·18	10·1	4·26	36·60	..	..	..

* Includes wages, fuel, and maintenance of generating and distributing system. † Includes interest, depreciation, and sinking fund. ‡ Last year's returns. § Assessed by local authority. ‖ In operation eleven months.
¶ Included in Central Power Board from 20th February, 1923.

NOTE.—Figures in parentheses not included in totals.

Table O.—Electric-supply Stations of New Zealand at 31st March, 1923.

(G = gas; O = oil; S = steam; W = water.)

Station.	Ownership.	Supply commenced.	Population supplied.	Number of Consumers.	Capacity, in Kilowatts.			Units.						Annual Load-factor Percentage.	System of Supply.	Supply Voltage.	Route-miles of Lines.	Static Head, in Feet.
					Main Plant.	Standby Plant.	Maximum Load.	Connected Load.	Diversity Factor.	Generated or purchased.	Sold.	Non-productive.	Percentage Non-productive.					
Hydro Stations.																		
1. Coleridge	P.W. Dept. ..	1915	(201,352)	486	9,000	1,500	9,390	49,343	5·3	43,451,660	37,561,627	5,890,033	13·6	52·8	A.C.	400/230	..	480
Banks Peninsula ..	Power Board ..	1920	3,935	758	Bulk	..	(121)	(713)	5·9	(334,610)	(136,984)	(197,626)	59·1	31·6	A.C.	400/230	183·0	..
Christchurch ..	City Council ..	1904	94,000	17,448	Bulk	750 (S.)	(4,560)	(29,275)	6·4	(17,855,080)	(15,794,810)	(2,063,790)	11·6	44·7	A.C.	400/230	235·0	..
,, ..	Tramway Board	1905	..	..	Bulk	..	..	..	..	(7,360,015)	..	..	..	..	D.C.	550	..	..
Eyre	County ..	1920	1,000	116	Bulk	..	(32)	(176)	..	(111,831)	(89,445)‡	(22,386)	20·0	..	A.C.	400/230	20·0	..
Halswell	County ..	1919	1,743	140	Bulk	..	(80)‡	(173)	..	(131,805)	..	..	20·0	..	A.C.	400/230	22·0	..
Heathcote ..	County ..	1914	4,000	743	Bulk	..	(175)	(693)	4·0	(743,307)	(594,646)‡	(148,661)	20·0	48·5	A.C.	400/230	26·0	..
Kaiapoi	Borough ..	1917	1,800	398	Bulk	..	(98)	(313)	3·2	(370,386)	(296,309)‡	(74,077)	20·0	43·3	A.C.	400/230	10·0	..
Kowai (started Mar.)	County ..	1923	200‡	..	Bulk	..	(18)	(42)	..	(7,040)	..	..	20·0	..	A.C.	400/230	3·0‡	..
Lyttelton ..	Borough ..	1917	3,744	315	Bulk	..	(84)	(447)	5·3	(250,650)	(225,000)	(25,650)	10·3	34·0	A.C.	400/230	9·0	..
Riccarton ..	Borough ..	1916	3,251	556	Bulk	..	(130)	(636)	4·9	(272,797)	(246,626)	(26,171)	9·6	24·0	A.C.	400/230	15·0	..
Rangiora	Borough ..	1919	2,000	280	Bulk	..	(61)	(305)	5·0	(163,989)	(132,044)	(31,945)	19·5	30·7	A.C.	400/230	11·0	..
,, ..	County ..	1918	3,150	236	Bulk	..	(80)‡	(316)	..	(276,366)	..	..	20·0	..	A.C.	400/230	49·0	..
Springs-Ellesmere ..	Power Board ..	1921	5,400	588	Bulk	..	(87)	(724)	8·3	(81,313)	(65,043)	(16,270)	20·0	10·7	A.C.	400/230	90·0‡	..
Sumner	Borough ..	1915	3,250	552	Bulk	..	(75)	(590)	7·9	(363,960)	(291,168)	(72,792)	20·0	55·4	A.C.	400/230	15·0	..
Tai Tapu ..	Company ..	1915	5,000	139	Bulk	..	(180)	(389)	2·2	(423,786)	(339,029)‡	(84,757)	20·0	26·9	A.C.	400/230	37·0	..
Waimairi ..	County ..	1916	12,394	2,319	Bulk	..	(300)	(3,060)	10·2	(1,212,874)	(970,300 §	(242,574)	20·0	46·1	A.C.	400/230	130·0	..
2. Dunedin (Waipori) ..	City ..	1907	75,000	12,745	6,000	860 (O.)	7,489	30,800	4·1	27,273,880*	20,092,361	7,181,519	26·3	41·6	A.C.	400/230	353·0	700
3. Horahora	P.W. Dept. ..	1913	(48,110)	11	6,300	1,500 (S.)	6,900	19,565	2·8	33,775,450	30,030,369	3,745,081	11·1	55·8	A.C.	11,000	125·0	27
Hamilton ..	Borough ..	1913	13,500	1,574	Bulk	..	(360)	(2,099)	5·8	(860,000)	(801,825)	(58,175)	6·8§	27·2	A.C.	400/230	43·0	..
Cambridge ..	Power Board ..	1921	5,000	605	Bulk	..	(229)	(916)	4·0	(519,450)	(413,760)	(105,690)	20·4	25·9	A.C.	400/230	90·0	..
Central	Power Board ..	1921	9,100	970	Bulk	..	(260)	(1,213)	4·7	(657,000)	(452,700)	(204,300)	31·1	28·8	A.C.	400/230	20·0	..
Te Awamutu ..	Power Board ..	1920	9,000	666	Bulk	..	(208)	(981)	4·7	(622,040)	(354,360)	(267,680)	43·0	34·2	A.C.	400/230	240·0	..
Thames Valley ..	Power Board ..	1921	28,721	1,950	Bulk	..	(1,221)	(5,558)	4·6	(3,785,000)	(3,028,000)‡	(757,000)	20·0	35·4	A.C.	400/230	355·0	..
4. Waikaremoana ..	Power Board ..	1923	2,500	425	700	..	536	657	1·2	297,240	239,500	57,740	19·4	25·3	A.C.	400/230	37·0	..
Wairoa	Borough ..	1913	(2,100)	(323)	Bulk	..	(68)	(461)	6·8	(103,635)	(88,095)	(15,540)	15·0	17·4	A.C.	400/230	10·0	..
5. Wairua	Company ..	1916	4,700	29	2,000	..	1,800	..	..	8,872,720	7,278,892	1,593,828	18·0	56·2	A.C.	400/230	31·0	130
Whangarei ..	Borough ..	1915	(4,000)	1,131	Bulk	..	(203)	(1,200)	5·9	(616,360)	(510,473)	(105,887)	17·2	34·7	A.C.	400/230	42·0	..
6. New Plymouth ..	Borough ..	1906	26,000	3,976	800	..	800	3,320	4·2	3,809,510*	2,593,760	1,215,750	31·9	54·5	A.C.	400/230	194·0	120
7. Hawera	Company ..	1903	5,750	1,900	625	135 (O.)	396	1,914	4·8	904,925	678,694	226,231	25·0	26·1	A.C.	400/230	62·0	57
8. Rotorua	Government ..	1901	3,886	903	200	20 (O.)	200	1,096	5·5	729,608	486,953	242,655	31·9	41·6	A.C.	200/115	28·0	14
9. Tauranga	Borough ..	1915	4,656	845	800	..	544	2,193	4·0	2,838,701	2,303,113	535,588	18·8	59·5	A.C.	400/230	68·0	110
Te Puke	Town Board ..	1921	(875)	155	Bulk	..	(46)	(243)	5·3	(110,015)	(93,709)	(16,306)	14·8	27·3	A.C.	400/230	8·5	..
10. Taihape	Borough ..	1912	2,099	400	175	..	190	490	2·6	443,953	354,528	89,425	20·1	26·6	D.C.	460/230	7·0	30
11. Thames	Borough ..	1914	5,000	853	100	105 (O.)	130	860	6·6	360,412	312,819	47,595	13·2	31·6	D.C.	460/230	19·0	130
12. Te Aroha	Borough ..	1906	2,110	476	Bulk	150 (W.)	(136)	(766)	5·6	(231,362)	(217,753)	(13,609)	5·9§	19·4	A.C.	400/230	14·0	560
13. Gore	Borough ..	1905	3,700	829	240	..	151	760	4·6	414,799	376,279	38,520	9·3	31·4	A.C.	400/230	32·0	23

* Including tramways. ‡ Assessed from incomplete returns. § Assessed by local authority.

Note.—Figures in parentheses not included in totals.

TABLE O (*continued*).—SUMMARY OF RETURNS OF OPERATING RESULTS FOR THE YEAR ENDED 31ST MARCH, 1923.

Station.	Capital Outlay at 31st March, 1923.	Gross Revenue.	Working-expenses.*	Capital Charges.†	Total Annual Costs.	Net Result.		Average Revenue.		Working-costs.		Capital Charges.		Total Costs.		Retail Selling-rates.		
						Profit.	Loss.	Per Unit sold.	Per Kw. P.H. Max.	Per Unit sold.	Per Kw. P.H. Max.	Per Unit sold.	Per Kw. P.H. Max.	Per Unit sold.	Per Kw P.H. Max	Lighting.	Heating.	Power.
Hydro Stations.	£	£	£	£	£	£	£	d.	£	d.	£	d.	£	d.	£	s. d.	s. d.	s. d.
1. Coleridge	848,033	69,152	19,270	44,582	63,852	5,300	..	0·44	7·4	0·12	2·1	0·29	4·7	0·41	6·8	..	..	..
Banks Peninsula ..	81,300	3,874	1,810	4,227	6,037	..	2,163	6·78	32·0	3·17	15·0	7·40	34·9	10·57	49·9	0 8	0 3	0 3
Christchurch (C.C.) ..	441,962	109,160	50,872	41,147	92,019	17,141	..	1·66	23·9	0·77	11·1	0·62	9·0	1·39	20·1	0 6	0 3	0 1½
,, (T.B.) ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Eyre	5,500	972	489	323	812	160	..	2·61	..	1·31	..	0·87	..	2·18	..	Flat rates.		
Halswell	7,013	1,020	621	313	934	86	..	..	..	..	..	..	..	..	..	Flat rates.		
Heathcote	17,124	4,415	2,943	484	3,427	988	..	1·78‡	25·2	1·19‡	16·8	0·19‡	2·8	1·38‡	19·6	0 6	0 1½	0 3
Kaiapoi	4,500	2,231	1,485	281	1,766	465	..	1·81	22·8	1·20	15·2	0·23	2·9	1·43	18·1	Flat rates.		
Kowai	..	(49)	..	..	..	..	..	..	Returns	incomplete for first year		..	..	..	..	..	..	..
Lyttelton	5,000	3,612	2,590	750	3,340	272	..	3·85	43·0	2·76	30·8	0·80	8·9	3·56	39·7	0 6	0 1½	0 3
Riccarton	7,809	3,549	2,030	305	2,335	1,214	..	3·46	27·3	1·97	15·6	0·30	2·3	2·27	17·9	0 5	0 1½	0 3
Rangiora (Borough) ..	7,551	2,135	804	784	1,588	547	..	3·88	35·0	1·46	13·2	1·42	12·8	2·88	26·0	0 6	0 3	0 3
,, (County) ..	14,600‡	1,945	1,032	761	1,793	152	..	..	..	..	..	..	..	..	..	Flat rates.		
Springs-Ellesmere ..	57,140	1,650	2,169	..	2,169	..	519	6·10	19·0	8·00	24·9	..	..	8·00	24·9	0 8	0 3	0 3
Sumner	9,716	2,803	1,941	700	2,641	162	..	2·31	37·4	1·60	25·9	0·58	9·3	2·18	35·2	0 6	0 1	0 1
Tai Tapu	7,641	2,490	1,734	693	2,427	63	..	1·76	13·8	1·23	9·6	0·49	3·8	1·72	13·5	Flat rates.		
Waimairi	49,641	12,173	5,460	2,895	8,355	3,818	..	3·01	40·6	1·35	18·2	0·72	9·6	2·07	27·8	0 6	0 3	0 3
2. Dunedin (Waipori) ..	718,028	115,748	37,380	54,226	91,606	24,142	..	1·39	15·4	0·45	5·0	0·65	7·2	1·10	12·2	0 5	0 2	0 2
3. Horahora	395,022	41,819	9,721	25,828	35,549	6,270	..	3·35	6·1	0·08	1·4	0·21	3·7	0·29	5·1	..	..	..
Hamilton	44,034	19,439	9,329	3,802	13,131	6,308	..	5·82	54·0	2·79	25·9	1·14	10·6	3·93	36·5	0 8	0 3½	0 3½
Cambridge	75,000	4,771	3,203	4,640	7,843	..	3,072	2·77	20·9	1·86	14·0	3·03	22·8	4·89	36·8	0 9	0 3	0 3
Central	115,000	8,371	4,063	4,000	8,063	308	..	4·44	32·2	2·15	15·6	3·85	27·9	6·00	43·5	0 9	0 3	0 3
Te Awamutu ..	119,814	7,145	6,276	2,849	9,125	..	1,980	4·84	34·3	4·25	30·2	1·93	13·7	6·18	43·9	0 8	0 3	0 3
Thames Valley ..	333,587	30,632	14,145	20,618	34,763	..	4,131	1·78	18·8	1·12	11·6	2·57	26·6	3·69	38·2	0 8	0 3	0 3
4. Waikaremoana ..	40,000	810	1,070	2,800	3,870	..	3,060	0·81	0·04	1·07	2·0	2·80	20·8	3·87	28·8	..	..	..
Wairoa (Borough) ..	11,600	3,362	1,968	757	2,725	637	..	9·17	49·5	5·36	28·9	2·06	11·1	7·42	40·0	0 10	0 7	0 6
5. Wairua	87,643	11,249	5,005	7,019	12,024	..	775	3·71	6·2	1·65	2·8	2·31	3·9	3·96	6·7	0 5	0 2·7	2 2·7
Whangarei	27,916	8,466	4,190	1,317	5,507	2,959	..	3·98	41·7	1·97	20·6	0·62	6·5	2·59	27·1	0 5½	0 3	0 3
6 New Plymouth ..	266,101	28,252	7,172	16,283	23,455	4,797	..	2·62	35·3	0·66	8·9	1·51	20·3	2·17	29·2	0 7	0 2	0 2
7. Hawera	71,866	18,901	7,003	5,685	12,688	6,213	..	6·69	47·8	2·48	17·7	2·01	14·3	4·49	32·0	0 7·2	0 2·7	0 3·6
8. Rotorua	45,071	8,483	4,319	4,055	8,374	109	..	4·18	42·1	2·13	21·5	2·00	20·3	4·13	41·8	0 6	0 3	0 3
9. Tauranga	66,509	10,470	4,034	3,529	7,563	2,907	..	1·09	19·2	0·42	7·4	0·37	6·5	0·79	13·9	0 7	0 1½	0 2
Te Puke	8,590	1,560	1,054	876	1,930	..	370	4·00	33·9	2·70	22·9	2·25	19·0	4·95	41·9	0 10	0 4½	0 4½
10. Taihape	13,387	4,132	2,296	613	2,909	1,223	..	2·80	21·8	1·55	12·1	0·42	3·2	1·97	15·3	0 8	0 1½	0 2
11. Thames	24,283	6,924	4,128	1,268	5,396	1,528	..	5·31	53·3	3·17	31·7	0·97	9·7	4·14	41·4	0 10	0 3	0 3
12. Te Aroha	15,172	4,418	3,097	1,007	4,104	314	..	4·88	32·5	3·42	22·8	1·11	7·4	4·53	30·2	0 7	0 3	0 3
13. Gore	26,133	7,826	4,745	1,196	5,941	1,885	..	4·99	51·8	3·03	31·4	0·76	8·0	3·79	39·4	0 7	0 3	0 3

* Includes wages, fuel, and maintenance of generating and distributing system. † Includes interest, depreciation, and sinking fund. ‡ Assessed by local authority.

NOTE.—Figures in parentheses not included in totals.

TABLE O (*continued*).—ELECTRIC-SUPPLY STATIONS OF NEW ZEALAND AT 31ST MARCH, 1923—*continued.*

(G = gas; O = oil; S = steam; W = water.)

Station.	Ownership.	Supply commenced.	Population supplied.	Number of Consumers.	Capacity in Kilowatts.			Units.						Annual Load-factor Percentage.	System of Supply.	Supply Voltage.	Route-miles of Lines.	Static Head, in Feet.
					Main Plant.	Standby Plant.	Maximum Load.	Connected Load.	Diversity Factor.	Generated or purchased.	Sold.	Non-productive.	Percentage Non-productive.					
Hydro Stations—continued.																		
14. Reefton	Company	1887	1,400	218	75	103 (S.)	90	..	..	201,600†	161,300	40,300	20·0	25·3	D.C.	230	8·0	27
15. Oamaru	Borough	1918	8,000	940	270	..	222	1,500	6·8	611,736	480,228	131,508	21·5	31·4	A.C.	400/230	28·0	250
16. Inglewood	Borough	1905	1,300	389	120	..	85	744	8·8	214,088	191,156§	22,932	10·7	28·8	A.C.	400/230	10·0	38
17. Patea	Borough	1901	1,700	253	135	..	56	160	2·9	129,000	119,000	10,000	7·8§	26·3	A.C.	100 S.P.	13·0	78
18. Raetihi	Borough	1917	4,500	306	100	..	55	358	6·5	118,912	107,021§	11,891	10·0	24·6	A.C.	400/230	11·0	350
19. Ohakune	Borough	1914	1,670	231	120	..	77	450	5·8	85,192	77,994	7,198	8·5§	12·6	A.C.	400/230	9·0	42
20. Kaponga	Town Board	1916	1,200	177	140	..	32	..	..	52,800‡	42,242	10,558	20·0	18·7	A.C./D.C.	400/230	31·0	31
21. Brightwater	Company	1911	4,000	450	40	40 (G.)	55	240‡	4·4	70,000	60,000§	10,000	14·3	14·5	A.C.	230 S.P.	30·0	10
22. Waverley	Town Board	1916	650	156	40	..	13	90	6·9	30,598	26,607	3,991	13·0	26·8	A.C.	400/230	6·0	60
23. Akaroa	Borough	1911	606	164	30	..	32	..	..	58,008	46,400‡	11,608	20·0	..	D.C.	230	7·0	310
24. Mataura	Borough	1913	1,280	225	75	..	48	..	..	53,137	45,153	7,984	15·0	12·6	A.C.	440/220 S.P.	25·0	23
25. Mangaweka†	Town Board	1913	400	92	45	40 (O.)	30	..	..	183,100	146,480	36,620	20·0	68·5	A.C.	400/230	6·0	37
26. Havelock South†	Town Board	1918	300	50	20	..	19	..	..	29,800‡	23,840‡	5,960	20·0	17·0	D.C.	460/230	2·0	270
27. Hokitika (Kanieri)	Company	1908	2,400	286	700	150 (S.)	460	707	1·5	2,386,514	1,873,980	512,534	21·5	59·2	A.C.	400/230	18·0	250
28. Murchison	County	1921	400	90	80	..	51	103	2·0	96,000	76,800	19,200	20·0	21·5	A.C.	400/230	14·0	105
29. Havelock North	Town Board	1915	1,500	230	176	..	75	..	..	189,605	151,683	37,922	20·0	28·8	A.C.	400/230	16·0	50
30. Whakatane	Borough	1922	1,800	150	240	..	55	..	..	23,054	18,443	4,611	20·0	4·8	A.C.	400/230	..	..
31. Fairlie	County	1922	1,860	117	40	..	14	89	6·4	21,816	17,536	4,280	19·6	17·8	A.C.	400/230	5·5	66
Totals	..	..	380,555	60,037	29,386	5,353	29,995	115,379	3·9	127,727,820	105,974,758	21,753,062	17·0	48·6	..	..	2,873	..

† Last year's figures. ‡ Assessed from incomplete returns. § Assessed by local authority.

NOTE.—Figures in parentheses not included in totals.

TABLE O (*continued*).—SUMMARY OF RETURNS OF OPERATING RESULTS FOR THE YEAR ENDED 31ST MARCH, 1923—*continued*.

Station.	Capital Outlay at 31st March, 1923.	Gross Revenue.	Working-expenses.*	Capital Charges.†	Total Annual Costs.	Net Result.		Average Revenue.		Working-costs.		Capital Charges.		Total Costs.		Retail Selling-rates.		
						Profit.	Loss.	Per Unit sold.	Per Kw. P.H. Max.	Per Unit sold.	Per Kw. P.H. Max.	Per Unit sold.	Per Kw. P.H. Max.	Per Unit sold.	Per Kw. P.H. Max.	Lighting.	Heating.	Power.
Hydro Stations—continued.	£	£	£	£	£	£	£	£	o	£	£	£	£	£	£	s. d.	s. d.	s. d.
14. Reetton	6,763	3,087	3,316	312	3,628	..	541	..	34·3	..	36·8	..	3·5	..	40·3	Flat rates.		
15. Oamaru	42,125	8,338	3,912	2,420	6,332	2,006	..	4·16	37·5	1·95	17·6	1·21	10·9	3·16	28·5	0 9	0 3	0 3
16. Inglewood	10,123	3,540	2,335	510	2,845	695	..	4·45	41·6	2·93	27·5	0·64	6·0	3·57	33·5	0 7	0 2	0 2
17. Patea	8,663	1,866	1,450	412	1,862	4	..	3·76	33·3	2·92	25·9	0·83	7·4	3·75	33·3	0 8½	0 6	0 4
18. Raetihi	17,376	2,583	913	1,110	2,023	560	..	5·79	47·0	2·05	16·5	2·49	20·2	4·54	36·8	0 10	0 3	0 3
19. Ohakune	10,094	2,170	1,111	534	1,645	525	..	6·68	28·2	3·42	14·4	1·65	6·9	5·07	21·4	0 9	0 3	0 4
20. Kaponga‡	13,338	979	422	420	842	137	..	5·60	30·5	2·40	13·3	2·38	13·1	4·78	26·4	0 9	..	0 4
21. Brightwater	13,600	2,000	2,500	..	2,500	..	500	8·0	36·4	10·00	45·5	..	..	10·0	45·5	0 9	0 4	0 4
22. Waverley	5,279	965	500	291	791	174	..	8·70	74·2	4·50	38·4	2·62	22·4	7·12	60·8	0 10	0 6	..
23. Akaroa	7,930	1,614	673	439	1,112	502	..	8·35	50·5	3·48	21·6	2·27	13·8	5·75	34·8	0 7	0 3	0 4
24. Mataura	4,348	1,061	891	120	1,011	50	..	5·65	22·1	4·74	18·5	0·64	2·5	5·38	21·0	0 6	0 2½	0 2½
25. Mangaweka‡	4,894	628	545	205	750	..	122	3·52	20·8	3·06	18·1	1·15	6·8	4·21	24·9	1 0	..	..
26. Havelock South‡ ..	1,932	382	335	88	423	..	41	3·85	20·0	3·38	17·7	0·88	4·6	4·26	22·3	Flat rates.		
27. Hokitika (Kanieri) ..	32,614	4,916	4,098	1,239	5,337	..	421	6·30	10·7	5·25	8·9	1·59	2·7	6·84	11·6	0 6	0 1½	0 3
28. Murchison	13,350	850	400	800	1,200	..	350	2·13	16·7	1·0	7·9	2·0	15·7	3·0	23·6	0 4	0 3	0 3
29. Havelock North ..	23,032	2,695	924	1,484	2,408	287	..	4·3	36·0	1·46	12·3	2·35	19·8	3·81	32·1	0 7	0 4	0 4
30. Whakatane	44,941	(323)	..	..	..	..	..	4·2	5·9	Returns incomplete for first year.				..	..	..	..	..
31. Fairlie	10,489	436	70	557	627	..	191	5·96	31·1	0·96	5·0	7·63	39·8	8·59	44·8	0 9	0 4½	0 4½
Totals	4,340,177	602,069	253,844	271,553	525,397	94,908	18,236	1·36	20·0	0·57	8·5	0·68	9·0	1·19	17·5	..	..	..

* Includes wages, fuel, and maintenance of generating and distributing system. † Includes interest, depreciation, and sinking fund. ‡ Last year's figures.

NOTE.—Figures in parentheses not included in totals.

TABLE P.—AVAILABLE WATER-POWER IN NEW ZEALAND: SCHEMES OF 1,000 HORSE-POWER AND OVER.

Source of Power.	Position of Power-house.	Available Flow: Cubic Feet per Second.	Available Head.	Average Power on 50-per-cent. Load-factor.		Nearest City, Port, or Deep Water.	Distance.
			Ft.	H.p.	Kw.		Miles.
NORTH ISLAND.							
North Auckland District—							
Wairua Falls	Wairua Falls	150*	130	3,200	2,400	Whangarei	18
Omapere	Utakura Stream	11*	550	1,000	750	..	..
South Auckland District—							
Kaituna	Kaituna River	500†	784	65,000	50,000	Tauranga	25
						Auckland	125
Wairoa River	Wairoa	420*	80	5,600	4,200	Tauranga	20
Waikato River	Aratiatia Rapids	4,400†	170	136,000	100,000	Auckland	154
Waikato River	Orakeikorako Rapids	4,400†	35	14,000	10,000	Auckland	148
Waikato River	Aniwhaniwha Falls	4,400†	80	32,000	24,000	Auckland	142
Waikato River	Atiamuri Rapids	4,400†	25	10,000	7,500	Auckland	139
Waikato River	Arapuni Gorge	5,300†	165	163,000	120,000	Auckland	105
Waikato River	Horahora Rapids	5,300†	27	13,000	10,000	Auckland	97
Pokaiwhenua River	Horahora Rapids	165*	170	4,600	3,400	Auckland	97
Marakopa Falls	Marakopa	90	420	3,100	2,300	Te Kuiti	27
Wairere Falls	Wairere Falls	160*	60	1,600	1,200	Te Kuiti	22
Hawke's Bay District—							
Waikaremoana	Upper Waikaretaheke	530†	1,100	97,000	75,000	Gisborne	50
Waikaremoana	Lower Waikaretaheke	530†	360	32,000	24,000	Napier	60
Te Reinga Falls	Te Reinga Falls	124	125	1,300	1,000	Gisborne	35
Waikohu River	Waikohu	45†	847	6,000	4,500	Gisborne	28
Wanganui District—							
Mangawhero River	Raukawa Falls	125	90	1,000	750	Wanganui	45
Mangawhero River	Wanganui River	125	680	7,100	6,950	Wanganui	24
Rangitikei River	Makohine	1,500†	300	75,000	56,000	Wanganui	48
Wangaehu River	Wangahu River	260	70	1,500	1,100	Wanganui	25
Karioi	Karioi	300*	180	8,800	6,600	Wanganui	60
Taranaki District—							
Waitara River	Waitara River	400	140	4,600	3,600	New Plymouth	12
Waiwakaiho	Waiwakaiho	150†	250	6,200	4,800	New Plymouth	4
Manganui River	Waitara River	415†	340	26,000	19,400	New Plymouth	25
Wellington District—							
Mangahao River	Shannon	160†	895	24,000	18,000	Wellington	65
Makuri River	Makuri Gorge	100*	384	6,400	4,800	Pahiatua	20
Waiohine	Woodside	120*	120	2,400	1,800	Masterton	15
Hutt River	Mungaroa	200†	330	11,000	8,300	Wellington	24
Tauherenikau	Featherston	150*	440	11,000	8,300	Wairarapa	..
Kourarau	Kourarau	20	755	2,680	2,000	Masterton	12
Totals—North Island	..	..	..	776,080	582,650		
SOUTH ISLAND.							
Marlborough District—							
Clarence	Ericaburn	640	158	8,300	6,300	Blenheim	45
Waihopai River	Waihopai Gorge	130*	96	2,000	1,500	Blenheim	28
Nelson and Buller District—							
Boulder Lake	Aorere River	50*	2,600	22,000	16,000	Golden Bay	10
Rotoiti Lake	Buller River	200†	600	20,000	15,000	Nelson	50
Rotoroa Lake	Gowan River	900†	400	60,000	45,000	Nelson	60
Inangahua River	Blackwater River	78	125	8,000	6,000	Westport	20
Four-mile Creek	Four-mile Creek	24*	450	2,000	1,500	Westport	4
Westland District—							
Lake Brunner	Stillwater	1,750	200	29,000	22,000	Greymouth	10
Kumara Water-race	Kumara	87	330	2,400	1,800	Greymouth	12
Otira River	Otira	40	700	2,300	1,700	Greymouth	52
Rolleston River	Otira	36	700	2,000	1,500	Greymouth	52
Kanieri Lake	Kanieri River	100	330	2,800	2,100	Hokitika	12
Toaroha River	Toaroha River	150	760	10,000	7,500	Hokitika	17
Whitcombe River	Hokitika River	250	800	16,000	12,000	Hokitika	20
Kakapotahi River	Kakapotahi River	100	580	4,800	3,600	Hokitika	26
Wanganui River	Hende's Ferry	830	580	40,000	30,000	Hokitika	36
Wataroa River	Wataroa	1,360	700	80,000	60,000	Hokitika	48
Canterbury District—							
Clarence River	Jollie's Pass	200	1,160	20,000	15,000	Christchurch	90
Clarence River	Conway River	1,150	1,050	100,000	75,000	Christchurch	90
Waiau-ua River	Culverden	1,600	200	27,000	20,000	Christchurch	75
Waimakariri River	Gorge Bridge	1,000*	90	15,000	11,000	Christchurch	30
Waimakariri River	Otarama	1,000*	150	30,150	22,500	Christchurch	42
Lake Coleridge	Rakaia River	100†	480	8,000	6,000	Christchurch	65
Acheron River	Rakaia River	50†	480	4,000	3,000	Christchurch	65
Harper River	Rakaia River	320†	480	25,000	18,000	Christchurch	65
Wilberforce River	Rakaia River	1,100	480	44,000	33,000	Christchurch	65
Rakaia River	Gorge Bridge	2,600	30	6,500	4,800	Christchurch	50

TABLE P.—AVAILABLE WATER-POWER IN NEW ZEALAND—*continued.*

Source of Power.	Position of Power-house.	Available Flow: Cubic Feet per Second.	Available Head.	Average Power on 50-per-cent. Load-factor.		Nearest City, Port, or Deep Water.	Distance.
	SOUTH ISLAND—*continued.*						
Canterbury District—continued.			Ft.	H.p.	Kw.		Miles.
Lake Heron	Rakaia River ..	300	200	4,000	3,000	Christchurch ..	88
Opihi River	Opihi Gorge ..	200	400	6,700	5,000	Timaru ..	30
Pukaki Lake	Pukaki	5,000†	460	50,000	37,000	Timaru ..	85
Tekapo Lake	Fairlie	5,100†	900	400,000	300,000	Timaru ..	40
Ohau Lake	Waitaki River ..	5,000†	300	125,000	90,000	Timaru ..	85
Otago and Southland District—							
Ahuriri River	Waitaki River ..	600	200	10,000	7,500	Oamaru ..	62
Waitaki River	Waitaki River ..	15,000	30	37,000	28,000	Oamaru ..	60
Waipori Falls	Waipori River ..	230†	700	26,800	20,000	Dunedin ..	30
Lee Stream	Outram	15*	750	1,800	1,300	Dunedin ..	18
Deep Stream	Taieri River ..	110	900	8,400	6,300	Dunedin ..	20
Taieri River	Deep Stream ..	700	220	12,000	9,000	Dunedin ..	44
Talla Burn	Clutha River ..	30	890	2,200	1,600	Dunedin ..	60
Teviot River	Roxburgh ..	100†	1,900	30,000	21,000	Dunedin ..	90
Manuherika River ..	Chatto Creek ..	200	350	5,800	4,400	Dunedin ..	127
Hawea Lake	Wanaka Lake ..	2,500†	205	80,000	60,000	Dunedin ..	170
Shotover	Wakatipu Lake ..	500	250	10,000	7,500	Invercargill ..	112
Lake Hall	Doubtful Sound ..	220	2,625	48,000	36,000	On seaboard ..	..
Lake Cecil	Lake Te Anau ..	200	900	15,000	11,200	On seaboard ..	..
Lake Hilda	Lake Te Anau ..	1,550	1,190	55,000	41,080	On seaboard ..	..
Lake Te Anau	George Sound ..	12,630	694	1,600,000	1,200,000	On seaboard ..	..
Lake Manapouri	Smith Sound ..	8,400†	600	840,000	630,000	On seaboard ..	..
Bowen Falls	Milford Sound ..	700	600	35,000	25,000	On seaboard ..	..
Lake Monowai	Waiau River ..	500†	160	16,000	12,000	Invercargill ..	60
Lake Hauroto	Tewaewae Bay ..	2,300	514	100,000	75,000	Invercargill ..	51
Totals—South Island	..	..	..	4,109,950	3,073,680		

* Signifies daily storage available to utilize 50-per-cent. load-factor. † Signifies seasonal storage made available.

APPENDIX E.

ARTHUR'S PASS TUNNEL.

EARLY EXPLORATION AND CONSTRUCTION.

NEXT to a prolific soil and the possession of great natural resources otherwise there is no adjunct of material progress that is so generally important and exercises so vital an influence on national characteristics as the growth of the railway system. This being so, the Dominion of New Zealand may fairly claim to be supplied with the principal requirements for well-being and prosperity, inasmuch as nature has provided the former and the enterprise of its inhabitants has attended to the latter.

Among the colonists in the early days of New Zealand there were many who had a keen perception of the advantages that would attend the introduction of railways into the new country they were helping to found. The progress of colonization was, however, naturally somewhat slow in those days, and it was not until 1860 that a contract was let for the construction of the first New Zealand railway: this was between Christchurch, the chief town of Canterbury, and Lyttelton, its seaport. Since then railway-construction has progressed as rapidly as the financial position of the country and the great natural obstacles encountered have allowed. At the present time there are about three thousand miles of line open for traffic, and a large number of new lines under construction.

In the Middle Island of New Zealand (or South Island, as it is more commonly called) the great obstacle to railway communication between the fertile plains of Canterbury, with its port, Lyttelton, on the east coast, and the timber and coal lands of Westland on the west coast, has been the high mountainous ranges of the Southern Alps, which run parallel with the east and west coasts. The South Island is roughly about five hundred miles in length, with an average width of probably one hundred and twenty miles, and it is divided for almost its entire length by this alpine range. Some of the summits of the range reach a height of from 10,000 ft. to 12,000 ft. Mount Cook, the highest point, rising to 12,349 ft.

From the earliest days of colonization the question of railway communication between Christchurch, on the east coast, and Greymouth, on the west coast, had attracted great attention, more especially among the residents of Canterbury and Westland. Greymouth is a bar harbour, difficult to work, and seldom if ever visited by steamers from Europe or America; but Lyttelton, the port of Christchurch, is a common port of discharge and loading for such vessels.

Surveys and explorations for the purpose of ascertaining the best route over the mountain-ranges were put in hand at an early date. In 1864 Mr. Arthur Dudley Dobson made a survey for a road over the mountains from Christchurch to Greymouth. This was taken over a pass called "Arthur's Pass," in his honour, and runs down the famous Otira Gorge. The survey of this road and its

subsequent construction enabled a considerable amount of useful information to be collected in furtherance of the projected railway.

Between 1878 and 1883 numerous surveys of proposed routes were made, the most notable being the Cannibal Gorge route, running from Culverden, in Canterbury, to Reefton, in Westland; the Hurunui Gorge route, from Waikare to Jackson's; and the Arthur's Pass route, running from Springfield, in Canterbury, to Stillwater, near Greymouth. In 1883 a Royal Commission was set up by Parliament to decide on the best route for the proposed railway, and the Arthur's Pass route was finally adopted.

The line from Christchurch had already been constructed as far as Springfield, and from Greymouth to Springfield the route was roughly as follows: It ran from Greymouth up the valley of the Grey River to Brunnerton and Stillwater Junction, and thence up the Arnold, and round the north-eastern side of Lake Brunner, through a natural depression, into the Teremakau Valley; up the Teremakau River and its tributary (the Otira) to Otira; from Otira over Arthur's Pass to Bealey Flat (or "Arthur's Pass," as it is now generally called); from Bealey Flat down the Bealey Valley to the left bank of the Waimakariri River, then crossed to the right bank, which is descended as far as the Cass River, where it left the river and made for the saddle of Mount St. Bernard, whence it descended by the long valley of Slovens Creek to the Waimakariri Gorge; thence down this Gorge to Springfield, and across the plains to Christchurch.

At that time the intention was to construct the line on a 1-in-15 grade over Arthur's Pass, using a centre-rail, Fell system. The summit of Arthur's Pass is about 3,000 ft. above sea-level.

As soon as the Arthur's Pass route was finally adopted, several influential New Zealand gentlemen formed what was known as the Chrystall Syndicate, to push ahead with the construction of the Midland Railway, as it was now generally called. They entered into various railway-construction contracts with the New Zealand Government. In 1886 the Chrystall Syndicate was merged into the Midland Company, with a capital of £500,000.

The New Zealand Midland Railway Company (Limited) was what is generally known as a land-grant railway-construction corporation, similar to the great railway companies of Canada, and was founded in England by a syndicate who took over the contracts of the Chrystall Syndicate. Those contracts were subsequently annulled, and a new one, dated 3rd August, 1888, was entered into between the New Zealand Government and the Midland Company. That contract provided, among other matters, that the company should contruct a line from Springfield, in Canterbury, to Brunnerton, near Greymouth, in Westland.

As an inducement to the company to build the railway, all Crown lands remaining at the time of the signing of the contract in the provincial districts of Canterbury and Westland and Nelson (aggregating about 6,000,000 acres, and of an estimated value of £3,150,000) were earmarked and cut up into blocks, each block being valued in a schedule attached to the contract, and none at less than 10s. per acre. The entire line was divided into sections for the purpose of allocating the proportionate estimated cost of the construction of each particular section; the company, upon completion of a section, being enabled to select blocks of land, upon the basis of 10s. worth of land for each £1 spent upon the construction of the railway.

Between 1886 and 1895 work proceeded vigorously, but when about thirty-five miles of the line had been completed the physical difficulties to be overcome were found to be so great that the company shrank from attempting the apparently impossible, and accordingly the ambitious idea was abandoned. The result was that the Government took the railway over and determined to penetrate the mountain-chains at all hazards.

From 1895 construction work was pushed ahead on both sides of the mountain-ranges, and in 1900 a committee of engineers was set up to consider the best means of crossing the actual dividing-range—whether to adhere to the original proposal of a 1-in-15 grade over the range, or to have a long summit-tunnel. The committee decided in favour of a summit-tunnel about six miles long, with a grade of approximately 1 in 37.

In 1902 Mr. V. G. Bogue, an eminent American engineer, was called in by the New Zealand Government, and after considerable investigation recommended a line with a shorter summit-tunnel on a grade of 1 in 32. As he considered a line with a summit-tunnel on such a steep grade was quite suitable, further surveys were made, and a line with summit-tunnel on a grade of 1 in 33, and in its present position, was finally located. This proposal was submitted to Mr. Bogue, who confirmed the recommendations of the local engineers, and it was finally decided to adopt this route.

The eastern end of the tunnel is at the summit of the line between Christchurch and Greymouth, and is in the valley of the Bealey River, near what is now known as Arthur's Pass Station; and the western end is in the gorge of the Rolleston River, about three miles and a half above Otira Station. Otira is about fifty-two miles from Greymouth, and Arthur's Pass is about eighty-five miles from Christchurch.

The location of the tunnel having been decided, final surveys were at once made for the purpose of carrying out the construction. A line was ranged out over the mountains from one end of the tunnel to the other, a series of trigonometrical stations were established, and precise levels were carried from one side to the other. Owing to the mountainous nature of the country and the severe weather experienced at times, the whole of this work was carried out under extremely trying and difficult conditions; but, as will be seen later, it was done with extreme accuracy.

The surveys completed, plans and specifications were prepared, and on the 12th August, 1907, a contract was let to Messrs. J. H. McLean and Sons for the sum of £599,794, the time for completion being fixed at five years—a very optimistic estimate as events transpired.

In April, 1908, the work of driving the bottom heading was commenced at the Otira end; and on the 5th May, Sir J. G. Ward, as Prime Minister, fired the first shot at the official opening of the work. On the 1st July, 1909, the bottom heading at the Arthur's Pass end was commenced.

After spending about £250,000 on plant and material, and making great efforts to proceed with the work, the contractors found that they could not possibly finish the work for the contract price. They informed the Government accordingly. A parliamentary Committee looked into the whole position before releasing Messrs. McLean and Sons from the contract, and came to the conclusion that, as the Arthur's Pass Tunnel was a national work which ought to be completed, fresh tenders should be called, and the Public Works Department be instructed to continue the work meanwhile. It was fairly evident that no private contractors would face the task which the original contractors had found so difficult; consequently the responsibility for the work was shouldered by the Public Works Department, which has now brought it to finality.

The summit-tunnel, though the most notable work on the line, is but one of many notable works, for the bridges and shorter tunnels compel just as much attention. To give some idea of their frequency and character it may be mentioned that, in a short length of nine miles, there are three high steel viaducts, one of which carries the rails 236 ft. above the floor of the gorge, and no less than seventeen short tunnels, the longest of which is about 2,000 ft.; while there is scarcely a mile of level in the whole line. A tremendous amount of work has also been done in protecting the railway embankments from mountain-torrents, which run at a terrific pace in flood-time.

The exact length of the tunnel is 5 miles 554 yards, all on the straight, with a grade of 1 in 33, or 2 ft. per chain, rising from about 1,585 ft. above mean sea-level at the western end to a height of 2,435 ft. above mean sea-level at the eastern end—a rise of 850 ft. It will carry a single-track line of 3 ft. 6 in. gauge, which is the standard gauge of the New Zealand Government railways. In cross-section the clear height above rail-level is 15 ft. 6 in., with a maximum width of 15 ft. The tunnel is lined throughout. The side walls and footings are of mass concrete, and the arch is formed of concrete blocks. Except where the ground is very bad the mass concrete is carried part way up the arch, and only a few rows of blocks are used.

The tunnel is in solid rock except for a few hundred feet at the portals. Those who expected some interesting geological discoveries as a result of the big drive through the range have been disappointed. The rock was found to be monotonously alike right through, varying only in degree of hardness. The rock lies on its edge in more or less vertical beds of greatly varying thickness, whose strike is more or less parallel to the tunnel. The rock is jointed in all directions and is fissured badly. It is of such a nature that explosives can be used to great advantage; but it is gritty and hard on the drill-steels used for boring the holes for blasting. In places it changes abruptly from extremely hard sandstone to medium sandstone and indurated slaty shale. Some of the rock was so hard that the greatest difficulty was experienced in hardening the drill-bits so that they would stand the wear and not break. The greater part of the tunnel was, however, fair boring.

Temporary timbering was used throughout to prevent flaking of the rock-surface, and fairly heavy timber was necessary in some of the worst places where faults in the rock-structure were encountered. The ground was sometimes dry, commonly wet, and occasionally very wet; but the tunnel was pierced without striking any very great volume of water necessitating special methods such as were employed in the construction of the Simplon and other long tunnels. The greatest flow of water was about 3,000 gallons a minute, but as the lining was completed this was considerably reduced, and the present flow is about 1,500 gallons a minute.

The greater part of the work was done uphill from the lower or western end, on account of the assistance of the grade in getting rid of the excavated material, and because of the heavy pumping required to drain the tunnel at the eastern end until the headings met.

The excavation was carried out by the bottom-heading method, followed by enlargement to full section: *i.e.*, a bottom heading or drive about 8 ft. high and 10 ft. wide was first driven; when this had advanced far enough a top heading was driven, followed by the breaking-down and excavation of the arch, walls, and footings. This method allowed more men to be employed in the workings than if the tunnel had been excavated in one face, and is in general use, except that sometimes the top heading is driven first. The best average rate of excavation was 13½ ft. per day for twelve consecutive working-days. The headings were timbered as required, and when the full section was excavated it was also timbered and lagged ready for concreting. The concrete lining of the tunnel was kept as close to the full-section excavation as possible. All concrete was machine-mixed, and was in the proportion by volume of one part of cement, two parts of sand, and five parts of shingle. The concrete blocks in the top of the arch were made outside the tunnel, and allowed to mature for three months before use when possible.

About half the stone for concrete aggregate was obtained from rock excavated from the tunnel, and the remainder from deposits near each end of the tunnel. Good sand was scarce, and grinding-machinery was used for a time at one end. Most of the stone and sand obtained outside the tunnel had to be washed, and the cost of the concrete aggregate was high.

The drilling of the holes for blasting was all done by drills operated by compressed air. Two or three drills were used in each of the headings, and others elsewhere as required. The compressed air was conveyed to the working-faces by a 5 in. main at one end and a 6 in. main at the other end.

Power for the air-compressers, for lighting purposes, for driving the electric-mine locomotives, and for driving the miscellaneous machinery was obtained from hydro-electric plants at each end of the tunnel. At the western end the plant generated 600 horse-power at 500 volts, direct current. The plant at the eastern end was of similar capacity; and before the bottom headings met, power for operating the pumps for pumping water out of the eastern bottom heading had to be supplied by the plant, in addition to the power required for compressors, locomotives, lighting, &c.

The haulage of trucks from the working-faces to the completed part of the tunnel was effected by means of compressed air-driven winches and wire ropes. The haulage of the excavated material from the completed parts of the tunnel, and the haulage of timber, concrete, &c., into the tunnel, was done by means of 10-ton electric mine-locomotives. These ran on a 2 ft. 6 in. gauge line, and in the completed portions of the tunnel power was taken from a bare overhead trolly-wire, in the usual way.

As these locomotives often worked beyond the completed portions of the tunnel, each locomotive was fitted with a drum carrying an insulated cable, and a rewinding motor and brake. The cable was hooked to the end of the trolly-wire, and enabled the locomotive to run 1,300 ft. beyond it. This enabled the locomotive to run right up to the working-faces if necessary, and avoided the difficulty and danger of providing a suspended bare trolly-wire in the uncompleted part of the tunnel.

In a tunnel five miles and a quarter long adequate ventilation is absolutely necessary. In the Arthur's Pass Tunnel ventilation was effected by a system of exhausting the air from the working-faces, pure air being thus induced through the completed part of the tunnel. A Roots blower having a capacity of 4,000 cubic feet per minute was installed at each end if the tunnel, the air being exhausted through a 16 in. riveted steel pipe, which extended to the completed parts of the tunnel. At the Otira end, as the working-face advanced, the blower at the end of the tunnel was found to be insufficient, and a "booster" blower was installed about a mile and a half from the tunnel-portal. The working-faces were further ventilated by the exhaust air from the air-drills. When the work was first started ventilation was effected by releasing compressed air at the face, thus driving out the impure air along the tunnel. This meant the fouling of the line along which spoil had to be hauled, and a change to the exhaust system was made by the Public Works Department.

Lighting outside and in the finished parts of the tunnel was by electric incandescent lamps, using two 250-volt lamps in series at each point. This voltage was too high for lighting in tunnel working-places, and miners' acetylene hand-lamps were there used, one to each man.

At both ends of the tunnel water for drilling, drinking, &c., was supplied to all faces. The men employed at the tunnel were housed, and change-rooms, baths, drying-rooms, &c., were provided at the portals. A hospital was erected and equipped at Otira, and at the Arthur's Pass end arrangements were made for special trains in case of accidents.

The progress of the work was slow, and the estimated time for completion, and also the estimated cost, were considerably exceeded. A large part of the work was done during the war period. Wages rose 50 to 60 per cent. The cost of the material was in some cases more than doubled; cement, for instance, rose from £4 per ton to £9 and £10 per ton, and was at times almost unprocurable. In fact, on one occasion the concreting-work had to be stopped for a short time as no cement was available. The supply of skilled underground workers was never equal to the demand, and, although good wages were paid, the works were never more than half-manned. In parts the rock proved much harder than was anticipated, and at different times falls of rock at the parts previously mentioned delayed the work.

As previously stated, the work was taken over from the contractors by the Public Works Department in December, 1912. At that time the bottom headings had been driven for a length of two miles and a third, and the tunnel was completed and lined for about a mile and three-quarters. From that time steady progress was made. On the 7th May, 1918, the men at the Arthur's Pass end of the tunnel heard the sound of the firing of the charges used in the bottom heading at the Otira end. Keen interest was aroused; and on the 29th June the sound of the rock-drills working on the face at the Otira end was heard by the Arthur's Pass workers, who were about 200 ft. away. Shortly after this, on the 20th July, the bottom headings met—3 miles 68 chains 10 links having been driven from the Otira end, and 1 mile 37 chains 0·8 links from the other end.

The meeting of the headings showed that the surveys had been made and the tunnel driven with remarkable accuracy: the difference between the actual length and the calculated length was 36 in., the difference in level was only $1\frac{1}{8}$ in., and the alignment was extremely accurate, being only $\frac{3}{4}$ in. out. By way of comprison: In the Mount Cenis Tunnel, seven miles and a half long, the error in direction was found to be nil, the error in levels to be 1 ft., and the actual length to be 15 ft. in excess of the calculated length.

On the 21st August, 1918, the final barrier in the bottom heading was shot away by a charge fired by Sir William Fraser, then Minister of Public Works; and about three years afterwards the whole of the excavation and lining was completed.

Arthur's Pass Tunnel is the seventh-longest tunnel in the world, and the longest in the British Empire.

Serious and fatal accidents have been few: there have been occasional falls of rock, as mentioned above, delaying the work and increasing the cost. At the east end, for 1,000 ft. or more from the portal, the tunnel runs close to the river, under a steep hillside, and with very little cover in places. In May, 1910, at a point where the arch was within 30 ft. of the surface, and the roof was very thin rock covered with clayey gravel, the weight of ground broke through the timbering of completed excavation for 50 ft. along the tunnel and ran to the surface. Some men were caught in this fall, one of whom died later. Two men, free and unhurt, were imprisoned in the bottom heading beyond the break for four days, while an adit was driven from the river side to get them out. Conversation with them was carried on through the 5 in. air-main, through which also they were provided with dry clothes and food. They were none the worse for their experience.

Owing to the steep grade and the difficulty of dealing effectively with the smoke from steam-locomotives, it was decided to electrify the tunnel. Several schemes were considered—hydro-electric power against steam for the generating plant; the electrification of a considerable length of the line on each side of the tunnel; the electrification of the tunnel only; and several other alternatives. It was finally decided to electrify the track from Otira to Arthur's Pass, a distance of about eight miles and three-quarters.

The generating plant is to be steam-driven, and the power-house is at Otira. The system which is to be used is 1,500 volts direct current, overhead contact. Three marine-type water-tube hand-fired boilers are installed, and the generating-sets consist of two geared turbine-driven generators of 1,600 kilowatts capacity. In the future, when power becomes available, it is intended to link up the line with the hydro-electric system, and to use the steam-plant as a stand-by.

The power-house was built by the Public Works Department. The construction of the reservoirs and pipe-lines for the water-supply for the power-house, and the laying of the rails for the electrified portion of the line, were also carried out by the Department.

Two contracts were let for the rest of the work—one for the installation of the boilers, and another for the prime movers and the electrical equipment. The electrical-equipment contract included the supply and installation of the generating-sets, locomotives, and all overhead work.

Climatic conditions have been against the rapid completion of the electrical work. The summit of the line is 2,435 ft. above sea-level. Otira is at an elevation of 1,260 ft. above sea-level. The rainfall is very high, the average annual rainfall being 195 in. or over 16 ft. Considerable snow also falls during some winters, a fall as much as 5 ft. having been experienced at Otira.

Temperature records have been kept near the tunnel-portal at the Otira end. The lowest temperature record was 11° Fahrenheit, and the highest 82° Fahrenheit. The thermometer remained below freezing-point for one period of thirty-six consecutive days (thermometer outside in the shade).

In addition to the extreme cold and the intense rainfall, gales of great violence occur in the district.

Notwithstanding the difficulties which have had to be overcome, and the adverse climatic conditions, the electrical work is practically completed, and it is hoped to have trains running regularly through the tunnel in a few months' time.

APPENDIX F.

ARTHUR'S PASS TUNNEL.

ELECTRIFICATION.

THE electrification of the tunnel having been decided upon, various sources of power were investigated, and the choice fell on steam; though eventually it is probable that the State hydro-electric lines will pass near the power-house, when motor generators will be installed, and the steam be used only as a stand-by.

The plant consists of three Babcock and Wilcox marine-type water-tube boilers, with 3,020 sq. ft. of heating-surface. Grate area, 89¼ sq. ft.; superheater heating surface, 590 ft.; pressure, 250 lb. per square inch. Each boiler evaporates normally 13,500 lb. per hour from feed at a temperature of 100° F. to steam at 250 lb. pressure, and when working at that rate the superheater will raise 95 per cent. of the steam to a final temperature of about 530° F. This is for use in the main turbines, the other 5 per cent. being taken by the feed-pumps, fan-engines, &c. Each boiler and superheater will for short periods be capable of an emergency capacity of 19,000 lb. per hour. The performance above is based on coal of a calorific value of 12,000 B.Th.U. per pound, and the use of mechanical-induced draught. The chimneys, one for each boiler, are 60 ft. above grate-level, of mild steel, $\frac{3}{16}$ in. and ¼ in. thick, 4 ft. diameter.

The main steam range is 6 in. bore, so arranged that steam can be taken from any or all boilers to either or both of the main turbines, through two reducing-valves which reduce the pressure from 250 lb. to 160 lb. Should either of the valves fail, the whole station can be operated through the other while the defective one is shortcircuited and repaired. The whole of the main steam pipes and valves are covered 2 in. thick with plastic magnesia non-conducting composition, and the auxiliary steam and exhaust piping with 1½ in. of same. The whole of lagged work is enclosed by painted canvas.

The power-house plant consists of—

(*a.*) Two steam turbines, horizontal-impulse type, rated 1,600 kw. with a 50-per-cent. overload capacity, 3,000 r.p.m., steam-consumption 14·26 lb. per kilowatt.

(*b.*) Two sets of double helical reduction gearing, 3,000 to 450 r.p.m., with special forced lubrication.

(*c.*) Two D.C. generators, 1,650-volt, 1200 kw. normal rating, but capable of giving 25 per cent. overload for two hours, 50 per cent. for thirty minutes, 100 per cent. for five minutes with 94 per cent. efficiency; temperature-rise after six hours, 40° C. The exciters are 15 kw., 110 volts.

(*d.*) Two surface condensers maintaining 29 in. vacuum when supplied with 3,000 gallons per minute of water at 50° F., and dealing with 22,500 lb. of steam per hour.

(*e.*) Two sets compound high-speed engines, 100 kw.

(*f.*) Two 125 K.V.A. alternators, twelve poles, 2,200 volts, 25 per cent. overload for two hours and 50 per cent. momentarily; efficiency, 91 per cent.; temperature after six hours full load, 40° C., or 25° C. above surrounding air.

(*g.*) One surface condenser to deal with exhaust from either of lighting-sets (*e*, *f*), and maintaining vacuum 26 in. with 210 gallons of cooling-water per minute.

(*h.*) One negative booster driven by interpole-type motor operating on 1,650-volt D.C. supply; separate exciter on same shaft, 110 volts; the booster D.C. interpole type arranged for voltages from 0 to 225. Combined sets, 25 per cent. overload, two hours; 50 per cent., thirty minutes; and 100 per cent. momentarily; temperature, 25° C. above surrounding air.

(*i.*) One battery booster consisting of induction motor driving two D.C. generators arranged in tandem (similar overload capacity).

(*j.*) Two 70 kw. station transformers; primary, 2,200 volts; secondary, 400 volts; with neutral brought out giving 230 volts for lighting purposes; efficiency, 97·87 per cent.

(*k.*) One overhead crane, 10 tons, electrically operated from cage: three motors. Also a full set of switching-apparatus and the usual auxiliaries.

In the workshop, which is part of the main power-house building, there is one overhead crane, 15 tons, 3-motor; one armature turning-lathe; one banding reel and brake for holding banding-wire for armature; and a set of the usual drilling, turning, grinding, and forging machine tools.

The power-house is built of reinforced-concrete framing and concrete-block panelling; steel roof in boiler-house and main turbine-room, and wood and steel roofs over balance; galvanized corrugated-iron roofing covers the whole. The battery locomotive compartment is all of concrete, and completely cut off from rest of building. The locomotive sheds are fitted with inspection-pits throughout, the rails being supported on cast-iron pedestals, 10 in. high, for light and general convenience. All pits are wired for lighting; this does away with long lengths of flexible cord.

The overhead work in the open is of the double catenary type as used on the London, Brighton, and South Coast Railway. In the Otira station-yard the catenary wires are steel, but on the main line they are of copper, each 37/13 S.W.G. stranded 0·25 sq. in. section. The contact wire is 6/0 S.W.G. grooved and suspended every 15 ft. to catenary. Every 300 ft. there is also a feeder of 37/15 to contact wire. In the tunnel a single catenary of $\frac{1}{2}$ sq. in. stranded copper is used, supported every 60 ft.

A positive feeder of 0·5 sq. in. is used, bonded every 300 ft. to catenary in open and every half mile in tunnel. This feeder is bare in open and lead-covered in tunnel.

The negative feeder connected to negative booster is 1 sq. in. in section, carried as two bare cables, 0·5 sq. in. each, on same poles as positive feeders, and as one lead-covered cable in tunnel, and it ends 5·2 miles from the power-house, where it is bonded to the rails. A pilot wire, 7/18 S.W.G., is carried throughout for purpose of measuring rail-drop. Two copper bonds, 4/0 B. & S., are used at each rail-joint, and cross-bonds between adjacent tracks at every structure. These are connected to the bracket-arms on poles, or to cross-girders for earthing purposes. All metal-work of insulators and pins, &c., is earthed to rail, both in tunnel and outside.

The tunnel is lighted throughout, the primary conductors being 19/·064 in. diameter hard-drawn copper in open, connecting to two lead-covered cables in tunnel, supplying 9 single-phase transformers, $2\frac{1}{2}$ K.V.A., 2200/250, in tunnel. Each transformer supplies approximately 4,400 ft. of tunnel. There are two low-tension circuits; each supply a 60-watt lamp in bulkhead fitting every 165 ft., so that there is a lamp every $82\frac{1}{2}$ ft. One circuit burns continuously; the other can be switched in as required for inspection. There are also plug-sockets for attaching flex cords with cluster light for the use of repair gangs.

The H.T. cable supplying current for main lighting also serves Arthur's Pass yard and buildings; this is comprised of 0·025 three-core high-tension, paper-insulated, lead-covered, to carry 37 kw. at 2,200 volts.

The locomotives, five in number, are of the 0–4–4–0 type, weight approximately 50 tons, giving $12\frac{1}{2}$ tons per axle. Only one type is installed, the idea being to reduce number of spares and simplify operation, maintenance, and overhaul. One will be utilized for passenger-trains and two for freights. The contract loads are 280 long tons for freight-train at 15·35 m.p.h., and for passenger 138 tons at 17·35 m.p.h. up hill and 24·8 m.p.h. down.

There are four driving-axles, giving 100 per cent. wheel-adhesion; each axle mounts one 170 b.h.p. (one-hour rating) 750-volt motor with single reduction spur-gear drive, 15/68; this gives an acceleration of 0·5 ft. per second on the 3·03-per-cent. grade with a trailing-load of 140 tons.

The control is of the Zwiegberg multiple-unit cam-shaft operated type, and enables two or more coupled locomotives to be operated by a single crew; current to operate the controls, 110 volts, is supplied by a rotary transformer and by an emergency storage battery. The main motors are fan-cooled. There are four systems of braking: (1) Westinghouse automatic; (2) Westinghouse non-automatic, for locomotive alone; (3) hand-brake, independent of Westinghouse brake rigging; (4) rheostatic electric brake.

In addition to the main-line locomotives, there is also a shunting and inspection storage-battery-operated locomotive, 50 tons in weight, carrying half its ironclad oxide battery on a tender. This locomotive is 0–4–4–0 type, central cab. Each half of battery, 400 volts, can be used separately, and they are interchangeable. Locomotive is to haul 40 tons up grade at 8·5 m.p.h. Each half-battery is rated as follows:. Discharged in 5 hours, 387 ampere-hours; discharged in 1 hour, 252 ampere-hours; discharged in $\frac{1}{2}$ hour, 198 ampere-hours.

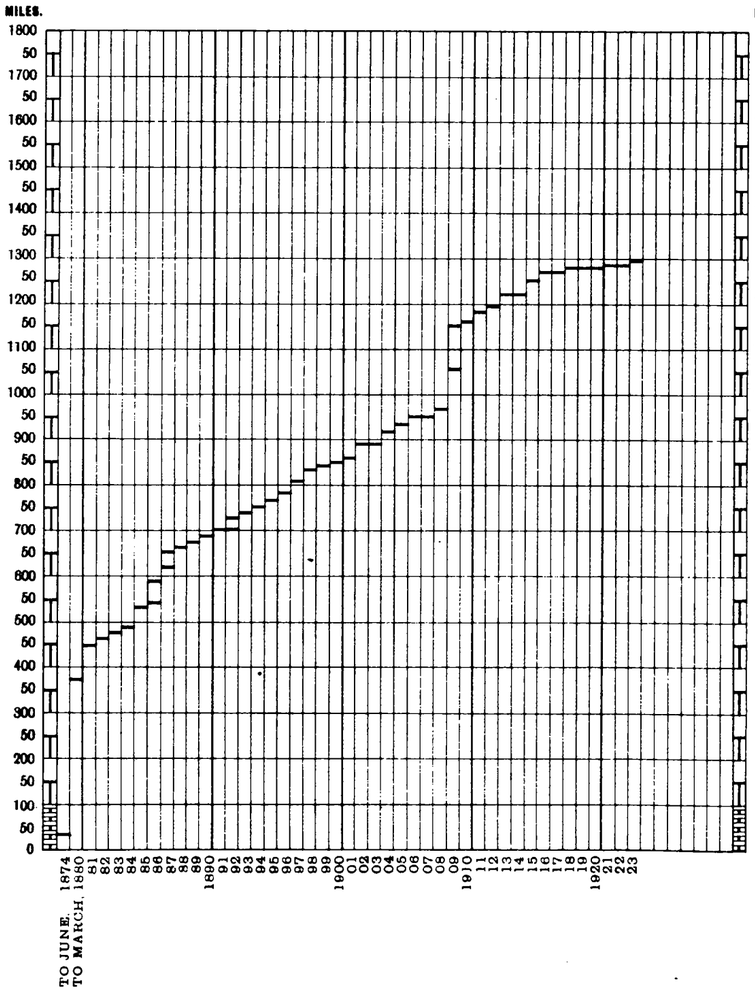
The locomotives have been illustrated in the *Beama* of December, 1922.

An interesting feature in connection with the condensing-water is this: It is drawn from Goat Creek, 625 ft. above the power-house. There is a concrete weir, and the intake is protected from avalanches by a grillage of old rails. It then passes through a pipe concreted into a trench in rock till clear of floods and slides, and then through gravel-traps and silt-chambers; then by 10 in. and 12 in. welded steel pipes to 520 ft. below, where it passes through a Pelton wheel driving a 125-K.V.A. 2,200-volt alternator, which operates in parallel with the similar steam-driven machine in power-house. This hydro set will normally provide all the current for lighting, thus obviating power-house being manned at night, on Sundays, or when no train movements are taking place. The waste from the Pelton wheel flows into a circular concrete tank of 78,000 gallons capacity. Thence it is carried in 10-in.-diameter pipes to drive the air-extraction pumps with a head of 90 ft. The surplus runs on into a concrete reservoir, 380,000 gallons capacity, placed 25 ft. above power-house, whence by 18 in. riveted pipe it is carried to the main surface condensers. The small flow in Goat Creek when frost-bound, and the large demand for condenser-water, necessitated this arrangement of reservoirs, which fill up between trains. The same source supplies domestic water-supply to the railway employees' village, which is fitted with a water-borne septic-tank-treated sewage system, and also is lighted electrically.

By Authority: W. A. G. Skinner, Government Printer, Wellington.—1923.

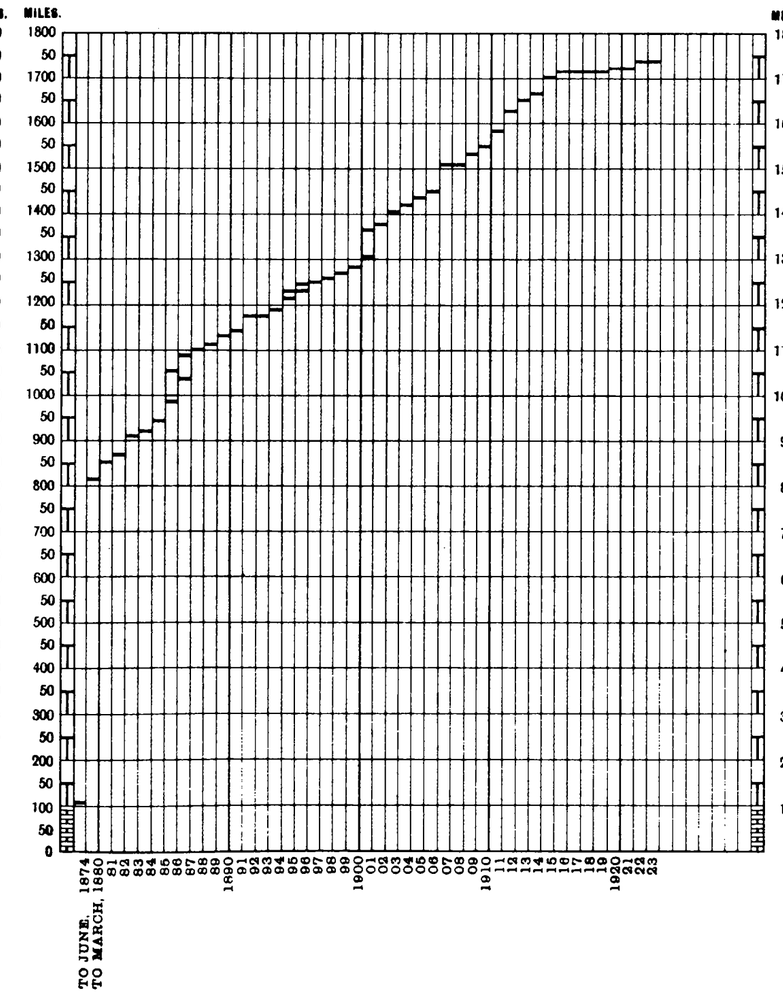
NUMBER OF MILES OPEN
OF
GOVERNMENT LINES.

NORTH ISLAND.



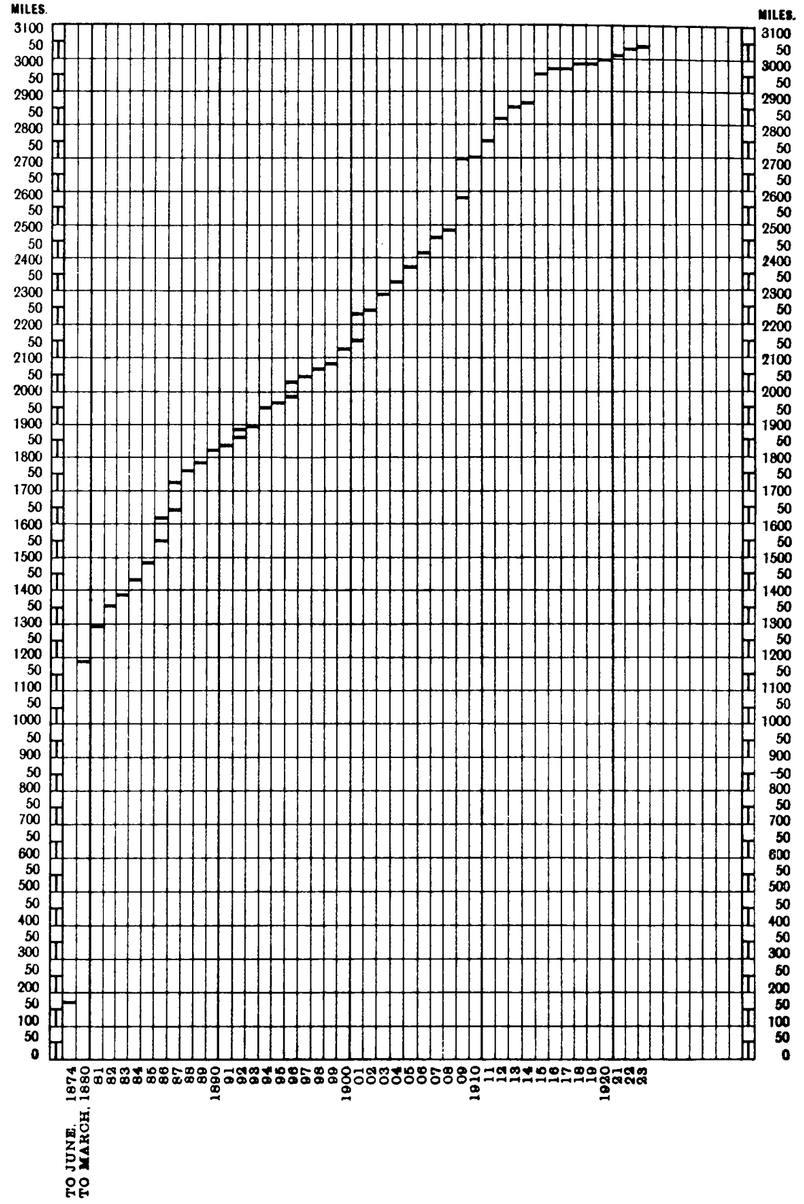
NUMBER OF MILES OPEN
OF
GOVERNMENT LINES.

SOUTH ISLAND.



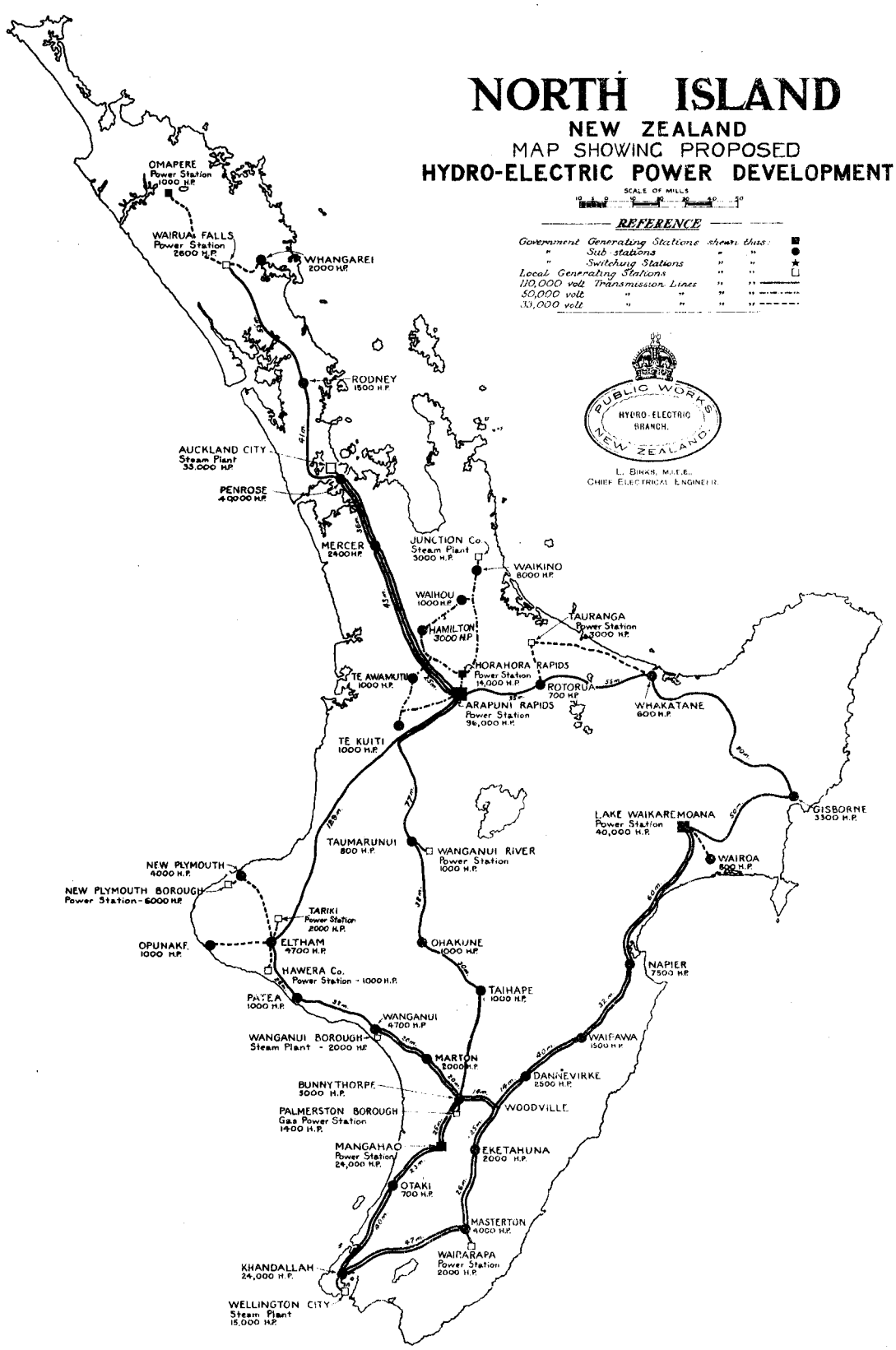
NUMBER OF MILES OPEN
OF
GOVERNMENT LINES.

NORTH AND SOUTH ISLANDS COMBINED.



Private railways acquired by the Government shown thus: ▭

NORTH ISLAND
NEW ZEALAND
MAP SHOWING PROPOSED
HYDRO-ELECTRIC POWER DEVELOPMENT



E142B

W.F.C.VINE, JULY 1922. REVISED 31.1.23. & 15.8.25

SOUTH ISLAND
NEW ZEALAND
MAP SHOWING PROPOSED
HYDRO-ELECTRIC POWER DEVELOPMENT

SCALE OF MILES

REFERENCE

Government Generating Stations shown thus	■
" Sub-stations " "	●
Local Generating Stations " "	□
66,000 volt Transmission Lines "	———
33,000 volt " " "	– – –

PUBLIC WORKS HYDRO-ELECTRIC BRANCH. NEW ZEALAND.

L. BIRKS, M.I.E.E.,
CHIEF ELECTRICAL ENGINEER.

COLLINGWOOD 200 H.P.
TAKAKA 400 H.P.
MOTUEKA 600 H.P.
NELSON 3800 H.P.
NELSON BOROUGH Steam Plant 1000 H.P.
BLENHEIM 2500 H.P.
WAIHOPAI Power Station 2500 H.P.
WESTPORT 2000 H.P.
DENNISTON Steam Plant 1000 H.P.
GOWAN RIVER Power Station 5000 H.P.
MURCHISON 200 H.P.
NINE MILE CREEK Power Station 2000 H.P.
REEFTON 700 H.P.
GREYMOUTH 2500 H.P.
KUMARA Power Station 10000 H.P. 12000 H.P.
JOLLIE'S PASS (Future development) 25,000 H.P.
HOKITIKA 1500 H.P.
KANIERI Power Station 1000 H.P.
OTIRA Railway Steam Plant 3500 H.P.
TOAROHA Power Station 10,000 H.P.
CULVERDEN 1100 H.P.
LAKE COLERIDGE Power Station 38,000 H.P.
RANGIORA 2500 H.P.
CHRISTCHURCH 22,000 H.P.
CHRISTCHURCH TRAMWAYS Steam Plant 5000 H.P.
METHVEN 400 H.P.
HORORATA 1400 H.P.
LEESTON 1100 H.P.
LITTLE RIVER 600 H.P.
TEKAPO Power Station 5000 H.P.
ASHBURTON 3000 H.P.
FAIRLIE 100 H.P.
TIMARU 8000 H.P.
HAWEA - WANAKA (Future development) 80,000 H.P.
NASEBY 600 H.P.
OAMARU 3300 H.P.
ALEXANDRA 1000 H.P.
PALMERSTON 1000 H.P.
ROXBURGH 500 H.P.
WAIPORI Power Station 25,000 H.P.
DUNEDIN 18,500 H.P.
DUNEDIN CITY Oil Plant 1000 H.P.
MONOWAI Power Station 16,000 H.P.
NIGHTCAPS 500 H.P.
WINTON 500 H.P.
GORE 4000 H.P.
BALCLUTHA 4200 H.P.
INVERCARGILL 7300 H.P.
INVERCARGILL BOROUGH Steam Plant 2000 H.P.

W.F.C.VINE., SEP. 1922

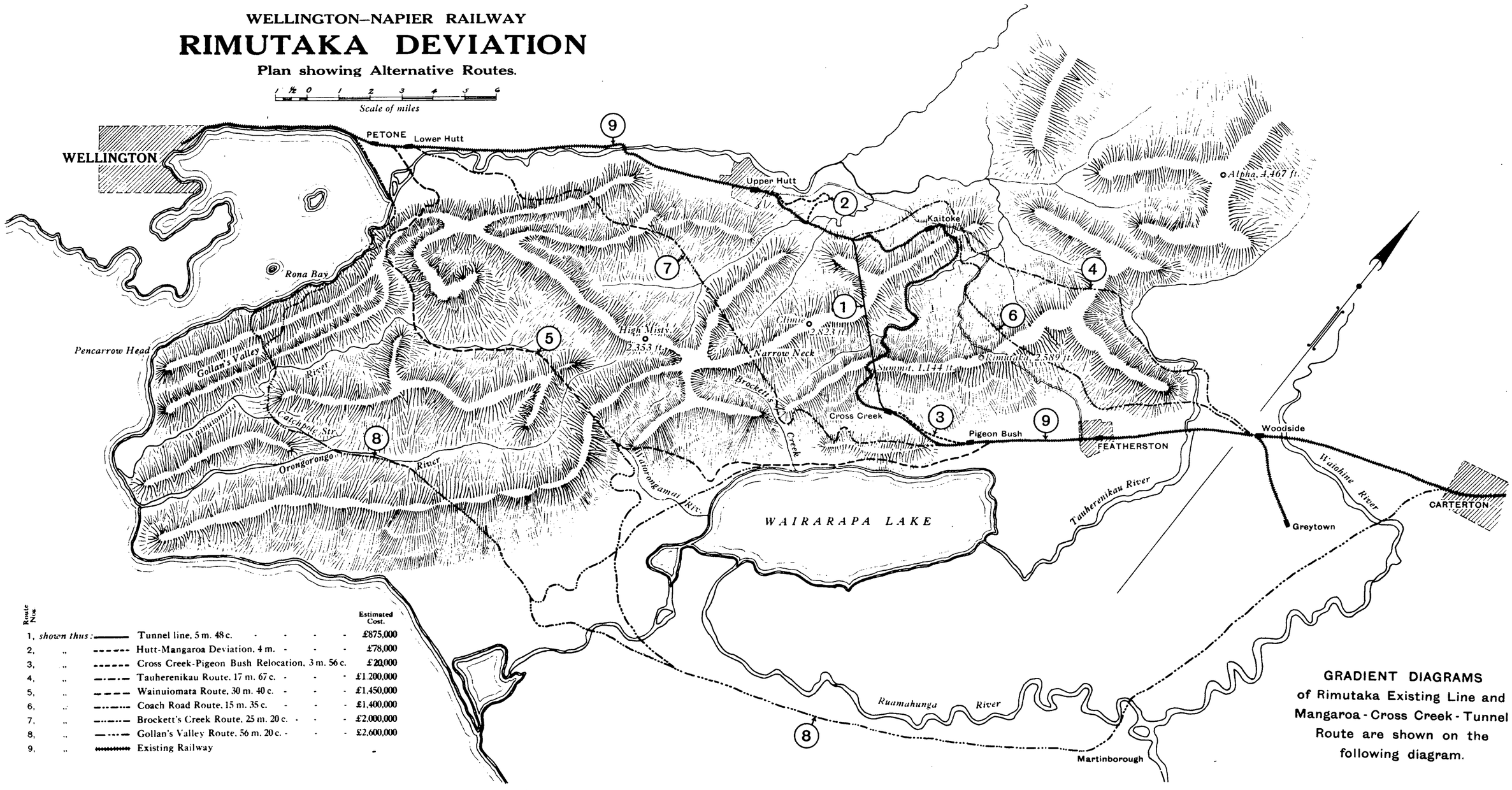
E352

WELLINGTON–NAPIER RAILWAY

RIMUTAKA DEVIATION

Plan showing Alternative Routes.

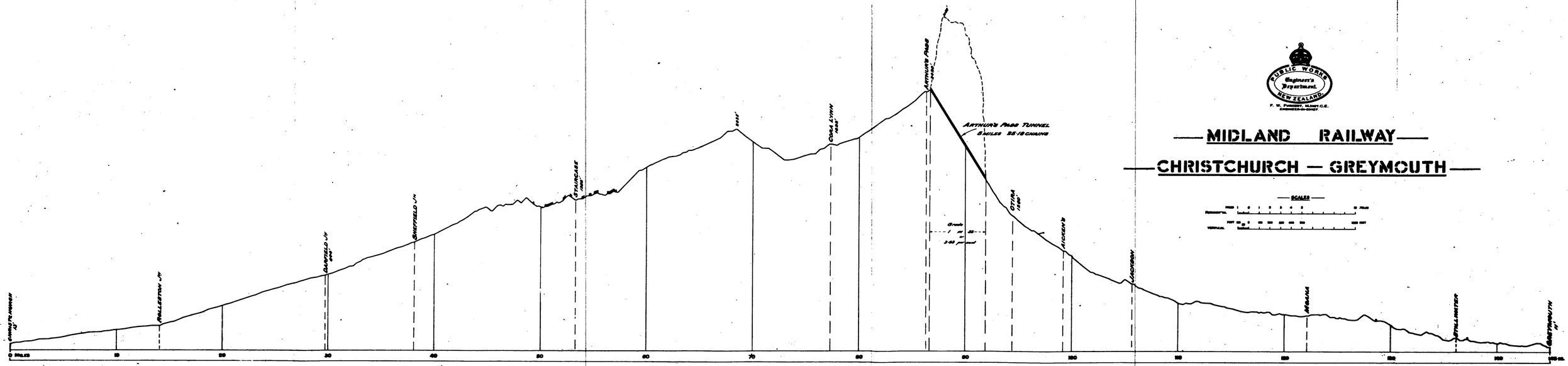
Scale of miles: ½ 0 1 2 3 4 5 6



Route Nos			Estimated Cost.
1,	*shown thus:*	Tunnel line, 5 m. 48 c.	£875,000
2,	,,	Hutt-Mangaroa Deviation, 4 m.	£78,000
3,	,,	Cross Creek-Pigeon Bush Relocation, 3 m. 56 c.	£20,000
4,	,,	Tauherenikau Route, 17 m. 67 c.	£1,200,000
5,	,,	Wainuiomata Route, 30 m. 40 c.	£1,450,000
6,	,,	Coach Road Route, 15 m. 35 c.	£1,400,000
7,	,,	Brockett's Creek Route, 25 m. 20 c.	£2,000,000
8,	,,	Gollan's Valley Route, 56 m. 20 c.	£2,600,000
9,	,,	Existing Railway	-

GRADIENT DIAGRAMS
of Rimutaka Existing Line and Mangaroa - Cross Creek - Tunnel Route are shown on the following diagram.

DE



PUBLIC WORKS
Engineer's Department
NEW ZEALAND

F. W. Furkert, M.Inst.C.E.
Chief Engineer-in-Charge

MIDLAND RAILWAY

CHRISTCHURCH — GREYMOUTH

SCALES

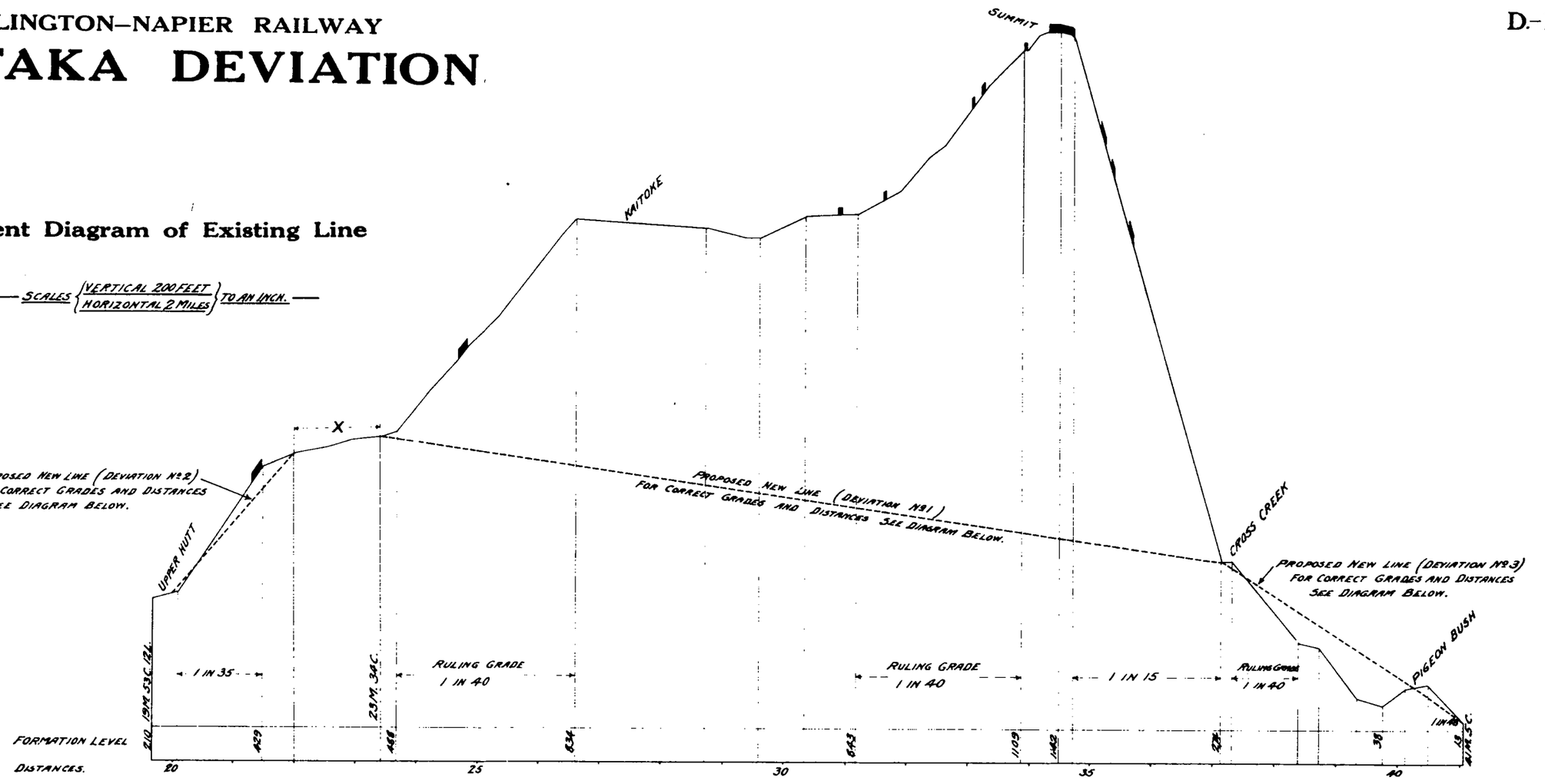
Horizontal 1 Inch = 1 Mile

Vertical 1 Inch = 100 Feet

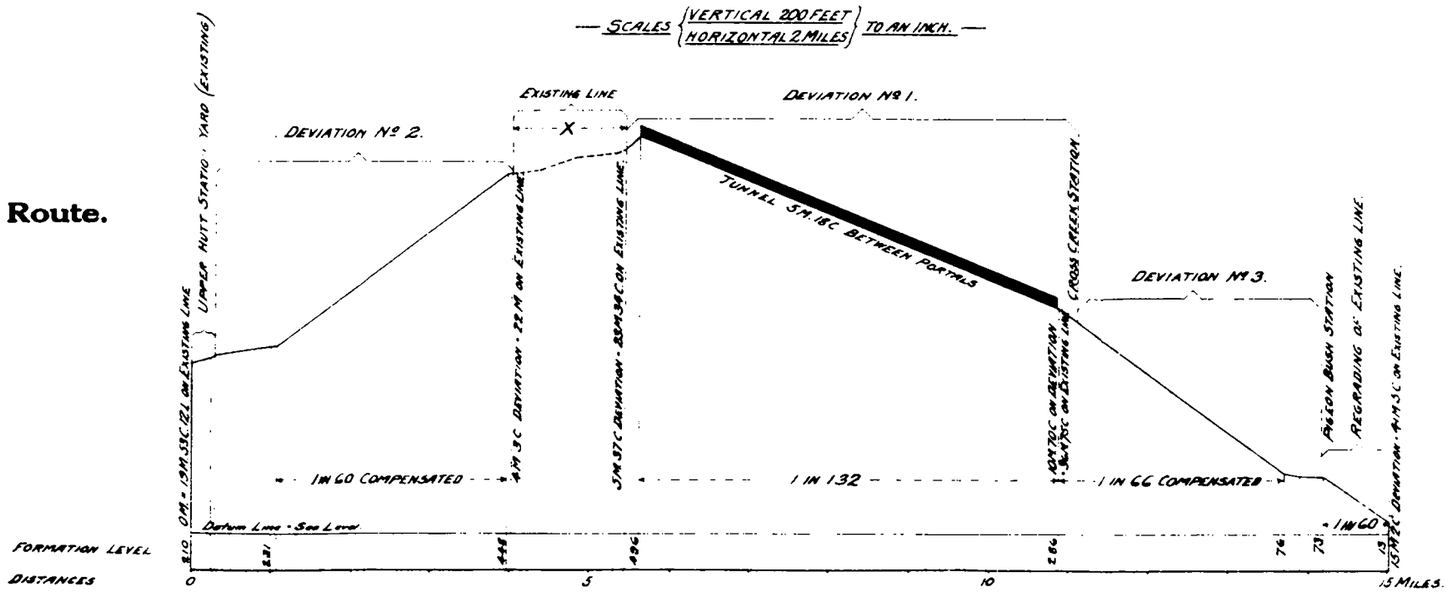
WELLINGTON–NAPIER RAILWAY

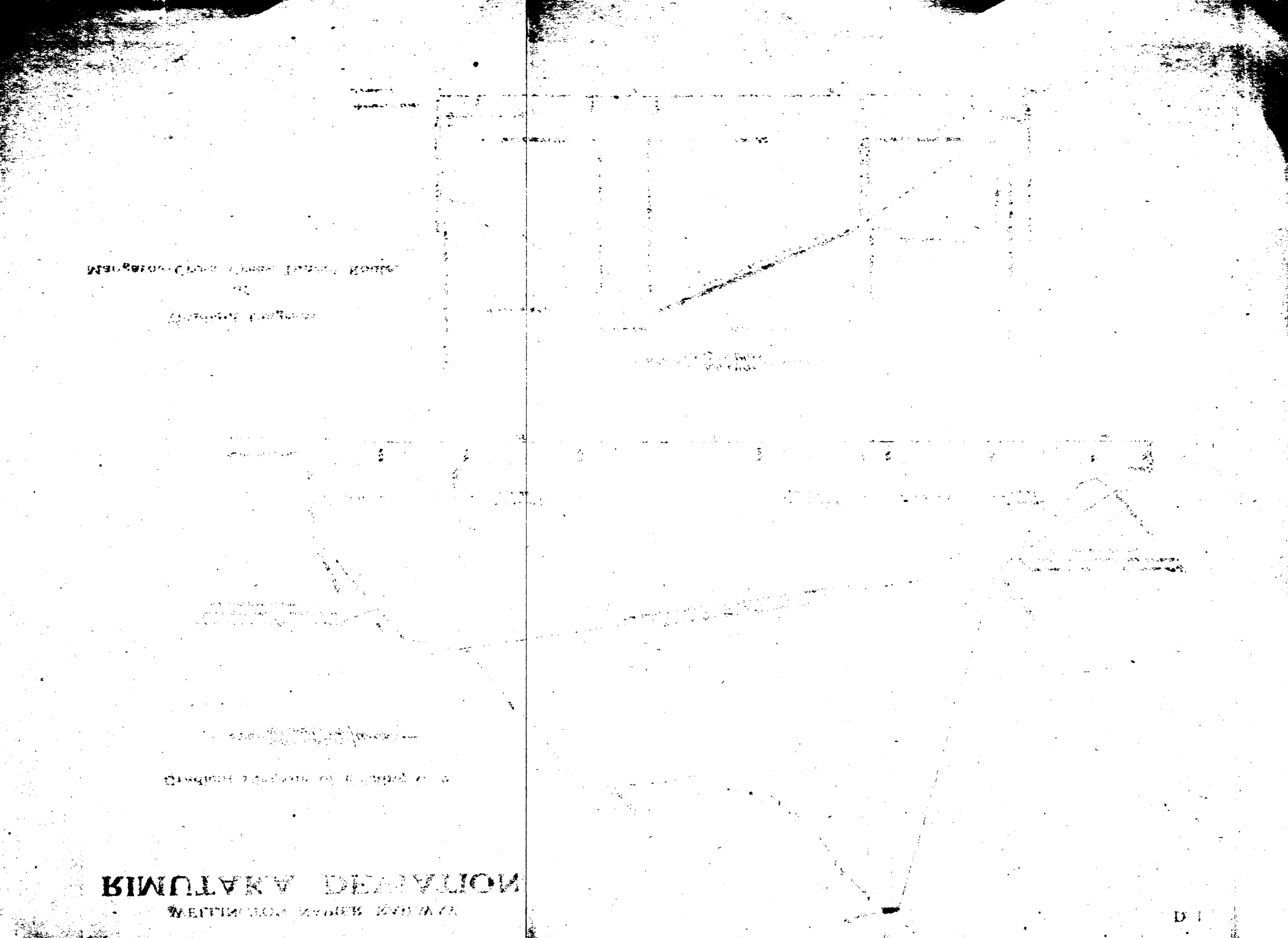
RIMUTAKA DEVIATION

Gradient Diagram of Existing Line



Gradient Diagram of Mangaroa-Cross Creek-Tunnel Route.





PUBLIC WORKS
Engineer's Department
NEW ZEALAND.

F. W. FURKERT, M.INST.C.E.
ENGINEER-IN-CHIEF

PUBLIC WORKS MAP
SHOWING THE RAILWAYS
SOUTH ISLAND
OF
NEW ZEALAND
1923

— Scale of Miles —

10 0 10 20 30 40 50 60 70 80

— REFERENCE —

GOVERNMENT RAILWAYS.

Opened - -
Under construction
Proposed - -
Explored - -

PRIVATE RAILWAYS.

Opened - -

TASMAN SEA

PACIFIC OCEAN

COOK STRAIT

FOVEAUX STRAIT

SOUTH

C. Farewell
GOLDEN BAY
D'Urville Id
French Pass
TASMAN BAY
Karamea R.
KARAMEA BIGHT
Mokikinui R.
C. Foulwind
C. Campbell
CLOUDY BAY
WELLINGTON
Buller River
Kaikoura Peninsula
Clarence R.
Conway R.
Waiau-ua R.
Hurunui R.
Ashley R.
PEGASUS BAY
Waimakariri R.
Banks Peninsula
Abut Hd
Pt Elizabeth
Arahura R.
Haast R.
JACKSON'S BAY
Mt Cook 12349ft
Mt Sefton 10959ft
Hermitage 8703ft
L. Tekapo
Pukaki L.
L. Ohau
L. Wanaka
L. Hawea
L. McKerrow
Milford Sound
Ada L.
L. Wakatipu
L. Te Anau
Manapouri L.
Monowai L.
Hauroto L.
Waiau R.
Rangitata R.
CANTERBURY BIGHT
Ashburton R.
Rakaia R.
Taieri R.
Clutha R.
Waitaki R.
Shag Point
Otago Har.
C. Saunders
DUNEDIN
Foveaux Strait
The Bluff
SOLANDER Id
RUAPUKE Id
STEWART Id
MASON BAY
Port William
East Head
S.W. Cape
Port Pegasus

DISTANCES BY RAILWAY BETWEEN PRINCIPAL PLACES.

	Miles.	Miles.
Bluff to Invercargill	17	
Invercargill to Lumsden	50	
Lumsden to Kingston	37	
Bluff to Kingston		**104**
Invercargill to Gore	39	
Gore to Balclutha	47	
Balclutha to Milton	17	
Milton to Dunedin	36	
Invercargill to Dunedin		**139**
Invercargill to Tuatapere		**56**
Invercargill to Tokanui		**34**
Balclutha to Tahakopa		**43**
Dunedin to Clyde		**143**
Dunedin to Port Chalmers		**8**
Gore to Lumsden		**37**
Gore to Waikaka		**16**
Waipahi to Edievale		**26**
Milton to Big Hill		**31**
Dunedin to Oamaru	78	
Oamaru to Timaru	53	
Timaru to Ashburton	47	
Ashburton to Rolleston	38	
Rolleston to Christchurch	14	
Dunedin to Christchurch		**230**
Christchurch to Lyttelton		**7**
Oamaru to Hakataramea		**43**
Timaru to Fairlie Creek		**39**
Christchurch to Arthur's Pass		**87**
Christchurch to Little River		**36**
Christchurch to Waiau		**82**
Christchurch to Mina		**76**
Picton to Wharanui		**56**
Nelson to Glenhope		**59**
Greymouth to Reefton		**47**
Greymouth to Ross		**39**
Greymouth to Otira		**51**
Westport to Mokihinui Colliery		**31**

By Authority: W. A. G. Skinner, Government Printer, Wellington.

PUBLIC WORKS
Engineer's Department
NEW ZEALAND.

F. W. FURKERT, M.INST.C.E.
ENGINEER-IN-CHIEF.

PUBLIC WORKS MAP
SHOWING THE RAILWAYS
NORTH ISLAND
OF
NEW ZEALAND
1923

— Scale of Miles —

10 0 10 20 30 40 50 60 70 80

— REFERENCE —

GOVERNMENT RAILWAYS.

Opened - - ———

Under construction - - - - - -

Proposed - - ———

Explored - - - - - -

PRIVATE RAILWAYS.

Opened - - ———

C. Maria van Dieman
North Cape
Motu Pia
Mangamui R.
Utoa
RANGAUNU BAY
DOUBTLESS BAY
WHANGAROA HAR.
Cavalli Is
TAKOU BAY
AHIPARA BAY
Reef Pt
BAY OF ISLANDS
C. Brett
Herekino R.
Whangape
HOKIANGA HAR.
Poor Knights
WHANGARURU B.
NGUNGURU B.
Maungamui Bluff
Bream Hd
WHANGAREI HAR.
Bream Tail
Aiguilles Pt.
Gt BARRIER Id
Lt BARRIER Id
HAURAKI GULF
KAIPARA HAR.
C. Colville
KENNEDY B.
MERCURY B.
Frith of Thames
MANUKAU HAR
WHANGAMATA H.
Waikato R.
White Id
BAY OF PLENTY
C. Runaway
HICKS B.
East C.
WHAINGAROA HAR.
TAURANGA HAR.
RAUKUMARA RANGE
KAWHIA HAR.
TE UREWERA COUNTRY
KAINGAROA PLAINS
Thermal Springs
L. Taupo
NORTH TARANAKI BIGHT
Mokau R.
C. Egmont
SOUTH TARANAKI BIGHT
Kaupokonui R.
Waitotara
Wanganui R.
Rangitikei R.
Manawatu R.
Waikare
Moana
POVERTY BAY
HAWKE BAY
Malhia Peninsula
Portland Id
C. Kidnappers
Bare Id
Pourerere R.
Porongahau R.
C. Turnagain
Castle Point
Wharerama R.
Flat Point
Kapiti I.
Mana I.
PORIRUA H.
WELLINGTON
L. Wairarapa
C. Palliser
C. Campbell
COOK STRAIT
TASMAN SEA
PACIFIC OCEAN

DISTANCES BY RAILWAY BETWEEN PRINCIPAL PLACES.

	Miles.	Miles.
Wellington to Palmerston North	87	
Palmerston North to Wanganui (Aramoho Junction)	60	
Aramoho to New Plymouth	104	
Wellington to New Plymouth		251
Wellington to Palmerston North	87	
Palmerston North to Woodville	18	
Woodville to Napier (Spit)	97	
Wellington to Napier via Manawatu		202
Wellington (Te Aro) to Woodville	116	
Woodville to Napier (Spit)	97	
Wellington to Napier via Wairarapa		213
Auckland to Onehunga		8
Auckland to Hamilton (Frankton Junction)	85	
Hamilton to Ongarue	75	
Ongarue to Taumarunui	15	
Taumarunui to Ohakune	50	
Ohakune to Waiouru	17	
Waiouru to Marton	68	
Marton to Wellington	116	
Auckland to Wellington		426
Auckland to Hamilton (Frankton Junction)	85	
Hamilton to Te Aroha	30	
Te Aroha to Thames	33	
Auckland to Thames		148
Auckland to Rotorua		171
Auckland to Ranganui		86
Dargaville to Tarawhati		20
Whangarei to Kawakawa		46
Gisborne to Motuhora		49
Thames to Waihi		33

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