

FIFTY YEARS OF THE OTIRA TUNNEL

Its Conception and Construction as Reported in 1923

With an Introduction by T. A. McGavin

WHEN the Otira Tunnel through the Southern Alps beneath Arthur's Pass was opened on 4 August 1923, it brought to a close more than 50 years of proposals, explorations, surveys, construction, and sheer hard work in remote and rugged country. Before it was completed, transport of goods to and from Westland was necessarily almost entirely by sea. Indeed, back in the 1860s, such was the state of communications in New Zealand at the time, the early settlers in Greymouth and Hokitika found it more convenient to obtain their supplies from Australia than from other parts of their own country.

In this number we present the text of a report originally published as Appendix E to the Public Works Statement 1923 (Parliamentary Paper D-1) describing the explorations for and the construction of what was then known as the Arthur's Pass Tunnel, later to become more popularly known as the Otira Tunnel. This article includes a sketchy account of the origins and early efforts of the New Zealand Midland Railway Company, more details of which may be found in *The New Zealand Railway Observer* of 1949 and 1950 (Volumes 6, pp. 93-97, and 7, pp. 35-39). Following the failure of the Company to fulfil the terms of its contract to build railways linking Westland with Nelson and Canterbury, the Public Works Department took over the work and, in spite of the failure of another contractor who found the boring of the tunnel much harder than anticipated, ultimately carried it through to a successful conclusion.

At the time of its opening, the Otira Tunnel, a hole 15ft. 6in. high and 15 feet wide punched in a dead straight line on a gradient of 1 in 33 from west to east through the hard rock backbone of the South Island, was the

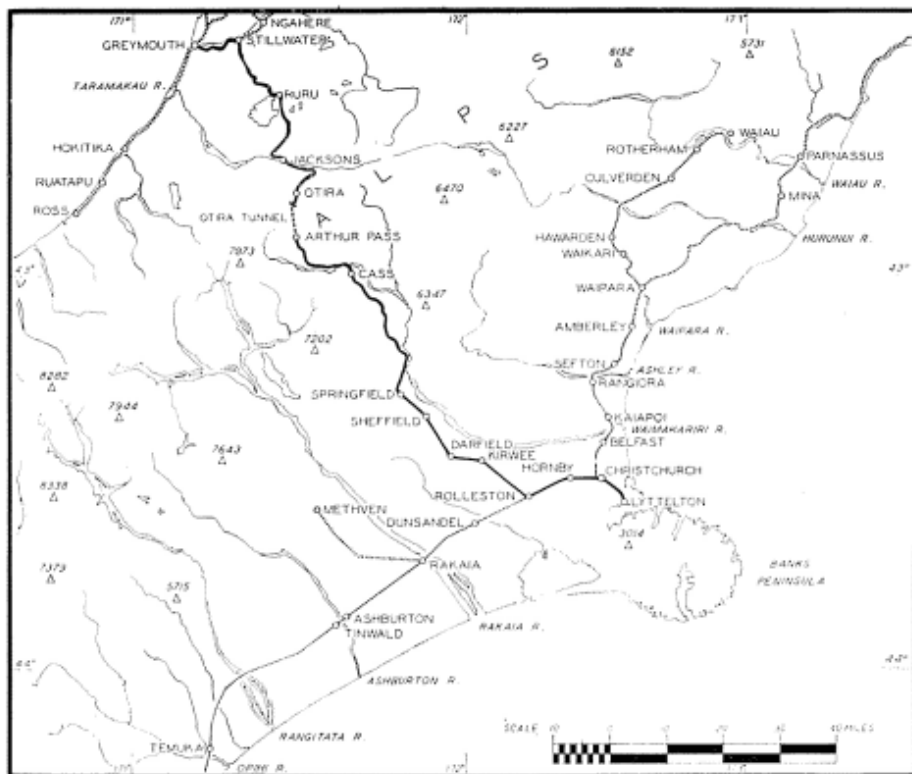


Photograph: N.Z. Railways Publicity

Opposite the confluence of the Otira and Rolleston Rivers, three "Ea" class electric locomotives exert their total 3,855 horsepower as they growl up the 1 in 33 grade from Otira to the long tunnel with a train-load of coal and other goods from the West Coast. The trans-alpine highway can be seen on the opposite bank entering the Otira Gorge for its steep climb over Arthur's Pass. Notice the waterfall issuing from a cleft high in the mountains.

seventh longest railway tunnel in the world and the longest in the British Empire. With the subsequent construction of other long railway tunnels in various parts of the world, it is now the 19th longest. The honour of longest in the British Commonwealth and longest in the Southern Hemisphere passed in 1955 to New Zealand's Rimutaka Tunnel, which in turn appears likely to lose the title to yet another New Zealand railway tunnel, the Kaimai, in 1975.

Completion of the Midland Line in 1923 brought the markets of Canterbury and other parts of the South Island within much easier reach of the coal and timber that were the primary products of the West Coast, quite



New Zealand Railways Midland Line

The railway northwest from Rolleston was open as far as Springfield by 1880, as the Malvern Branch. Meanwhile, in 1876, a short line had been built from Greymouth to Brunner, near Stillwater, but it was 1923, more than 40 years later, before Brunner was linked by rail with Springfield. The entire railway from Greymouth to Rolleston then became known as the Midland Line.

apart from reducing the journey time for passengers to a reasonably comfortable 7½ hours or less. The timetable dated 2 December 1923 provided for five goods trains each way daily through the tunnel and one express train each way four days a week. The frequency of the express service was reduced to three days a week during the winter months. With the then practice of working goods trains of 280 tons with two electric locomotives, the capacity of the service from west to east was thus 1,400 gross tons daily, enabling about 1,000 tons of payload to be hauled eastward each day, though additional trips could be made when necessary.

In 1941 the power supply for the electrified Otira-Arthur's Pass section was improved to enable 375 tons to be hauled eastward through the tunnel by three locomotives, and a basic service of some 12 goods trains each way

daily soon became established, giving a capacity of some 4,500 gross tons each day. Coal nowadays is not in quite such heavy demand as it used to be, so seven 500-ton goods trains (using the more powerful electric locomotives introduced in 1968) now form the basic service in each direction, together with at least two railcars each way daily. The latter make the 145-mile run between Greymouth and Christchurch in five hours or less.

Because of the steep gradient and the length of the tunnel, electric traction was introduced between Otira and Arthur's Pass in 1923. This feature is only touched upon lightly in the following article. We hope to offer a more extended description of the character of this first section of electrified railway in New Zealand, and its locomotives, at a later date.

ARTHUR'S PASS TUNNEL

EARLY EXPLORATION AND CONSTRUCTION

(From the Public Works Statement, 1925, Appendix E)

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.



From an unidentified print

A special train bound from Christchurch to Arthur's Pass crosses the Waimakariri River between Cass and Cora Lynn. Peaks of the Dome Range of the Southern Alps in the background soar to more than 6,500 feet (1,920 metres) above sea level.

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 proposed 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 1882 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 Brunner and Stillwater Junction, and thence up the Arnold, and round the north-eastern side of Lake Brunner, through a natural depression, into the Teremakau



Photograph: courtesy Inksters of Greymouth

One of the five Nasmyth Wilson 4-4-0 tank locomotives of the New Zealand Midland Railway Company on a bridge near Stillwater. These locomotives were built in 1887.

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



Photograph: courtesy N.Z. Railways Publicity

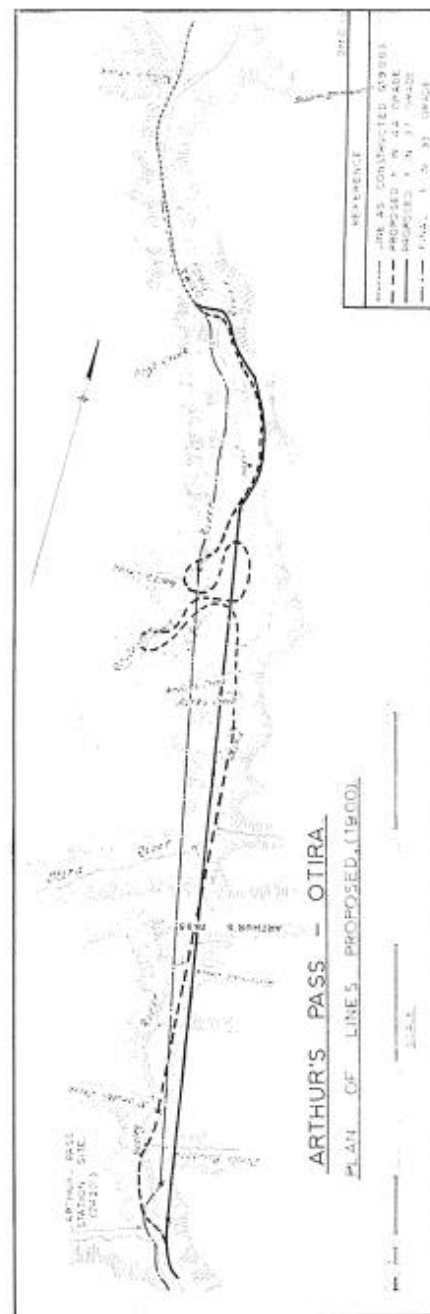
A view of the western portal of the Otira Tunnel during construction (about 1920). Arthur's Pass can be seen in the background. Note the line of cleared scrub up the mountainside to facilitate the surveyors' measurements.

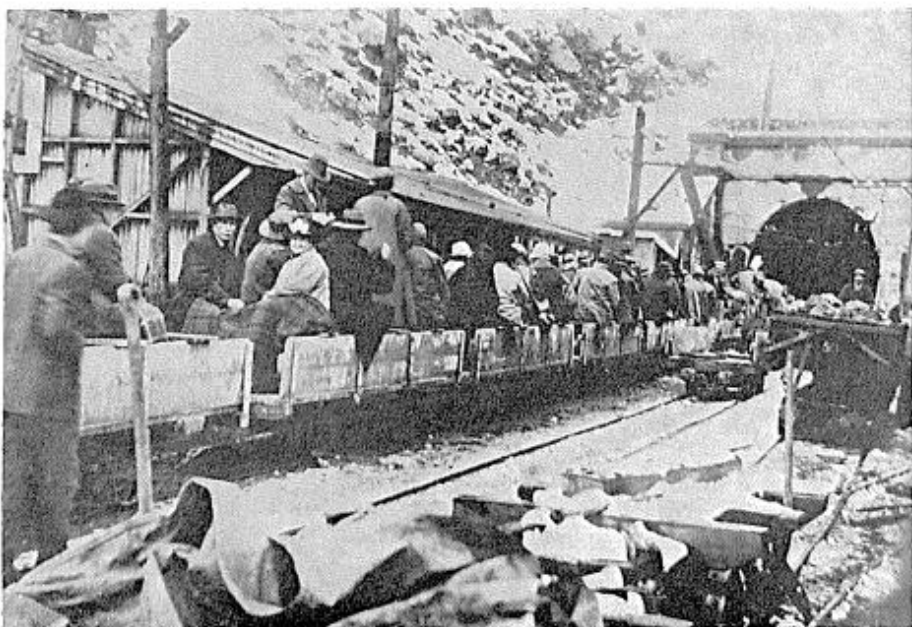
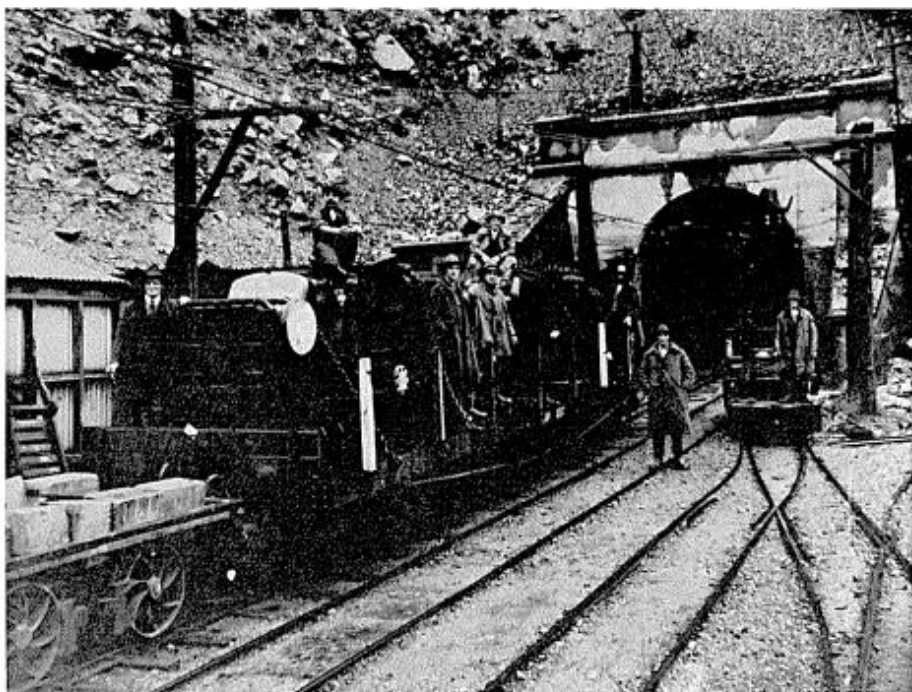
companies of Canada, and was founded in England by a syndicate who took over the contracts of the Chrystall Syndicate. Those contracts were subsequently annulled, and a new one, dated 3rd August, 1888, was entered into between the New Zealand Government and the Midland Company. That contract provided, among other matters, that the company should construct 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 recommendation 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.

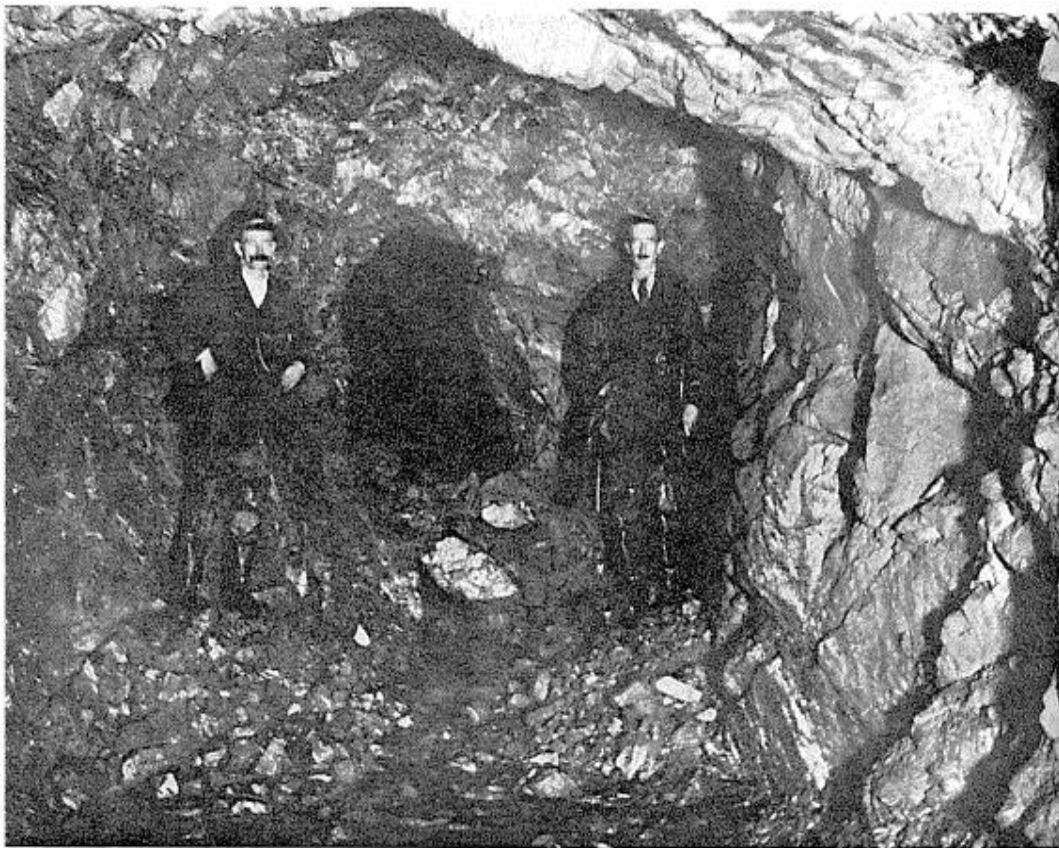
The summit-tunnel, though the most notable work on the line, is but one of many notable works, for the bridges and shorter tunnels compel just as much attention. To give some idea of their frequency and character it may be mentioned that, in a short length of nine miles, there are three high steel viaducts, 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.

LEFT, UPPER: The 2 ft. 6 in. gauge tracks used for handling spoil from the tunnel are prominent in this view of the west portal during the later stages of construction. A 10-ton electric mine locomotive can be seen.

LEFT, LOWER: An inspection party preparing to enter the west portal of the Otira Tunnel. Snow on the ground attests to the severe climatic conditions.

Photographs: courtesy N.Z. Railways Publicity



Photograph: courtesy N.Z. Railways Publicity

A proud moment on 20 July 1918 shortly after the two bottom headings had met, 5 miles 68.10 chains from the west portal, only three-quarters of an inch out in alignment, and $1\frac{1}{4}$ inch out in level.

The tunnel is 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



Photograph: courtesy N.Z. Railways Publicity

Oira railway station and yard about 1922, from the power station roof, looking down the valley of the Oira River. The station platform is on a gradient of 1 in 60, but the sidings are arranged on a level embankment.

special methods such as were employed in the construction of the Simplon and other 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 $13\frac{1}{2}$ ft. per day for



Photograph: courtesy N.Z. Railways Publicity

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-compressors, 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, etc.

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

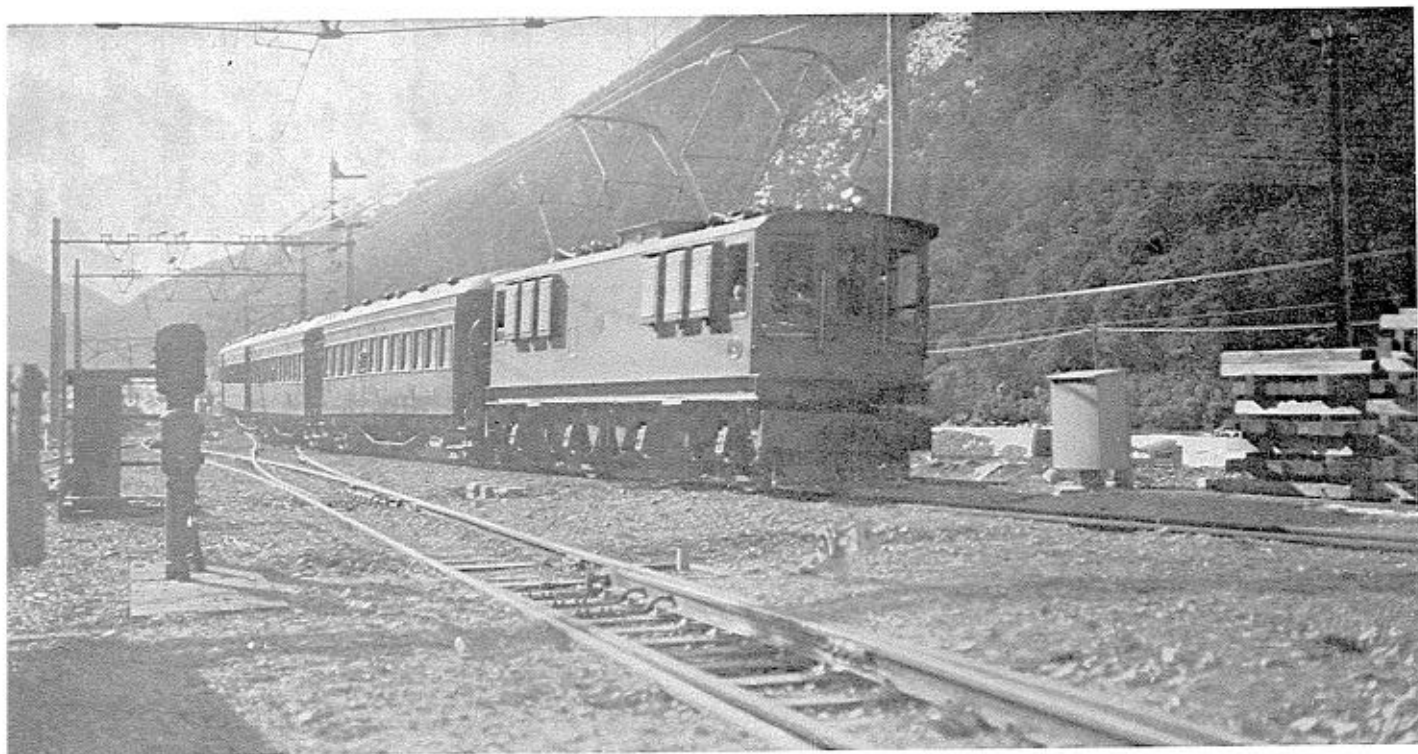
haulage of the excavated material from the completed parts of the tunnel, and the haulage of timber, concrete, etc., into the tunnel, was done by means of 10-ton electric mine-locomotives. These ran on a 2 ft. 6 in. gauge line, and in the completed portions of the tunnel power was taken from a bare overhead trolley-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 trolley-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 trolley-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 4000 cubic feet per minute was installed at each end of 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 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.

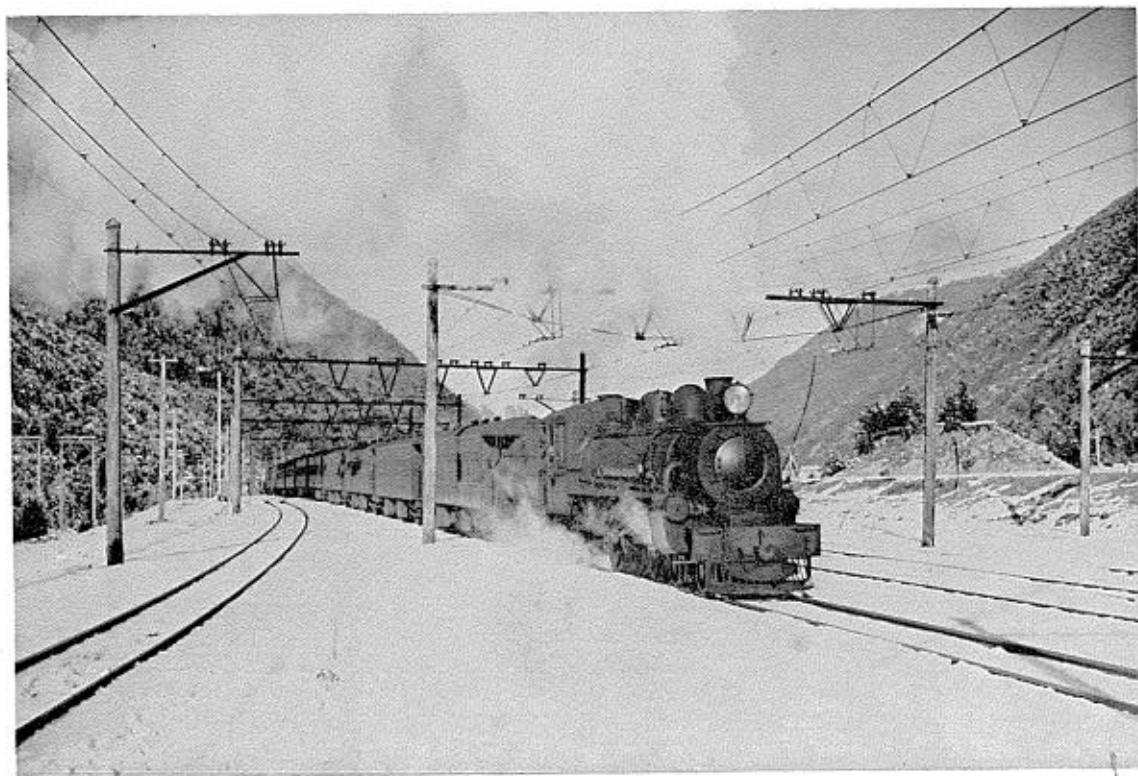
At both ends of the tunnel water for drilling, drinking, etc., was supplied to all faces. The men employed at the tunnel were housed, and change-rooms, baths, drying-

Interior of the Otira Tunnel shortly after its completion, showing a pin-point of light at the portal in the distance. The third rail for 2 ft. 6 in. gauge construction trucks is still in place. Height above rail level is 15 ft. 6 in., and maximum width 15 feet.



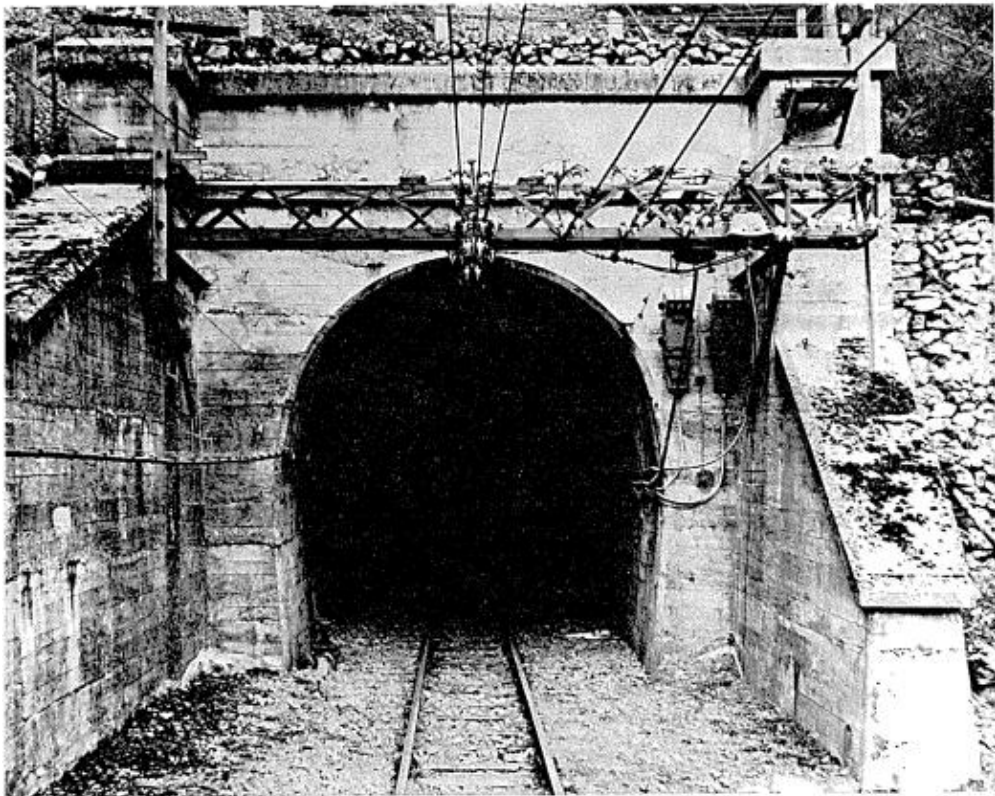
Photograph: W. W. Stewart

One of the five 50-ton electric locomotives supplied by English Electric in 1922 arriving at Arthur's Pass with the first through express train from Greymouth to Christchurch in August 1925. Then class "E", each locomotive could haul 140 tons up the 1 in 33 gradient. The maximum authorised speed was 25 m.p.h.



Photograph: N.Z. Railways Publicity

An "Ab" class Pacific arrives at Arthur's Pass in the snow with a passenger train from Christchurch about 1939. For many years the 10 a.m. Christchurch-Greymouth express required about 6½ hours to cover the 145 miles.



Photograph: courtesy N.Z. Railways Publicity

ABOVE: The western portal of the Otira Tunnel shortly after its completion in 1923.

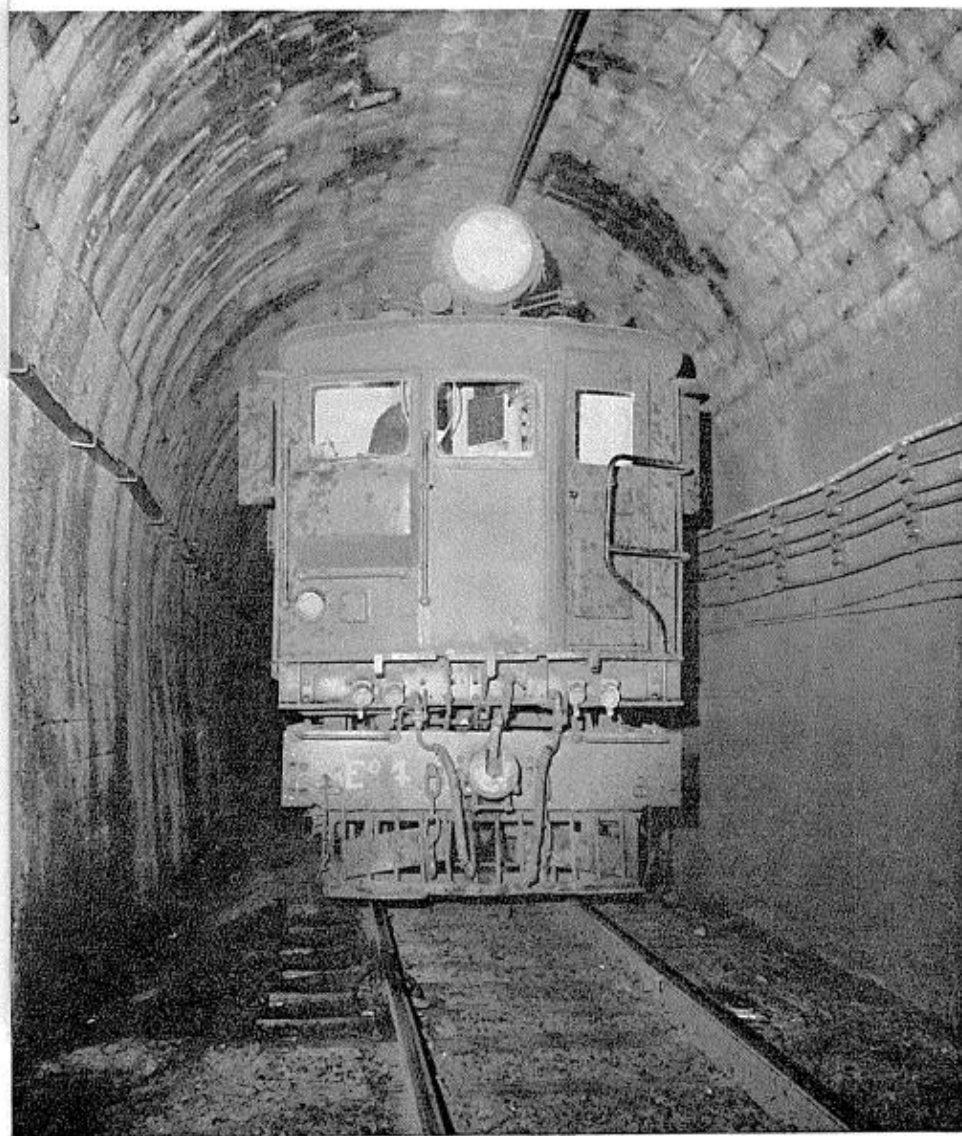
RIGHT: "Eo" 4 in the tunnel shortly before these locomotives were retired in favour of the new, more powerful "Ea" class in 1968.

rooms, etc., 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

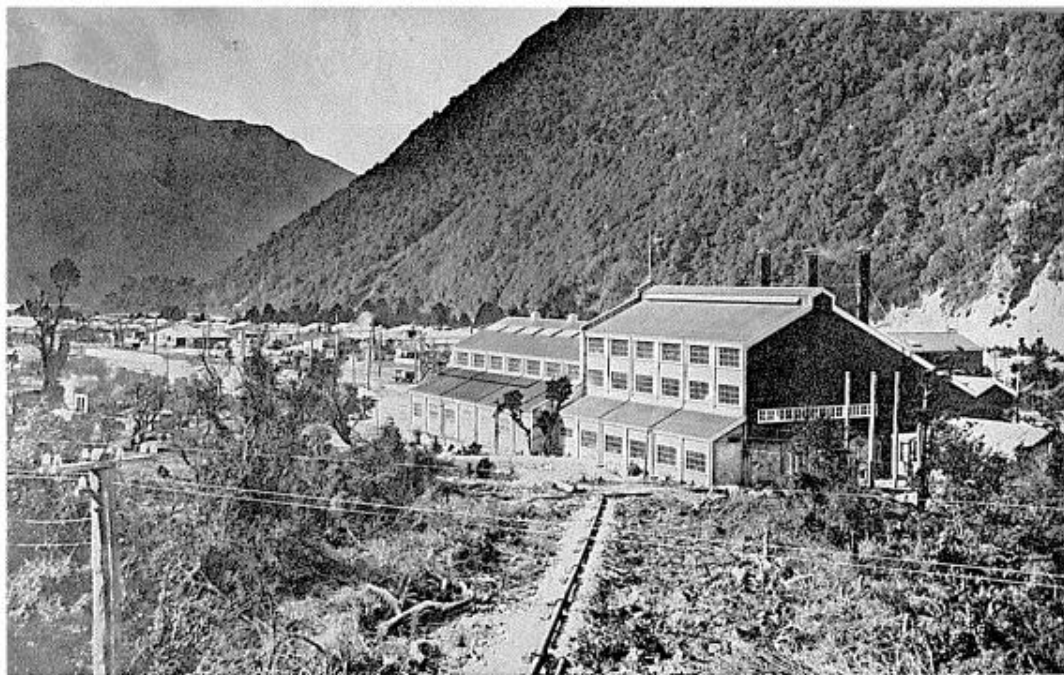


Photograph: N.Z. Railways Publicity

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



Photograph: courtesy N.Z. Railways Publicity

The power house at Otira, brought into use in 1925, housed three marine-type, water-tube, hand-fired boilers and two geared turbine-driven generators of 1,600 kilowatts capacity. It supplied power to the railway at a pressure of 1,500 volts, direct current.

driven with remarkable accuracy; the difference between the actual length and the calculated length was 36 in., the difference in level was only 1½ in., and the alignment was extremely accurate, being only ¾ in. out. By way of comparison: In the Mont-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.

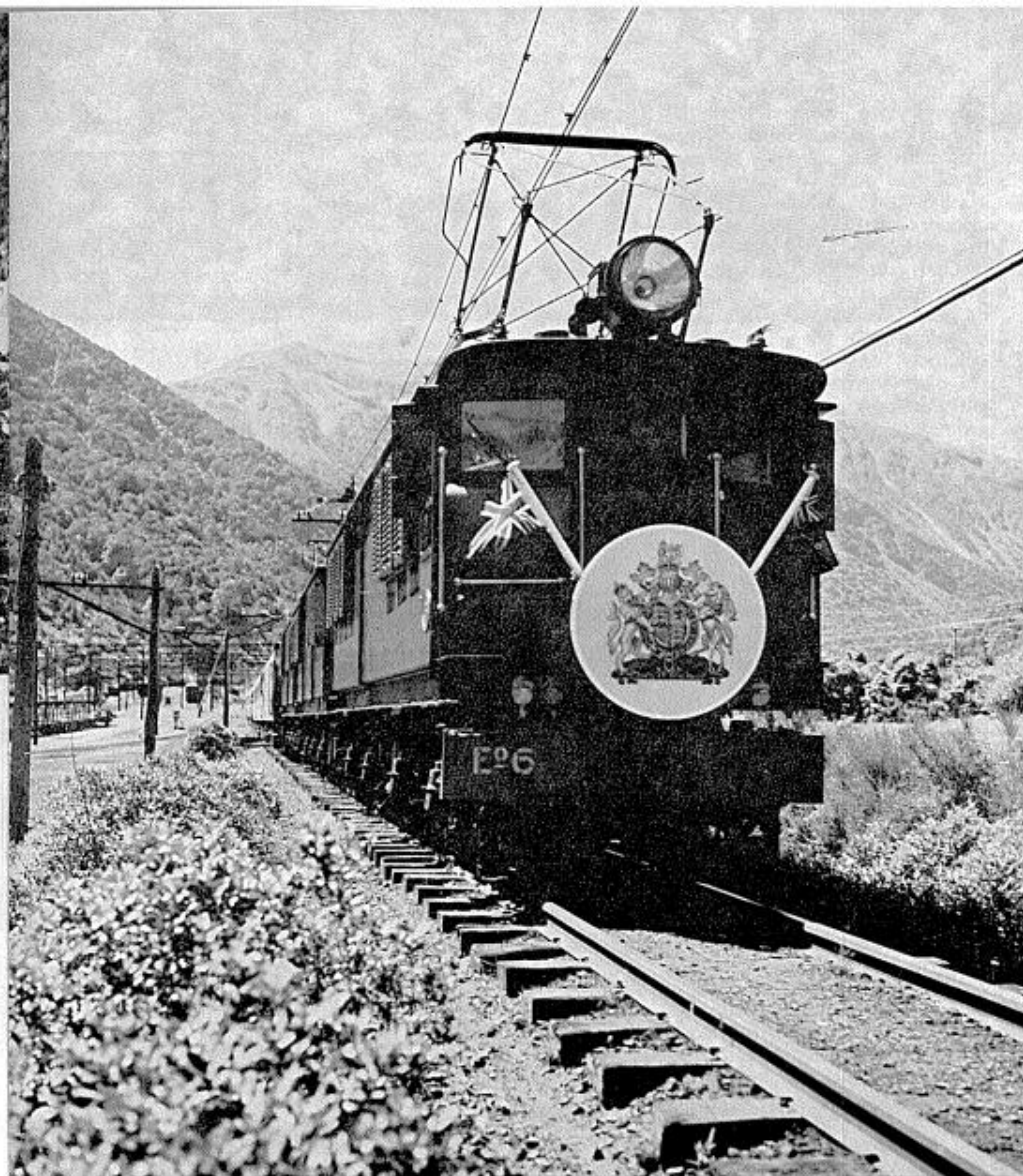
On the 21st August, 1918, the final barrier in the bottom heading was shot away by a charge fired by Sir William Fraser, then Minister of Public Works; and about three years afterwards the whole of the excavation and lining was completed.

Arthur's Pass Tunnel is the seventh-longest tunnel in the world, and the longest in the British Empire (in 1923).

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 1000 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.



ROYAL OCCASION AT OTIRA

At 2.30 p.m. on 18 January 1954, three "Eo" class locomotives Nos. 6, 3 and 5 leave Otira with the Royal Train for Arthur's Pass during the journey of the Queen and her party from Greymouth to Christchurch. It was a beautiful summer's day. The weight of the train on this occasion, excluding the locomotives, was 225 tons, seen above beginning the 1 in 33 climb.

Photograph: N.Z. Railways Publicity