# REPORT

OF THE

SELECT COMMITTEE

ON

# A UNIFORM GAUGE FOR RAILWAYS

THROUGHOUT THE MIDDLE ISLAND.

TOGETHER WITH THE PROCEEDINGS OF THE COMMITTEE, AND THE EVIDENCE.

WELLINGTON.

1867.

## ORDERS OF REFERENCE.

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*Extracts from the Journals of the House of Representatives.*

THURSDAY, 12TH SEPTEMBER, 1867.—*Ordered*, "That a Select Committee be appointed, consisting of Mr. McNeill, Mr. Macandrew, Mr. Moorhouse, Major Heaphy, V.C., Hon. Mr. Hall, Mr. Tancred, Mr. Curtis, Mr. Taylor, and the Mover, to consider the necessity of adopting one uniform gauge for railways throughout the Middle Island, with power to call for Persons, Papers, and Reports. Three to form a quorum, and to report on the 21st instant."—(*Mr. Burns.*)

FRIDAY, 13TH SEPTEMBER, 1867.—*Ordered*, "That the Committee on the Railway Gauge have leave to postpone the bringing up their Report until Wednesday next."—(*Mr Reeves.*)

SATURDAY, 14TH SEPTEMBER, 1867.—*Ordered*, "That the name of the Hon. Mr. J. C. Richmond be added to the Railway Gauge Committee."—(*Major Atkinson.*)

# RAILWAY GAUGE COMMITTEE.

## REPORT.

Your Committee having taken all the engineering evidence at present within their reach, also having examined Dr. Hector upon the topographical features of the Middle Island, beg to report that, however desirable it may be to establish one uniform gauge, the evidence before your Committee is not of such a conclusive character as to warrant them in recommending any particular gauge, and that therefore it would not be desirable, under the present circumstances of the Colony, to insist upon uniformity in this respect.

They are also of opinion that one trunk line of railway will not be applicable to the present requirements, nor suited for developing the resources of the country, with its present scattered population. As regards the present wants of the Colony, a narrow gauge appears calculated to carry all the traffic for many years, and would possess the advantage of greater cheapness in construction; for this reason railways of this character should be encouraged.

The question of gauge cannot, as it appears to your Committee, be satisfactorily settled, except by a Commission appointed specially to inquire into the whole subject, whose duty it should be to report, not only upon the best gauge, but also upon the direction of the main trunk lines of railway throughout both the North and Middle Island, and to recommend the necessary reservation of land for this purpose.

A. J. Burns,
Chairman.

# PROCEEDINGS OF THE COMMITTEE, AND EVIDENCE.

FRIDAY, 13TH SEPTEMBER, 1867.

PRESENT:

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| Mr. Moorhouse. | Mr. Macandrew. |
| Mr. Curtis. | Mr. McNeill. |

Mr. Burns.

THE Order of Reference read.

Mr. Burns was appointed Chairman.

The Committee then adjourned to Monday, 16th September, 1867, at 11 a.m.

MONDAY, 16TH SEPTEMBER, 1867.

PRESENT:

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| Mr. Curtis. | Mr. Tancred. |
| Mr. McNeill. | Hon. J. Hall. |

Mr. Burns in the Chair.

The Committee was then adjourned until Tuesday, 17th September, 1867, at 11 a.m.

TUESDAY, 17TH SEPTEMBER, 1867.

PRESENT:

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| Hon. J. Hall. | Hon. J. C. Richmond. |
| Mr. McNeill. | Mr. Tancred. |
| Mr. Curtis. | Mr. Macandrew. |

Major Heaphy, V.C.

Mr. Burns in the Chair.

Minutes of previous meeting read and confirmed.

*Resolved*, That evidence be taken.

*Resolved*, That the evidence relative to gauges, taken before the Commission appointed by the Provincial Government of Otago, "on Roads and their construction," be read.

Extracts from that evidence were read accordingly.

The Clerk was directed to write and request Mr. Wrigg, Mr. W. Weaver, C.E., Dr. Hector, F.R.S., Major Heaphy, V.C., and Mr. Balfour, C.E., and the Hon. J. C. Richmond, to attend the next meeting of the Committee.

The Committee then adjourned to 11 a.m., the 18th September, 1867.

WEDNESDAY, 18TH SEPTEMBER, 1867.

PRESENT:

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| Hon. J. Hall. | Hon. J. C. Richmond. |
| Mr. Tancred. | Major Heaphy, V.C. |
| Mr. McNeill. | Mr. Moorhouse. |
| Mr. Taylor. | Mr. Macandrew. |

Mr. Burns in the Chair.

Minutes of previous meeting read and confirmed.

Mr. Wrigg, C.E., called in and examined.

I am a Civil Engineer by profession, and have had considerable experience in construction of roads. I have not much knowledge of this country, but have had considerable engineering practice. I consider the proper suitable gauge for a trunk line in this country would be 4 feet 8½ inches. With that gauge you would easily obtain a speed of forty miles per hour, when the curves are moderate, and it is highly probable that the curves in this country would of necessity be sharper than those adopted in England, and the speed would consequently have to be diminished. High speeds would entail the necessity of heavier construction of the permanent way, a larger class of locomotives, and the working expenses are necessarily much higher than in moderate speeds. A larger gauge than 4 feet 8½ inches would be attended by enormously increased cost in construction of works. Upon a gauge much narrower than that higher speed would not be safe; say a gauge 3 feet 6 inches might attain a safe speed of fifteen miles per hour, with curves of favourable construction. So far as the construction is concerned with regard to viaducts, there would be very little difference in the cost, but in tunnels and earthworks an increase nearly in proportion to the gauge—in round numbers, about a third more. In constructing carriages on the overhanging principle, you seriously disturb the centre of gravity, thereby increasing the danger of travelling. In my opinion the gauge to be adopted on trunk lines should be 4 feet 8½ inches, because by adopting that gauge you would hereafter attain a higher rate of speed when the circumstances of the country required it. It must be borne in mind that alterations

in the earthworks to adapt them to a wider gauge could not be executed at the cost of one-third of the saving between the 3 feet 6 inches and the 4 feet 8½ inches gauge. The increased cost of a broad gauge line would be in relation to the weight to be carried as well as to the actual increase in width. I have been employed on the Derbyshire, Staffordshire, Dublin and Drogheda, South Durham and Lancashire Union, and several other lines. The gauges on these English lines were 4 feet 8½ inches, on the Irish lines 5 feet 3 inches. It must be borne in mind that all the broad gauges are now being converted at an enormous expense to the 4 feet 8½ inch gauge. Speed and security are the advantages to be derived from the broader gauge. Security being the same, speed is the only advantage. I do not know the population of New Zealand. I consider a 3 feet 6 inch gauge would give all the accommodation required for many years. I am not sufficiently acquainted with the country of the Middle Island to state definitely what gauge should be adopted. I have not seen a railway of 3 feet 6 inches gauge worked with locomotives. Supposing there were two-thirds of good country favourable to railway lines, and one-third bad, the gauge and construction of the line through the bad country, in my opinion, ought to give way to the construction of the line through the good country. I have no knowledge of the 3 feet 6 inch gauge railway, but I understand that that gauge has been a mistake. With curves of ten chains radius, there would not be any material difference in safety between 4 feet 8½ inch and the 3 feet 6 inch gauge. There is a greater temptation to construct carriages used on narrow gauges to overhang to a greater extent than on broad gauges. I do not think sufficient information is derivable to enable the Legislature to decide on one uniform gauge.

Mr. Weaver, C.E., appeared before Committee, and examined.

I have had considerable experience in engineering in New Zealand. I am not at all acquainted with the character of the country of the Middle Island. I cannot give an opinion definitely as to any uniform gauge for the Middle Island. I have seen railways carried over very heavy country in New South Wales and Victoria. The gauge of the Government lines in New South Wales was the English narrow gauge, 4 feet 8½ inches, and the gauge in Victoria 5 feet 3 inches, the Irish gauge. The Government railway gauge in Queensland is 3 feet 6 inches. The relative cost between the lines now being constructed in New South Wales and Queensland is, that in New South Wales the average cost per mile of lines, rough very heavy country, is from £10,000 to £11,000 per mile; and in Queensland, from £8,000 to £9,000 per mile. I should think that the cost of construction on a line of 5 feet 3 inch gauge would be one-sixth to one-seventh more than the 4 feet 8½ inch gauge. The lines I refer to in New South Wales are through extremely heavy country, excavations almost entirely of sandstone rock. Gradients of 1 inch in 30 and 1 inch in 33 for two miles continuously, and on these gradients, curves of 6 and 8 chains radius and a zig-zag. And of course the rolling stock was made specially for the working of this line. Both the above estimates of cost per mile includes rolling stock. I may add the gradients are not so heavy on the Queensland lines. The 3 feet 6 inch gauge railway in Queensland, as a railway, has been a success, but as an economical railway, a failure, both in cost of construction and working expenses. This is partly owing to the natural difficulties of the country being under estimated, and partly to the increased cost of rolling stock, which had to be made especially for that line. The actual current working expenses of this line can hardly be estimated as yet, as the line is only recently opened. I doubt if there are any advantages in increasing the gauge beyond 4 feet 8½ inches. You lose very considerably, both in power and speed by diminishing the gauge below 4 feet 8½ inches, and also carrying capacity. I would not recommend a 3 feet 6 inch gauge for a main trunk railway through the country. There would be no serious engineering difficulty in adding on a third rail on the trunk lines to admit of rolling stock of tributary lines running over the main trunk lines. There would be no difficulty in running a 4 feet 8½ inch engine with 3 feet 6 inch trucks behind it, at a speed not exceeding twenty miles per hour, provided that a third rail was laid. The average speed maintained on Queensland lines is about twenty miles per hour. I consider a great advantage on the point of economy would be attained by adopting the 4 feet 8½ inch gauge, as railway plant in Britain is almost always made for that gauge.

The clerk was directed to summons Mr. Balfour and Dr. Hector for Thursday, 19th September, at 11 a.m.

The Committee then adjourned to Thursday, the 19th September, 1867, at 11 a.m.

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THURSDAY, 19TH SEPTEMBER, 1867.

PRESENT:

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| Major Heaphy, V.C. | Mr. Macandrew. |
| Mr. Curtis. | Hon. J. Hall. |
| Mr. McNeill. | Mr. Tancred. |
| Mr. Moorhouse. | |

Mr. Burns, in the Chair.

The Committee met pursuant to adjournment, at 11 a.m.

The minutes of the previous meeting were read and confirmed.

Dr. Hector, F.R.S., appeared before the Committee, and gave the following evidence:

I am Director of the Geological Survey. I have had opportunities of examining the Middle Island; also a great part of the North Island, particularly Wanganui. From Nelson to Otago, a trunk line would follow the west by Jackson's Bay, then strike into the heart of the Province of Otago, about Lake Wanaka; this line, in my opinion, would be the best for opening up the mineral resources of the country. I do not think it would be possible to construct one trunk line that would serve the country. I do not think the completion of a through trunk line is necessary, with the facilities afforded by sea communication. Portions of such a trunk line might be constructed to act, in the first place, as feeders to the seaports, afterwards to be joined together to form one trunk line, when such expense could be warranted by the continuous settlement of the country. Transverse lines would be much cheaper than

longitudinal lines. From Nelson to Greymouth a longitudinal line would have advantages over a transverse line. I think railways ought to be constructed on a gauge best suited to the natural features of the country, because the through traffic will be for a long time a subservient consideration for reasons previously stated; one uniform gauge is therefore not an immediate necessity.

To a question by the Honorable J. Hall, and some questions by Major Heaphy, V.C., Dr. Hector promised to append answers and send them to the Committee at its next meeting.

Dr. Hector retired.

Mr. Balfour attended, and made the following statement to the Committee:

My practice has been exclusively in hydraulic engineering: bridges, harbours, docks, and light-houses; consequently, my opinion on railway matters is not based on actual experience of such work. In this country the question seems to be: How can you, at the least cost, make the greatest length of line of a reasonably substantial character? Any reduction of gauge which will save £1,000, or even £500 per mile, and yet leave the works of such a character as to be able to carry a moderate traffic, at a moderate speed, deserves attention. Other engineers will be able to estimate the difference of cost between the different gauges in various lines of country. In considering the question of trunk lines, if a gauge is to be fixed, it should be fixed in reference to the most difficult; or at all events to the average country, and not to the easiest. It is to be remembered that, even if a narrow gauge be adopted, the construction of such a line would greatly facilitate operations in constructing heavier lines hereafter, and the question of reconstruction and widening the lines may properly be left to posterity. In America, that system of temporary construction was largely adopted for their canals (and is, I believe, adopted for railways also); the locks were, in many instances, made of timber, and it was found that the pre-existence of the canal greatly facilitated the reconstruction of the locks in stone at a later period, as all materials were carried to the work at a minimum cost. I conceive that an ordinary gauge, such as 4 feet 8½ inch, can be worked with improved plant on as sharp curves and as steep gradients as a narrower line, so that even were a narrow gauge adopted in the meantime the only important work involved in reconstruction would be the widening of bridges and earthworks, and increasing the dimensions of tunnels; but the bridges would probably require renewal at any rate before the increasing traffic rendered such reconstruction necessary. If the 4 feet 8½ inch gauge can be constructed at a moderate cost over the cost of a narrower gauge, I should recommend its adoption; but even a moderate saving would make me incline to adopt a narrower gauge, especially when it is remembered that the weight and cost of plant diminishes in a rapid ratio. The earthworks might, if required, be made to the width for the permanent gauge at first, and a lighter line laid *pro. tem.* I am aware that there is a growing feeling in England that the 4 feet 8½ inch gauge is too narrow, and that it should be increased, but the amount of traffic there is so entirely out of proportion to what can be expected here, even fifty years hence, that that feeling should have but little weight. On the other hand I understand that the New South Wales railways do not pay running expenses* (I say this subject to correction, and only as the hazy recollection of, I think, a newspaper paragraph), and this seems an additional argument for keeping down first cost. Of course, in all such questions, cost of working must be considered along with prime cost, or the interest on prime cost, and that railway is the best which will result in these two items—interest on capital outlay, and annual working expenses—being a minimum, and it seems to me on this point that the evidence of engineers more experienced in railway works should be taken, and that a direct answer should, if possible, by any means be obtained.

JAMES M. BALFOUR, Mem. Inst. CE.,
Colonial Marine Engineer.

Mr. Balfour made the following verbal statement to the Committee:—

"I admit that the cost of widening embankments and tunnels lined with masonry at a future period is much greater in proportion than the extra cost of constructing the full width at first; but it is a question whether even that extra cost may not properly be borne by posterity. It is desirable that if a trunk line were constructed it should come out as near Port Underwood as possible."

Mr. Balfour retired.

Mr. Marchant, C.E., appeared to give evidence, but in order to save time some written questions were handed to him, to which he promised to append written answers, and send in to-morrow before the meeting of the Committee.

The Chairman read the following letter to the Committee:—

GENTLEMEN,— Wellington, 19th September, 1867.

Will you kindly permit me to say a few words relative to Railway Gauge. My acquaintance with railways in England, and with the principal engineers—the Nagin's, the Stephenson's, Pen, Ravenhill, &c., enable me to say, and I know I am only reflecting the opinion of those engineers in support of my own,—

1. That there can be no doubt of the desirability of a country adopting one uniform width of gauge.

2. That the gauge of 4 feet 8½ inches is the best possible width that can be relied on for safety, accommodation of passengers and merchandise, and also for speed.

3. That 4 feet 8½ inches is the gauge used throughout England, with the exception of the Great Western, and even on this an extra rail is laid for the 4 feet 8½ inch gauge trains to run on.

4. That the adoption of the narrow gauge of England of 4 feet 8½ inches has many and great advantages—namely, when the company lay down their permanent way of course, they would have new locomotives, carriages, and luggage trains. But here again is an advantage in adopting the uniform gauge of England of 4 feet 8½ inches, for at Leeds, Sheffield, Manchester, &c., there will be found ready to hand and procurable for much less cost, locomotives, &c., than those made to order, but if a different gauge be adopted, the whole expense will be greatly increased.

If the country should fall into so fatal an error as adopting a fancy gauge, it will end in numerous

* I am informed by Mr. Weaver that they more than pay working expenses, but do not pay interest on outlay.

disasters, and it is to be hoped that the Committee will ponder well before it be led to adopt any less or any other gauge than the one in England—namely, 4 feet 8½ inches.

And last, not least, the important fact that capitalists in England who look shrewdly at these things would be slow to part with a penny on a 3 feet gauge.

To the Committee on Railway Gauge. FRANCIS STEVENS, Sen.

The Committee adjourned till 11 a.m. to-morrow.

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MONDAY, 23RD SEPTEMBER, 1867.

PRESENT:

Mr. Tancred. | Hon. J. C. Richmond.
Mr. McNeill. | Hon. J. Hall.

Mr. Burns in the Chair.

Minutes of the previous meeting read and confirmed.

Answers from Dr. Hector to questions submitted to him were laid before the Committee and read.

A letter from Mr. R. M. Marchant, C.E., was laid before the Committee and read.

Copy of Mr. R. M. MARCHANT'S, C.E., Letter.

SIR,— Wellington, 19th September, 1867.

I have the honor of supplying the following answers to the questions submitted for my reply:—I am a member of the Institute of Civil Engineers since 1849, in which year I was elected an Associate. As in the Colonies it is not unusual for assurance to take precedence of ordinary professional reserve, it appears desirable that I should state, in answer to this question, both what my experience is and how it has been obtained, for the question under consideration may involve important results, and the value of any evidence depends on the experience of the witness, and the character of that experience. From 1838 to 1846 I was engaged as Assistant Engineer to Mr. Brunel on the Great Western Railway, the Bristol and Exeter Railway, and the South Devon Railway, in the construction of several tunnels, and other works. From 1846 to 1849 I was engaged as Resident Engineer for the most important works on the Oxford, Worcester, and Wolverhampton Railways. From 1849 to 1855 I became contractor for several important public works—railway and hydraulic. From 1855 to 1860 I was engaged as Superintending Engineer for the construction of the Don Pedro Second Railway, and afterwards as Engineer-in-Chief for the Tiguea Railway and other works in Brazil. From 1860 to 1866 I concluded extensive surveys in Victoria, and subsequently became Railway Engineer in Southland, where I continued until the expiry of my engagement on my notice to that effect on the approximate completion of the railway. I hold letters from Mr. Brunel himself, proving his appreciation of my professional capacity, and one in which he recommends me as qualified by professional capacity and personal integrity for the important appointment of Engineer-in-Chief to the East London Water Works Company, also documents and letters from other gentlemen to the time of my arrival in the Australian Colonies. I am acquainted with the character of the Middle Island generally, and in places particularly. I am of opinion that whilst it is desirable to provide by legislation for a future connected system of railway communication, no hindrance should be thrown in the way of private enterprise, or the execution of works in what may be the only feasible manner at the time of their organization. That the prudent course would be to decide on what the future Colonial gauge should be, and to require the provision of sufficient width of land, and the construction of bridges and culverts, &c., of such dimensions as should not interfere with the adoption of the gauge determined on at any future period. Such provision could be made at very little additional expense. I would recommend the adoption of the 4 feet 8½ inch gauge, which works satisfactorily at home for any speed not exceeding forty miles an hour, and may therefore be expected to carry any traffic satisfactorily here, and to allow such curves as will necessarily be in occasional use to be more easily worked. The advantage of a broader gauge, as particularly exhibited by the 7 feet 1 inch gauge of the Great Western Railway system in England, is not confined to speed, except in cases where the narrow gauge will conveniently carry the traffic. It will both allow of greater speed and of heavier traffic, but the necessity for either must exist to render the additional expense desirable. 220,000 or thereabouts. I think such a gauge would carry any traffic existing in New Zealand, or that is likely to exist in any locality for the next ten years. Many elements affect the answer to this query, the most important being the gradients that would be accessible. Speed must be one element in the consideration, and I assume the rate maintained to be that of fifteen miles an hour. With ordinary gradients and appropriable arrangements such a railway could be constructed to convey 200 tons each way daily, and with a double line of way throughout, the quantity so estimated could be at least trebled. Every sixty passengers would occupy space necessitating the deduction of twenty tons from the tonnage so estimated. This would appear to meet the requirements of a population of at least 20,000 at each extremity of such a railway. I am acquainted generally with considerable portions, and from personal observations, with particular localities. I am generally acquainted with the results, but have never constructed a railway to this gauge. I am fully acquainted with the working of them. If tributary lines had a gauge of 3 feet 6 inches, a third rail could be added to railway of 4 feet 8½ inches gauge to convey carriages of tributary lines. This arrangement is common in the south of England. This could be done, but would, as a rule, be objectionable. I think that any legislation which goes further than to provide that works should be so constructed as to be rendered applicable at any time for the reception of any particular gauge determined on, would be detrimental to local enterprise. I have such knowledge to a very considerable extent.

The Chairman of the Railway Gauge Committee. R. M. MARCHANT.

Copy of written answers from Dr. Hector to questions submitted to him:—

1. Do you think that the topographical character of the Middle Island is such as to allow of one

continuous trunk line being formed, or would a line to give access from Nelson towards Southland have to lead in oblique and even transverse directions in particular parts of the island?—Certainly, a main trunk line in the South Island must cross the mountains once for physical reasons. The natural passage between Nelson and Southland would cross from the West Coast to the interior of the Province of Otago, either by the Womaka or Wakatipu Lakes. By this route all the formidable shingle rivers on the east side of the island would be avoided, and the mountains crossed at the lowest altitude (under 2,000 feet). The line would cross through mineral bearing country throughout its entire length, and therefore might be adopted for the purpose of opening up country, but it would not be suitable as a line of through communication, as it would not connect the principal settlements.

2. Would this also be the case in the North Island?—The North Island is more suited to a central railway line, with branches radiating to each coast, than is the case in the South Island.

3. Does it not appear to you that the sea will subserve the purposes of trunk communication, and that transverse lines will, for a long period, be more suited than longitudinal lines?—

4. Would you indicate the districts which, in your opinion, present the greatest natural difficulties to railway communication, stating whether these difficulties are in lines generally longitudinal, or transverse, with respect to the direction of the island?—As a general rule, in Otago and Nelson it would be easier to construct North and South lines, owing to the direction of the rivers; but, in the central districts of the South Island, transverse lines could be made with less outlay at first. In the South Island, as a rule, the country occupied by the palæozoic rocks (coloured stone grey on the geological maps) is the worst for railway communication owing to the steep and complicated character of the valleys, and the large amount of shingle by which they are always occupied. In the North Island, the same formation forms a ridge from Cape Terawitte to Cape Colville, which would present the same difficulties; but there is an additional formation in the North Island, wanting in the South, that would be very formidable; namely, the pumice plains in the interior which have no regular system of drainage, being intersected by deep ravines, which no engineer can avoid without great expense. This region is principally in the interior, and towards the west coast at Kawhia.

5. Assuming it to be desired to undertake, within the next ten years, a trunk line of railway through the Middle Island, as part of a general line of communication from North to South of New Zealand, what line do you think should be adopted?—If the object of such a line be merely to facilitate through communication, it must necessarily follow the shortest route available for connecting the centres of population and the densely settled districts, even if the engineering difficulties are thereby increased as compared with other routes. This line, it may be anticipated, will pass through the eastern districts of Otago and Canterbury, in the southern part of the island, and through the western district of Nelson, in the northern part, involving the crossing of the mountains somewhere in the north part of the Province of Canterbury. By this route communication would be established between the principal agricultural or producing districts, and the mineral districts, where there will be a consuming population.

A Report was drawn up by Mr. Burns and Mr. Tancred, and adopted.

The Committee then adjourned *sine die*.