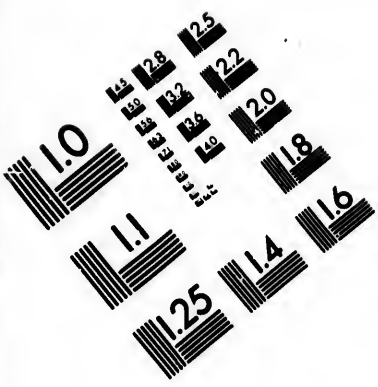

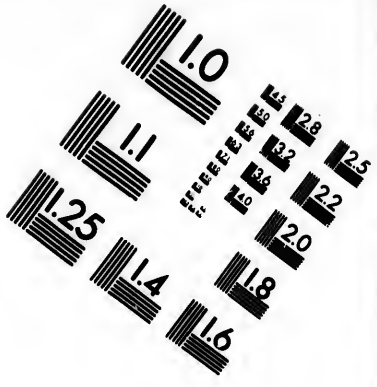

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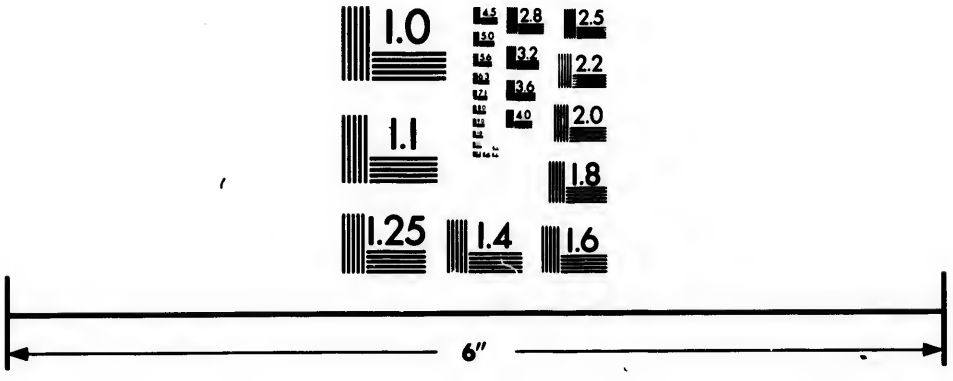

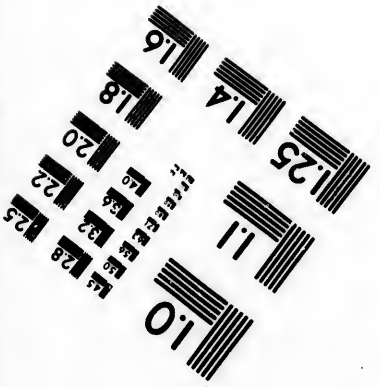

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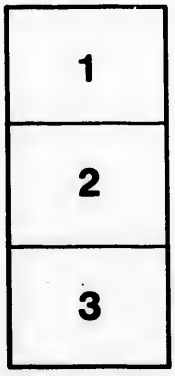

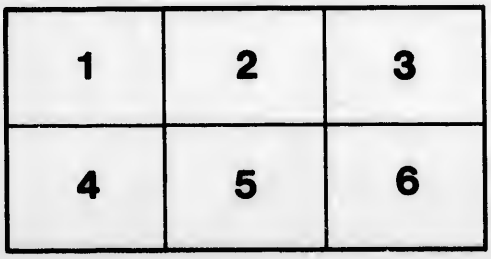

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REPORT

OF

MR. CHARLES HUTTON GREGORY, C.E.,

Dated the 15th of August, 1857,

UPON THE WORKS OF THE

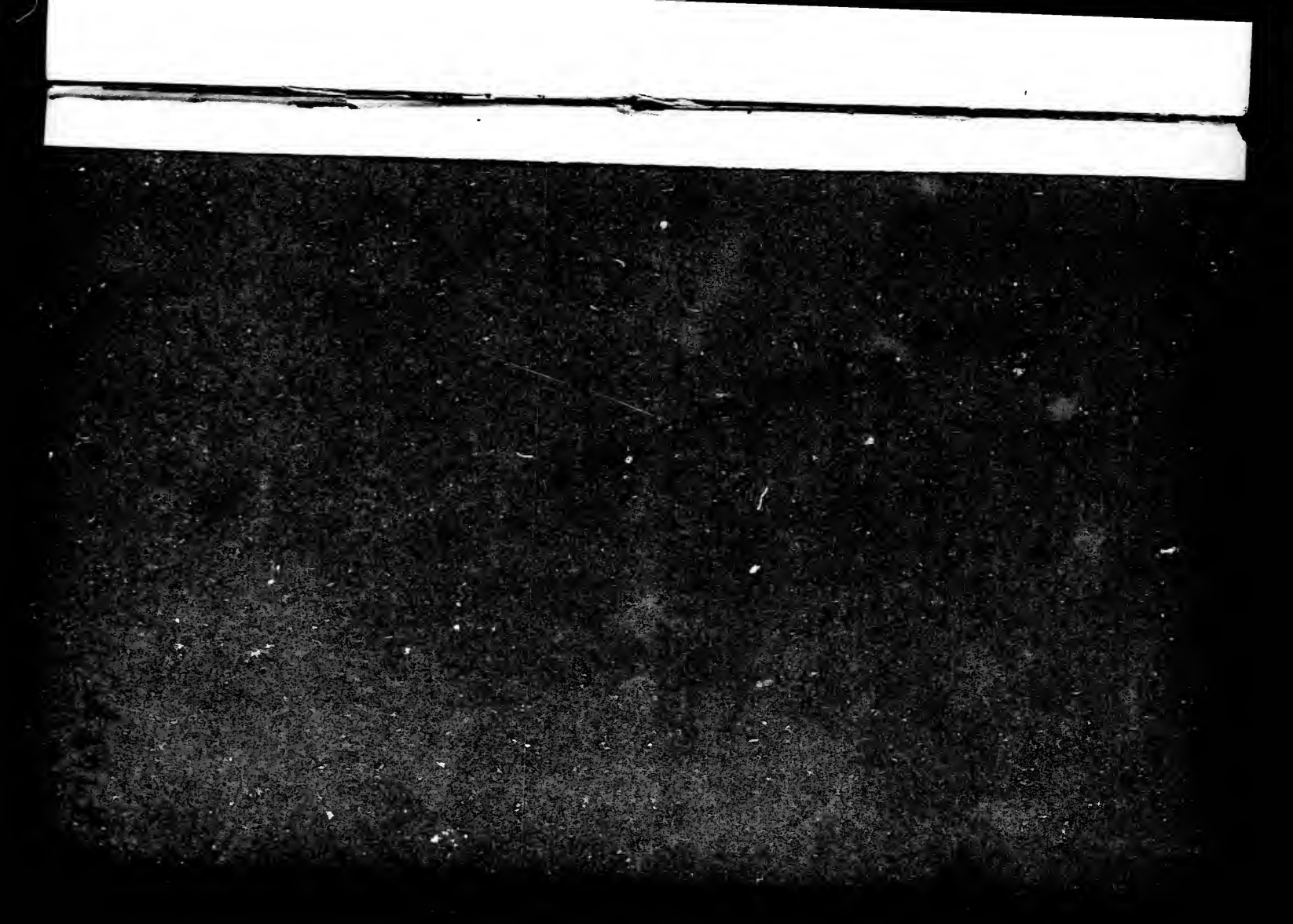
GRAND TRUNK RAILWAY COMPANY OF CANADA.

LONDON:

PRINTED BY WATERLOW AND SONS, CARPENTERS' HALL,

LONDON WALL.

1857.



To the Chairman and Directors of the Grand Trunk Railway Company of Canada.

Gentlemen,—In compliance with the instructions conveyed in your Secretary's letters of February 12th and April 23rd, 1857, I left England on April 25th; and on July 1st, having completed the necessary examination of the Works and Rolling Stock, I left America for this Country.

The Railways comprised in your System are: the Atlantic and St. Lawrence, (under lease,) from Portland to Island Pond, 149 miles; the St. Lawrence and Atlantic, from Island Pond, by Richmond, to Longueuil, opposite Montreal, 143 miles; the Quebec and Richmond, from Richmond, (72 miles short of Longueuil,) by Chaudiere to Point Levi, opposite Quebec, 96 miles; the Quebec and Trois Pistoles, from Chaudiere (8 miles short of Point Levi), at present open to St. Thomas, 40 miles; the Montreal and Toronto, 333 miles; the temporary Line through Toronto, about 2 miles; and the Toronto and Sarnia, at present open to Stratford, 87 miles.

The Atlantic and St. Lawrence, and St. Lawrence and Atlantic Railways, (which will be the subject of another Report, in accordance with Instructions I received from you while in America,) were opened in Sections, the connection between the Atlantic and the St. Lawrence being completed in July, 1853.

The Quebec and Richmond Line was opened in November, 1854; the Section of the Quebec and Trois Pistoles, between Chaudiere and St. Thomas, in December, 1855; the Sections of the Montreal and Toronto Line, between Montreal and Brockville, (129 miles;) Toronto and Oshawa, (33 miles,) and Brockville and Oshawa, (171 miles,) in November, 1855, August, 1856, and October, 1856, respectively; and the Sections of the Toronto and Sarnia Line, from Toronto to Guelph, (49 miles,) and from Guelph to Stratford, (39 miles,) in July, 1856, and August, 1856, respectively.

It will be remembered that the lengths from St. Thomas to Trois Pistoles, eastward, (113 miles,) and from Stratford to Sarnia, westward, (79 miles,) remain to be completed, besides the important con-

nection of the Victoria Bridge over the St. Lawrence, and a Junction Line of about 3 miles between the Victoria Bridge and the St. Lawrence and Atlantic Section; the river St. Lawrence at present breaking your Railway Communication east and west of Montreal.

The general tenor of my instructions required me to report whether the Contracts executed by Messrs. Jackson, Peto, Brassey, and Betts, the English Contractors, and by Messrs. Gzowski and Co., the Canadian Contractors, have been satisfactorily carried out, whether the amounts charged as extra have been legitimately so treated, and whether the apportionment of payments in respect of Contracts only partially completed, is justified by the amount of work executed.

Before proceeding to the investigation of these questions, it may be desirable to call your attention to certain circumstances of a general nature which ought not to be lost sight of in an equitable consideration of what has been done.

The various Lines of Railway now incorporated in the Grand Trunk Railway of Canada, were originally separate Schemes; and Contracts, more or less complete, and more or less corresponding with those under which the works have been carried out, had been initiated by the separate Companies previously to the Amalgamation.

In settling the provisions of these Contracts, the lengths of Sidings and the amount of Rolling Stock were in some cases reduced by the intervention of the Canadian Legislature, some of whose Members actively co-operated in all the arrangements, and in the details of the Contracts. In other respects, limitations were made in the specific requirements of the Contracts, with the view of keeping down the cost, and in some particulars, a necessarily partial knowledge of what had to be done may have led to omissions, while the extremely limited extent of Railway operations in Canada gave no adequate precedents of the forms of construction best suited for a climate of extreme severity and vicissitudes.

These circumstances will help to explain alterations and additions which subsequent experience may have proved to be necessary, and at the same time to show the reason why the Directors have been unable to realise the assurance expressed in the Appendix to the Prospectus, that the whole Railway, fully equipped and complete in every respect, would be delivered free from any further charge whatever.

The various Contracts, while aiming at a guaranteed amount, are nevertheless accompanied by specific provisions; and where these provisions have been exceeded, extra cost has of necessity arisen. In reference to these extras on the Montreal and Toronto Line, the report of Mr. A. M. Ross, the Engineer-in-chief, dated February 21st, 1855, gave full explanation, before the extra works themselves were constructed; and as it has been stated that no authority was given to him to carry them out, it is only due to him to state that I have not learned that any orders were given that the extras referred to should not be incurred, either at that time, or when the accounts for them began to come in.

Coincident with the progress of the bulk of the work, a great increase arose in the cost of labour, amounting to at least 50 per cent. above the price of labour in England. To this effect the carrying on of such an extent of Railway Work at the same time, no doubt, largely contributed. It has been stated to me that out of a population of about one million and a quarter, in Upper Canada, there were at one time, in that portion of the Province, about 16,000 Workmen on the lists of the Contractors, in daily employ on the actual works, in addition to quarrymen, "lumberers," and others, engaged in preparing materials.

At the same time, it must not be forgotten that the greater portion of the works under consideration has been carried out under circumstances of extraordinary financial difficulty, and that they have, notwithstanding, been conducted by the Contractors with energy, and in some cases with extraordinary rapidity. There cannot be a doubt but that to the perseverance thus exhibited must be ascribed the avoidance of the embarrassment, complication, and loss which must have ensued from the abandonment of the work. The Company has thereby been enabled to fulfil its obligations to the Province and the public, to an extent and in a manner which, I venture to think, should command the fullest consideration from the Country so greatly and permanently benefited by these exertions.

With these circumstances prominently in view, you would doubtless feel that the Contractors merited at your hands such indulgence as might not be inconsistent with justice to your Shareholders.

Assuming extra payments to be fairly payable under the contracts, one way of calculating the rates to be paid would be by reference to such prices as would make up the total amount of the contract. The agreement with the English Contractors, dated

July 23rd, 1855, provided that in the event of the abandonment of the unfinished portion of the Quebec and Trois Pistoles Line, any additional works required should be paid for at rates equivalent to those of the suspended works, which, I believe, would be found to be remunerative.

By the agreement with the same parties, dated August, 1855, provision was made for certain shares being written up to them, in payment of additional works, at prices to be determined by arbitration in case of difference.

I understand that all payments made to the English Contractors for extra works are in securities at a considerable depreciation in nominal value; and there can be no doubt that any arbitrator, in fixing prices for work, would take into account the real value of the medium of payment.

The Canadian Contractors being paid in cash for extra work, would not be entitled to ask a similar mode of calculation; but they would perhaps urge that the rise of prices should form an element of consideration in the payment of any work beyond the contract.

In the examination of railway works in Canada, the peculiar inclemencies of climate must not be forgotten. Previously to the setting in of the winter, the ground is usually charged with wet; during the winter there are heavy falls of snow, and occasional thaws; and when the frost finally breaks up, the ground, which had been frozen to a depth of three or four feet, is so disturbed, where the material is of a pervious nature, that the whole surface is set in motion; and even where there may be no serious slips, the rapid thaw, and even the rains of summer, produce irregularities in almost all earthwork, such as are only seen in the worst soils in England.

This movement is diminished in extent after a few seasons, but it is so considerable for the first year or two, that it has not been usual to soil and sow the slopes of Canadian Railways when the lines are made, nor did I observe sown slopes on the Railways of the Northern States; and in places where it was tried, in the first formation of the Grand Trunk Line, I observed that most of the soiling had been washed away. With a predisposition, therefore, to regard such soiling and sowing as a necessary accompaniment of good work, I subsequently came to the conclusion that, for the most part, it would at first have been labour in vain; and while I observed in those parts of the Grand Trunk Line, last completed,

that the slopes had evidently been finished off with care, I was obliged to recognize the unreasonableness of expecting in Canadian Railways that finished and regular appearance of earthwork ballast and drainage, for which an English Engineer would look.

Besides the inclemencies of the Canadian climate, which must have frequently opposed most discouraging obstacles to the prosecution of works of art, the greater part of the work had to be carried out in a country which is as yet defective in its means of internal communication, and in those facilities for construction which are found in this country.

I have alluded to these considerations at some length, because I feel that those at a distance should understand some of the difficulties which have been encountered, and that without a knowledge of all the circumstances of the case it would be impossible fairly to appreciate what has been accomplished.

For the information of the Board, and for future reference, I thought it desirable to request the Engineer-in-Chief to prepare Plans and Sections of the several Lines, enlarged Plans of the Stations, and Drawings of the principal Works of Art, to accompany and illustrate this Report.

QUEBEC AND RICHMOND SECTION.

The Quebec and Richmond Section was executed by the English Contractors, under a contract made with the then Quebec and Richmond Railway Company, dated October 20th, 1852.

Appendix A, is a brief abstract of the principal conditions of the Contract and Specification, which provided that the Contractors should complete the Line according to certain Sections, as a single line, with Stations, Plant, and Equipments, described in the Specification, which was to be taken as a part of the Contract.

I have now to state how far these conditions have been complied with in the execution of the work.

The Land has been provided on a very liberal scale; while the Contract is only for a single line, the land is almost everywhere found for a double line, without extra charge. The land at stations is also very full, and varies from a total of $3\frac{1}{4}$ acres to a total of

28¾ acres, as shown in Appendix B. These are beyond the average quantities of land at stations in England, and will allow for considerable extensions, if necessary, at any future time.

The Earthworks appear to have been properly executed, but the contract width of 15 feet was found to be insufficient for the embankments, which were subsequently increased, and the additional work allowed for in the final settlement.

It was stated to me that the preliminary and approximate Section of the Line, on which the Contract was let, did not correctly represent the actual quantities of Earthwork, and that partly from this cause, and partly from the shortening of the Line through difficult country, additional Earthwork was required to the extent of 1,175,048 cubic yards, of which a large amount was rock. This, at the rates of the divisional estimate, would have been valued at rather more than £100,000. Although it is by no means clear that the clause in the Contract which required the execution of larger works than were shown in the Section ought to cover so great an excess, the Engineer-in-Chief decided that he could not allow any extra payment to the Contractors on this account, but he very properly allowed it to weigh with him in not claiming any deduction for the shortening of the Line.

Abstract statements of the Gradients and Curves will be found in Appendix C, which shows that 8 per cent. of the gradients are from 40 to 50 feet per mile, and 61 per cent. either level or under 20 feet per mile; and that a total length of 3,900 feet near stations has curves of less than 1,000 feet radius, the prevailing radius of curves being 6,000 feet. These results are satisfactory.

To the Permanent Way I shall allude generally, after considering the several Sections seriatim. I will here only observe that it appears to have been carried out in accordance with the specification, with the exception of a few miles in which a lighter chair has been used; the difference, however, was made up on the other Sections.

The Drainage is generally satisfactory, the cross drainage being very complete and efficient.

Besides the ordinary drainage of the Railway, the Contractors executed four large outlet drains, extending beyond the fence to distances stated to me as averaging three-quarters of a mile. Although, perhaps, some claim might have been justifiable for these, I find that no extra payment has been allowed.

Many of the Culverts have been made with timber tops to facili-

tate the clearing of them, and I do not consider this variation from the Specification to be objectionable, while the saving to the Contractors, where any exists, would be inconsiderable.

Between Point Levi and Chaudiere there are several under Bridges, for farm roads, of rough masonry with timber tops; they were not well constructed, and some of the abutments and piers have cracked. These were built by the first Contractors, before the English Contractors took to the work.

In the Bridges and Culverts executed by the English Contractors, a close scrutiny only enabled me to discover comparatively few places where even unimportant failures could be seen in the work, and these were almost exclusively confined to the smaller structures.

In some cases timber tops have been allowed for road bridges over the Railway, but it would appear by the contract that level crossings might have been substituted, which would have been less satisfactory.

Of the larger works of art, a list is annexed in Appendix D, a reference to which will show that many of them are large and important works. Taken as a whole, they are works to which Engineer and Contractors may alike point without fear of criticism, and many of them are far superior to constructions of a similar character in England.

Among the best works I may cite the Etchemin River bridge, with two spans, one of 155 feet and one of 40 feet; the Chaudiere River bridge, with ten spans of 93 feet; the Becancour River bridge, with three spans of 100 feet; the Du Loup River bridge, with two spans of 100 feet; the Nicolet Arthabaska River bridge, with two spans of 100 feet; Ellis Brook bridge, with one span of 100 feet; and Nicolet Danville River bridge, with two spans of 80 feet.

The wrought-iron tubes and girders used are of excellent design and manufacture, and in those which I tested, the deflection did not exceed half an inch.

While the Specification provided for ten river bridges of a total opening of 2,135 feet, seventeen river bridges have, in fact, been erected, with a total opening of 2,535 feet. For these additional works no extra price has been allowed, although I believe that the clause in the contract which allowed the Company to require more expensive works than were shown in the section, without extra charge, would not strictly apply to such works as these, distinctly

enumerated in the specification, but was intended to apply to alterations in the section of the line.

The Woodsheds have not been carried out exactly as specified, but sheds have been placed where most convenient, so as to make up the contract amount. Of the water supply, the only complaints that have reached me appeared to have arisen from the unusual dryness of last autumn.

Taken as a whole, the extent of Locomotive Engine House accommodation stipulated has been exceeded.

The very convenient Passenger and Goods Station at Quebec was, as you are aware, burnt down. Although quite equal to the requirements of the traffic, it did not come up fully to the extent of accommodation specified. In some of the other stations also, although as much accommodation has been given, as the traffic would appear, by all accounts, to be likely to require, the specified dimensions are not fully supplied. I believe, however, that the value of the deficiency in stations would be covered by the value of the river bridges, in excess of what was specified.

The Pier works at Hadlow Cove were not constructed according to the Specification, but others substituted at Point Levi, and a deduction made in respect of the omitted work, in settling the sum at which the agreement fixed the price for the Tibbet's Cove Extension, to which reference will be made when treating of the Accounts in Appendix F.

To the general character of the Rolling Stock I propose to refer as a whole, in a later part of this report. The number of Engines and Carriages supplied on this Section, as compared with those specified, will be found carried out in Appendix E. The total numbers supplied were the same, but their description was varied, and the application of the rates used in the Engineer's divisional estimates shows a money deficiency of £1,080. On the rolling stock of the other lengths, however, similarly calculated, there is a total money excess of £854, so that in the entire rolling stock supplied by the English Contractors there would appear to be a money deficiency of £226; a deficiency inconsiderable in a quantity of an estimated value of upwards of £312,000.

I annex in Appendix F, an abstract of the total payments made for this Section, with observations on the several items of Account, the result of which, as a whole, I consider to be reasonable and equitable.

In the execution of the Quebec and Richmond Section, as well as the settlement made for it, I am of opinion that full justice has been done to the Company, and the spirit of the Contract properly fulfilled.

QUEBEC AND TROIS PISTOLES SECTION.

The Quebec and Trois Pistoles Section was executed by the English Contractors, under a Contract with the then Grand Trunk Railway Company of Canada East, dated March 23rd, 1853.

In Appendix G, I have briefly abstracted those Conditions of the Contract which bear upon my investigation. It referred to the Specification as defining the conveniences and plant to be supplied, and required that the Railway should be superior to any American or Canadian Railway, and equal in the permanence and substantiality of the work to the best English Railways, and be such a Railway as would be certified by the Board of Trade, as fit to be opened for traffic, and would be approved by the best English Engineers.

It also gives to the Contractors the selection of the Line, subject to the sanction of the Government.

The length of the entire Line is to be 153 miles. The Section made and opened is 40 miles in length. Many of the requirements of the Contract have therefore to be adapted to the shorter length.

In considering the due fulfilment of the Contract, the first question for inquiry was the judicious selection of the Line. Seeing the succession of villages along the banks of the St. Lawrence, I was inclined to think the Line ought to have followed its course more closely; on careful examination, however, I found that the difficulties of passing close to the river were so great, that I do not think a Railway Company, in laying out the Line for themselves, would have thought it reasonable to adopt that course.

The Line chosen I believe to be, all things considered, the best engineering Line, so far as it has been carried out. It leaves the Quebec and Richmond Section as soon as that Line has attained the level of the table land south of Point Levi, and then passes in a direction generally parallel to the St. Lawrence, running near the

inland population, and gradually descending from the table land, and approaching the river as it comes nearer to St. Thomas.

In this Line also, I find a similar liberal provision of Land to that on the Quebec and Richmond Section. Land for a double line has been provided, and Appendix H, shows that the quantities at Stations vary from two acres to nearly seven acres.

The Earthworks have been made as specified, and, in accordance with the Contract, the road bed has been generally kept above the level of the ground where desirable and convenient.

Appendix I, gives the abstract of Gradients and Curves. 8 per cent. of the length of the Line has gradients of from 40 to 50 feet per mile; and 76 per cent. of the length is either level or under 20 feet per mile. The smallest radius of curves is 15,729 feet, and the prevailing radius is 46,057 feet.

The Permanent Way has been executed in accordance with the Specification, with one exception. The Specification names 4 yards of ballast per lineal yard, and the quantity supplied is 2½ yards per lineal yard. It was explained to me that the quantity named in the Specification was set down in error, for a double line; an explanation readily admissible, since it would give for a single line an extraordinary depth, even if the ballast were boxed up to the rail level. As it is considered necessary generally in Canada and the Northern States to allow room for surface drainage of the ballast by leaving the tops of the sleepers bare, and trimming the ballast down to the sides, 2½ yards of ballast would give an adequate depth of ballast as a bed to the sleepers, and I think the Company may properly accept that amount in lieu of the obviously erroneous one.

The Drainage generally is efficient, and the timber tops of the Culverts are admitted by the specification.

The character of the Bridges and Culverts corresponds with those of the Quebec and Richmond Section. Details of the principal Bridges appear in Appendix D. The Etchemin River bridge, with six spans of 93 feet, and the Boyer bridge, with two spans of 80 feet, and two spans of 40 feet, are in every respect, very fine works.

I find that the works on the 40 miles executed are of a heavier nature than the average of the Line. For the excess of cost in the first Division, no extra has been charged; but a diminution has been allowed in the extent and character of Station and Engine-house accommodation, which would probably about balance this excess.

If the account for this Line be taken as a final settlement, I should set one against the other, as a fair adjustment; but if the Line be continued by the Contractors, a reconsideration of station accommodation, to make up the total specified, may become necessary. It is right to observe that the present accommodation appears to be fully adequate to the requirements of the traffic.

The water supply is similar to that in the Quebec and Richmond Section.

Appendix J, gives a statement of the Rolling Stock, which shows in its adjustment an excess of £14 in favour of the Company.

Appendix K, contains the abstract of Accounts, with my observations; from which I think you will conclude that the settlement has been a fair one.

Subject to the future reservation as to Stations, and due reference being had to the difficulties named in the earlier part of this Report, I consider that the requirements of the contract have been in spirit fulfilled.

MONTREAL AND TORONTO SECTION.

This Section was executed under a Contract between the Grand Trunk Railway Company and the English Contractors, dated 23rd March, 1853. Appendix L, gives its leading conditions.

This Contract agreed in many respects with that for the Quebec and Trois Pistoles Line. It set up the best English Railways as the standard for permanence and substantiality of work, with a like reference to the sanction of the Board of Trade, and the approval of English Engineers.

It gave to the Contractors the selection of the Line, subject to the approval of the Government, and with limitations of gradients and curves.

It also set aside certain contingencies of rise of prices, change of route, and cost of land, which, under a previous contract, might have influenced the price; and provided for the completion of the work, with all the appurtenances specified, for the sum of £3,000,000, without additions or deductions of any kind, or on any account.

The selection of a Line of 333 miles in length, is a question upon

which much difference of opinion may be supposed to exist. Without following the course of the Railway in detail, I may observe that in its whole length, there are only two places, namely, Montreal and Kingston, at which I should have been disposed to alter it; and, although in reference to these, much might be said on both sides, it is right to state that the route chosen has been settled by the sanction of the Officers of the Government, after the customary deposit of the proposed plans in each Township.

The Line starts from Montreal, at Point St. Charles, where its position is somewhat limited by the situation of the Victoria Bridge, and following a course generally parallel to the shores of the St. Lawrence and Lake Ontario, it passes, in most cases, on the north or land side of the Towns, which have grown up by the Navigation, the original great Thoroughfare of the Country.

The Contract nowhere stipulated for a connection with the Navigation, and the cases where such a connection would be useful are, in my opinion, few. Generally speaking, the Railway, by being placed on the land side of the Towns, is in a position to intercept the productions of the Country before arriving at the Towns, which owed their position to the circumstance of the Trade from the Back Country flowing to these places for shipment; and as the Railway becomes the main channel of traffic, these Towns may be expected, (as is already seen at Belleville and many other places,) to grow towards the Railway, which here, as usually in England, has not generally been carried through the centres of the Towns.

At Toronto, the provisional Terminus is near the mouth of the River Don, a trifle over a mile from the business Centre of that City. For a Line from Montreal to Toronto, I consider that situation a reasonable and proper one. Recent arrangements with the Municipality, under which you have already established a provisional connection with your Western Line, and a rough temporary Central Station in Front Street, will enable you hereafter to perfect that communication, and to erect, when thought desirable, a permanent Central Station for Passenger Traffic running both ways.

The Land for the Railway has been almost everywhere provided for a double line. The land at Stations, as detailed in Appendices M 1, and M 2, varies from 2 acres to 30 acres, the average of all being above 7 acres per station. At two Stations, viz., Kingston and the Don Station at Toronto, I considered the land provided to

be insufficient, and the Contractors at once undertook to supply more, at their own cost.

The widths of Cuttings and Embankments were altered by the Engineer to 22 feet for Cuttings, and 20 feet for Embankments; and as the Embankments, which were increased, are in excess of the Cuttings, this change was an expense to the Contractors, for which, however, no claim has been made. On many parts of the Line the Earthworks have suffered much from the effects of the weather, and these will for some time require the careful attention of the Contractors for Maintenance. The place which appeared to me to require most care, was along the high ground between Port Hope and Port Britain. There the Line runs near the cliff, and the ground, although extremely hard to excavate, has been so affected by frost, thaw and rain, that it will require careful draining, and probably some special protection, by covering the part most exposed to wet with dry material and faggots.

The Gradients of the Line are shown in Appendices N 1, N 2, and N 3. 18 miles, or 55 per cent. of the total length, are either level or under 20 feet per mile; and for 67 miles, or 20 per cent. of the length, they are of the maximum of 52.8 feet per mile. For the character of the country, this is not an undue proportion.

The Permanent Way has been executed generally according to the Specification, but there are certain deficiencies which have arisen from the somewhat premature openings of portions of the Line.

The first is a want of the proper quantity of ballast, which, although specified at 4 yards per lineal yard, was intended to be executed with $2\frac{1}{2}$ yards, for the reasons already given, but in some places fell short of this latter quantity.

On the western portion of the Montreal and Kingston Division, I found the deficiency being made up by the Contractors. At various parts of the Line between Kingston and Toronto I observed a deficiency, which was most marked in the section between Belleville and Oshawa, where sand ballast was frequently used, from the difficulty in obtaining, within the limited time, a better material.

This deficiency the Contractors always considered they would have to supply, but I found the Company had begun to make it good. I was informed that this arose from some misunderstanding, owing to the absence of the Engineer-in-chief.

In explanation of this and other defects, I would remind you that the lengths where they occur were opened in haste in the

autumn of last year; a length of 23 miles, from Grafton to Newtonville, being, as I was informed, constructed in about five months, although it comprised the Port Hope Viaduct, and about twelve miles of heavy work—an example of energy rarely surpassed. These portions so opened were not supposed to be complete, but the setting in of the winter put an early stop to all work which they might require.

Westward of Oshawa, I believe the line to have been for the most part fully ballasted, but some of the material used, (a sand which it was believed would stand,) has been wasted by the weather, and damaged by slips.

This cause, and the deficiency of ballast to which I have alluded, have, no doubt, contributed to the roughness of the road which was observable in the Divisions of the Line last opened.

I found between Kingston and Cobourg that many of the Sleepers were small in size. I was informed that suitable timber could not be got in the locality, in time to open the line; but that 30,000 full-sized Sleepers had been subsequently delivered for this length, which the Contractors left at the disposal of the Company; and this, I believe, would make ample compensation for this unavoidable defect.

The Rails on this, as well as the other Sections, appear to be of a very good quality, as a whole. For a short distance out of Montreal they have been much worn, by carrying over them the materials for the Victoria Bridge, for which the Contractors pay Toll to the Company. It need be no matter for surprise, that rails have been broken during the severe frosts, especially in those parts of the Line which were prematurely opened in an unfinished state.

The Rails were used by the Contractors, during the construction of the Line, and such use is so commonly acknowledged on Railways, both in England and abroad, that I do not consider the Company can ground any claim upon it, if the Rails have been fairly treated.

The Cross Drainage, generally, is good; but along the portions of the Line last opened, the Side Drainage was incomplete. Upon so much of this as was due to Construction, the Contractors had begun to work when my Inspection was made. Across the moss between the Lachine Railway and the Blue Bonnets Station, I found some Timber Structures to carry the Line over small streams, or cross drains. From the bad nature of the bottom, I consider this deviation from the Specification to have been judicious.

Between Kingston and Grafton several small Culverts have shown signs of failure. I attribute this to the difficulty of getting good materials to the ground, to the bad character of the soils, and to the speed with which the works were carried on to open the Line. When I saw them, the Contractors had begun the necessary repairs at their own cost.

The Works of Art upon this Line are of a very first-rate character. The details of the principal Bridges are given in Appendices O 1, O 2, and O 3.

To enumerate all which are worthy of note, would occupy more space than can be given in a general notice. The St. Anne's Bridge over the Ottawa River, with 16 spans varying from 60 feet to 200 feet; the Vaudreuil River bridge, with 17 spans, varying from 50 to 93 feet; the Rideau Canal bridge, with 3 spans of 100 feet; the Salmon River bridge, with 2 spans of 126 feet; the Trent River bridge, with 4 spans of 100 feet; the Port Hope Viaduct, with 55 spans, varying from 25 feet 6 inches, to 60 feet; with many other magnificent works of large size, many of them constructed under great difficulties of various sorts, will remain lasting monuments of energy and skill. The wrought-iron Beams and Tubes are of excellent manufacture, and those which I tested shewed in no case a deflection of half an inch.

On the whole Line I found no case where any failure of importance had taken place, even upon the worst foundations, while the class of masonry generally used was superior to what most English Engineers would require. On this item the Engineer-in-Chief might have allowed very great savings to the Contractors without injustice to the Company.

With this important excess beyond the requirements of the Contract, a small allowance may fairly be made for those few instances in which its requirements, as regards works of art, have not been strictly complied with.

At the Vaudreuil Bridge, double foundations, (in anticipation of a second line of rail,) have not been put in for the Land Piers. In this case the omission is unimportant, as it appears that the rock was close to the surface. In the Rideau Canal bridge I observed the absence of the double foundation to one pier. In the Port Hope Viaduct I did not find the double foundations to any of the piers; the omission in this case is explained by the circumstance of the deviation of the line required by the Company to bring it near the

shore of Lake Ontario, having entailed upon the Contractors a much heavier viaduct than would otherwise have been necessary.

The Stations and Workshops, as executed, differ widely from those specified. The workshops erected at Montreal are greatly in excess of those shown on the contract plan, having been so made with the view of centralizing there the heavy repairs of the whole System of the Grand Trunk Railway. The character of the permanent buildings is first rate, and they are well adapted for the purposes for which they are intended.

In order to meet the anticipated requirements of the traffic, additional Stations were ordered, while, in a few cases, it was considered that less accommodation at Stations might suffice. These have, therefore, been thrown into a debtor and creditor account, in the Report of the Engineer-in-Chief, dated December 20th, 1856; and my observations on the settlement for them will be found in Appendix Q.

At some of the Stations, principally in the lengths last opened, the metalling of the station yards is not complete. This the Contractors consider as to be done by them. Cranes are not furnished in the Goods' Sheds; the Traffic Manager does not consider them necessary for the character of the goods conveyed, and some that were supplied have not even been erected.

The extent of Water and Wood accommodation supplied I consider to be in conformity with the spirit of the contract. In some places, often away from the stations, additional Tanks and Wells, with Steam Engines, have been constructed to make good deficient sources of supply, which experience had detected in the Wells ordered under the contract. These have been charged as extra. The water supply gave great trouble last winter, partly owing to unobserved defects, but principally from the frost having set in when the ordinary sources of water supply were unusually low. I found the defects of construction in course of repair by the Contractors at their own cost.

I did not find the extent of Engine Shed room fully up to what, according to my calculation, would be due to the proportion of Engines supplied under the Contract, which would usually be in running order. This deficiency arose partly from the Engineer having found it necessary to put the turn-tables inside the sheds, to keep them protected and in working order, during the inclemencies of winter; but I still think that shed room for six more Engines

should be provided without charge—a requirement in which the Contractors at once acquiesced.

Appendix P, contains a statement of the Rolling Stock, in which, by varying the description of Waggons, an excess has been supplied, of the value of £840, according to the divisional estimates.

In Appendix Q, will be found abstracts of the Accounts for extra works, with my own comments upon them. I may here remark that the comparatively small amount in which I should differ from the Engineer-in-Chief, is insignificant, when weighed with the extra expense to which the Contractors have been put elsewhere.

The works for which allowance has been made, besides the additional road stations, and the enlarged workshops at Montreal, comprise a great addition to the specified Sidings,—additional Engine Stables, (not contemplated by the contract,)—a capacious landing wharf at Montreal for facilitating the transport of loaded goods waggons across the St. Lawrence, pending the completion of the Victoria Bridge,—an extension of the Line at Toronto,--and other works, none of which were specified in the Contract, and which could not therefore be included in the stipulated sum of £3,000,000, agreed upon as the price to be paid, without additions or deductions, for the works and conveniences specified.

Taken as a whole, I consider that the excess of cost, which appears to be less than 10 per cent. on the total Contract Sum, has been satisfactorily accounted for.

Considering all the circumstances alluded to in this Report, and the great physical and financial difficulties which have been successfully overcome, I regard the execution of this Line as a work reflecting the highest credit on the Engineer-in-Chief, on the English Contractors, and on the able Assistants of both Engineer and Contractors.

TORONTO AND SARNIA SECTION.

The Works of this Railway, begun in 1852, were ultimately executed under a Contract between the then Toronto and Guelph Railway Company and the Canadian Contractors, dated March 24th, 1853.

The general terms of the Contract, (abstracted in Appendix R,) corresponded in most of the details with those of the preceding Sections, implying a first-class single Line, but omitting any special reference to English Railways as a pattern of substantiality. It gave to the Contractors the choice of the Line, subject to arbitration, in case of difference with the Company.

The length of Line already open to Stratford is 87 miles, out of the total 166 miles; and without following its course in detail, I may observe that the selection, thus far, seems to me to have been such as a judicious Engineer, selecting a reasonable line for a Company, would have been likely to adopt.

At a considerable expense, for which extra payment would no doubt have been admitted by an Arbitrator, and has, in fact, been allowed by the Engineer, ground has been recovered at the Queen's Wharf for the Toronto Terminus, in a situation possessing many recommendations, and a little over a mile from the business Centre of the City; but the permanent passenger terminus has yet to be made; for which, I understand, you propose to erect a Central Station on the Esplanade Junction common to this and the Montreal and Toronto lines.

It is to be regretted that the impossibility of obtaining an adequate quantity of Land near your Passenger Station at Guelph, should have removed the Goods Station so far from it.

The Land has been provided almost everywhere for a double Line; and the Land at Stations, as detailed in Appendix S, varies from 4½ acres to 11 acres.

The large Embankments have been in some cases increased beyond the Contract Dimensions, for which an allowance has been made. In many places slips have occurred in the Earthwork, since the Line was opened; but I do not ascribe this to any fault of construction.

In the large Rock Cutting, between Acton and George Town, some protection such as Dry Walling, will, I expect, become necessary, to support the upper Rock, and to secure from waste the lower beds, which are wet and shaly.

Appendix T, gives the table of the Gradients and Curves. The undulations of the country have necessitated for 10¼ miles, the maximum Gradient of 52.8 feet per mile: 43¾ miles being either level or under 22 feet per mile. The smallest Radius of Curves is 2,865 feet, and the prevailing Radius is 11,460 feet.

I found the Rails and Sleepers good, and the Permanent Way generally in accordance with the specification, with the exception of some deficiences, for which deduction was made.

The Drainage generally is of efficient character and extent, but some of the smaller Culverts of brick have shown signs of failure.

The Bridges and Viaducts are very heavy, and comprise almost all the large works of the entire Line from Toronto to Stratford. Appendix U, will show that many of them are of great size, and most have been constructed at great cost, with an excellence of workmanship far beyond the requirements of the contract. Among these the Humber Valley Viaduct, with 9 openings of 60 feet span; the Eramosa Viaduct, with 8 openings of 60 feet span; the Grand River Bridge, with 2 spans of 96 feet, and 3 of 60 feet; and the river Nith Bridge, with 4 spans of 60 feet, deserve peculiar commendation; and I have rarely seen a work of finer design or execution than the Credit Viaduct, of an extreme height of 121 feet, with 8 spans of 96 feet.

The wrought-iron girders and tubes are of very good construction, and the small deflections I noted corresponded with those on the other Sections.

One Road Bridge at Brampton, and another at the Huron Road, I should have considered sufficiently large structures to make it a question, whether foundations for a second line might not, under the Contract, have been asked for.

In some cases the Stations did not come up to the requirements of the Specification, for which a deduction has been made; but on the whole a considerable increase has been found necessary, which has been allowed for in the accounts.

Some extra Watering Places beyond the reasonable intendment of the Contract, have been erected and charged for, often at places away from Stations, and where a more copious supply could be obtained.

Appendix V, gives a statement of Rolling Stock, showing that, in money value, the amount specified for the whole Line has been supplied to this Section, for which excess credit is of course taken in the Accounts.

Upon the settlement of Accounts I report at length in Appendix W. I need here only state that in the principle upon which the apportionment has been made between the payments for the finished and unfinished lengths, I entirely agree; that in the adjustment of

the accounts I may, to a comparatively small amount, differ in some of the items; but that the general result may be taken as a fair settlement on account, open to a readjustment of the Station Account in the Extension of the Line.

I consider that this Line is a Work of which both Engineers and Contractors may justly be proud.

PERMANENT WAY.

The description of Permanent Way specified and executed on your Railway was, I understand, settled after a consideration of the forms and details found to be most successful on the Lines of the Northern States.

The action of the severe frosts and rapid thaws distorts the whole structure of the road to such an extent, that the English systems of Continuous Bearing, or of cast-iron Chairs with fittings, were alike inadmissible; and it was necessary to adopt a form of great simplicity.

In Appendix X, I give a Statistical Return of some of the principal Railways in the States of Massachussetts and New York, (calculated in my office from official documents), from which you will see that the weight of Rail adopted is greater than on most of those lines.

The rail of 63 lbs. per yard, which is either of the form called the Bridge rail, or that called the single T rail, rests directly on Sleepers, 2 feet 6 inches apart, and is secured to them by spikes. The joints are supported on a wrought-iron Chair, weighing, in some cases, 8 lbs., and in some cases 12 lbs., the former being the prevailing weight.

Simplicity is no doubt thus attained; and from all the inquiries I made, I am led to the conclusion that the arrangement adopted is the one approved by most of the local Engineers; and an identical arrangement has been adopted by eminent English Engineers on the Haldiscoe and Halesworth Railway, in England, on the Altona and Kiel, on the Royal Danish Railway, and, I believe, on other Lines on the Continent.

These circumstances undoubtedly justified the adoption of such a system in the Specifications. This road is certainly superior to the road laid with light cast-iron chairs, so common in the Northern States; and where it is fully ballasted, and well maintained with good material, it runs well; but from a study of those parts of your Line where it has been most severely tried, I have concluded that present experience might lead you to the adoption, in future works, of the single T rail, with fished joints, or with Adams's bracket chair of wrought iron, either of which, I believe, would make a more perfect road; but it is right to add that even the first and best known of these was not generally accepted as an improvement when your road was designed. Meanwhile, on the existing portions of your system, I believe that a sensible improvement might be effected by putting in large-sized sleepers at the joints, and arranging the spaces between the sleepers so as to be least next the joint sleepers.

The Crossings of your Permanent Way are of good construction, and the simple shifting rail adopted for Switches is, in my opinion, the best suited for the climate.

ROLLING STOCK.

From the voluminous calculations prepared for me by Mr. Trevithick, your Locomotive Superintendent, I annex six Returns relating to the Rolling Stock and the working of Engines (Appendices Y 1, Y 2, Y 3, Y 4, Y 5, and Y 6).

The total number of Engines in stock on all your Lines, on June 1st, 1857, was 172, and their average age 29½ months.

The number of Engines supplied by the English and Canadian Contractors, under Contract, were 63 and 23 respectively; the total number supplied by the English Contractors being 69 and by the Canadian Contractors 25.

The engines supplied by the Canadian Contractors were made by approved manufacturers, and from an examination of the greater number of them I can speak favourably of their construction.

I was also satisfied with the Engines supplied by the English Contractors, most of which I examined; but exception having been taken to 42 of them, manufactured in England, it is necessary to

speak of those features in them which have been considered objectionable.

In common with all the other Engines, they have wrought-iron Fire-boxes. Their Tube Plates are wrought-iron; those supplied by the Canadian Contractors and by some of the American Houses being Copper. Twenty-nine of them have Iron Tubes; the Engines built in America having either Brass or Copper Tubes. They were built without the "truck" or "bogie" in front.

I greatly prefer Fire-boxes and Tube Plates of copper, and Tubes of brass; but it is right to state that iron Fire-boxes, Tube Plates, and Tubes, are frequently used in England, and well thought of by some Engineers of great experience; so that I do not feel that my decided preference for copper and brass would justify a rejection of iron, especially as no specific requirements in regard to such details were to be found in the Contracts. The Iron Tubes gave much trouble during the winter; a circumstance which I ascribe mainly to the absence of "trucks," which, experience shows, save the Engines from the effect of the blows given by the Permanent Way, when set by frost.

These Engines were built without "trucks" under the sanction of the Engineer-in-Chief, and in reference to such sanction I may state, that while I soon recognised the value of "trucks" under the Carriages, I felt for some time objections to the use of them under the Engines, which were only overruled by the statements of the experience acquired by your Officers.

The Engines made in England are in several respects superior to those made in America. Their workmanship, although plain, is more solid. Wrought-iron is used in many parts where the others have Cast Iron. Their Boiler Plates and Tube Plates average $\frac{7}{16}$ inch and $\frac{3}{4}$ inch in thickness, while those of the American Engines average $\frac{5}{16}$ inch and $\frac{1}{2}$ inch. I believe that when furnished with "trucks" they will be found to last longer than the American Engines; and the comparison of their Working Expenses shows no inferiority.

Of the generally good character of all the Engines, the following facts may be taken as some confirmation.

During the severities of a North American winter, when it is not an uncommon thing for the whole traffic of a Railway to be stopped, much delay and irregularity will of necessity occur. From an examination of a Return of the delays of trains on your Line, between

December 23rd, 1856, and February 28th, 1857, I find the delays ascribed to Locomotive causes amount to only 1¼ per cent. of the advertised running time. During the first four months of this year your Engines performed the average daily mileage of 47 miles; 45 miles being considered a high average daily mileage, including summer and winter, in England; 33 miles being the average daily mileage on seven Continental Railways, and 50 miles the average daily mileage on the Railways in the Northern States, tabulated in Appendix X.

To the well-known intelligence and zeal of your Locomotive Superintendent, much is no doubt due. The Returns in the Appendix show a decrease in the cost of Locomotive Power; and when, added to all the difficulties of climate, it is remembered that the present wages of mechanics in your Workshops average 37 per cent. more than those in England, and the cost of Engine Stores nearly 50 per cent. more, you have reason to be well pleased that the Locomotive expenses during the last half-year of 1856, were only 22·70 cents. per mile, and for the whole year 26·33 cents. per mile.

On May 17th, 1857, the total number of Carriages and Waggons of all sorts, including Snow Ploughs, was 2,346.

The Carriage and Waggon Stock, supplied by both English and Canadian Contractors, is of good quality: that built at Montreal by the English Contractors, constituting about half the quantity supplied by them, is of first-rate manufacture, and decidedly the best which I saw in America.

I refer you to Appendix Z, for my remarks on the charges for Engines used by the Contractors during construction.

CONCLUSION.

In the preceding sections of the Report I have intimated my general opinion that full justice has been done you, both by your Engineer-in-chief, and the Contractors.

Taking the accounts as a whole, I believe that if the Contractors had adopted a litigious course instead of confiding in the honourable adjudication of the Engineer-in-chief, the Company would have been serious losers.

I may add, that as far as I could judge of the comparisons of

cost with other Railways in Canada which I saw, or of which I obtained particulars, you have obtained your Lines at a more reasonable price, although of a much superior character. I have not the means of guiding your judgment, as to the necessary elements of comparison with the mileage cost of the American Railways enumerated in Appendix X; but in regard to some of these which I saw, passing observation of Lines far inferior, led me to a similar conclusion.

It is also noteworthy that the permanent character of the important Bridges on the Grand Trunk Railway proper, will in the course of years, be productive of great saving, from the absence of those losses by decay, or fire, or flood, which, as you know to your cost, are too prevalent elsewhere, both in Canada and the United States.

While there are some points on the existing Lines at which additional Traffic and Engine accommodation, beyond what could be fairly required of the contractors, may be desirable, I would venture to suggest that none should be sanctioned the necessity for which is not demonstrated to the Board by the Traffic Manager, or the Locomotive Superintendent.

At the same time, it will not be forgotten that there still remain Connections and Extensions whose completion will contribute greatly to the development of the traffic which should naturally flow upon your Lines.

The Eastern Extension towards Trois Pistoles, of more advantage probably to Canada and the neighbouring Province than to yourselves, might justly claim from the Government peculiar consideration and indulgence.

At Quebec, I understand that a project has passed the Legislature for establishing extensive deep water Quays, for ocean steamers, in immediate connection with your Line, which may reasonably be expected to increase very materially your traffic from that City.

The completion of the Victoria Bridge, at Montreal, by uniting the severed portions of your Railway, will remedy a defect which, at the present time, undoubtedly opposes a serious obstacle to the development of through traffic.

At no distant period it is to be hoped that the Municipality of Montreal may co-operate with you in some cheap Line to connect the principal Wharfs of the city with your Line at Point St. Charles, which I believe would be best effected by a Horse Line, running on the

common roads, along Wellington Street to Commissioners' Street, which at the minimum of cost would bring your line to the heart of the business population.

At Prescott, just above the head of the Canal Navigation, your existing connection with the Prescott and Ottawa Railway, would, by an arrangement with that Company for laying down an extra rail for about a mile and a half along the Line, give you access to the existing wharves, and by this means afford direct communication with the Lake navigation, and the Ferry to Ogdensburg, whence there are lines leading to New York and to the whole of the New England States.

At Kingston, whenever a branch can be made down to the Quays, further accessions of traffic may probably be expected.

At Toronto, the important site you have secured at the Queen's Wharf, may perhaps, at some future period, be made more valuable by access to the existing pier.

Lastly, the completion of the suspended works west of Stratford, may be reasonably expected to develop a traffic to which your undertaking has always pointed.

I cannot conclude this Report without expressing my acknowledgments to the President, the Vice-President, and Mr. Rose, your Colleague, for the time they devoted to me, and much valuable information very courteously communicated.

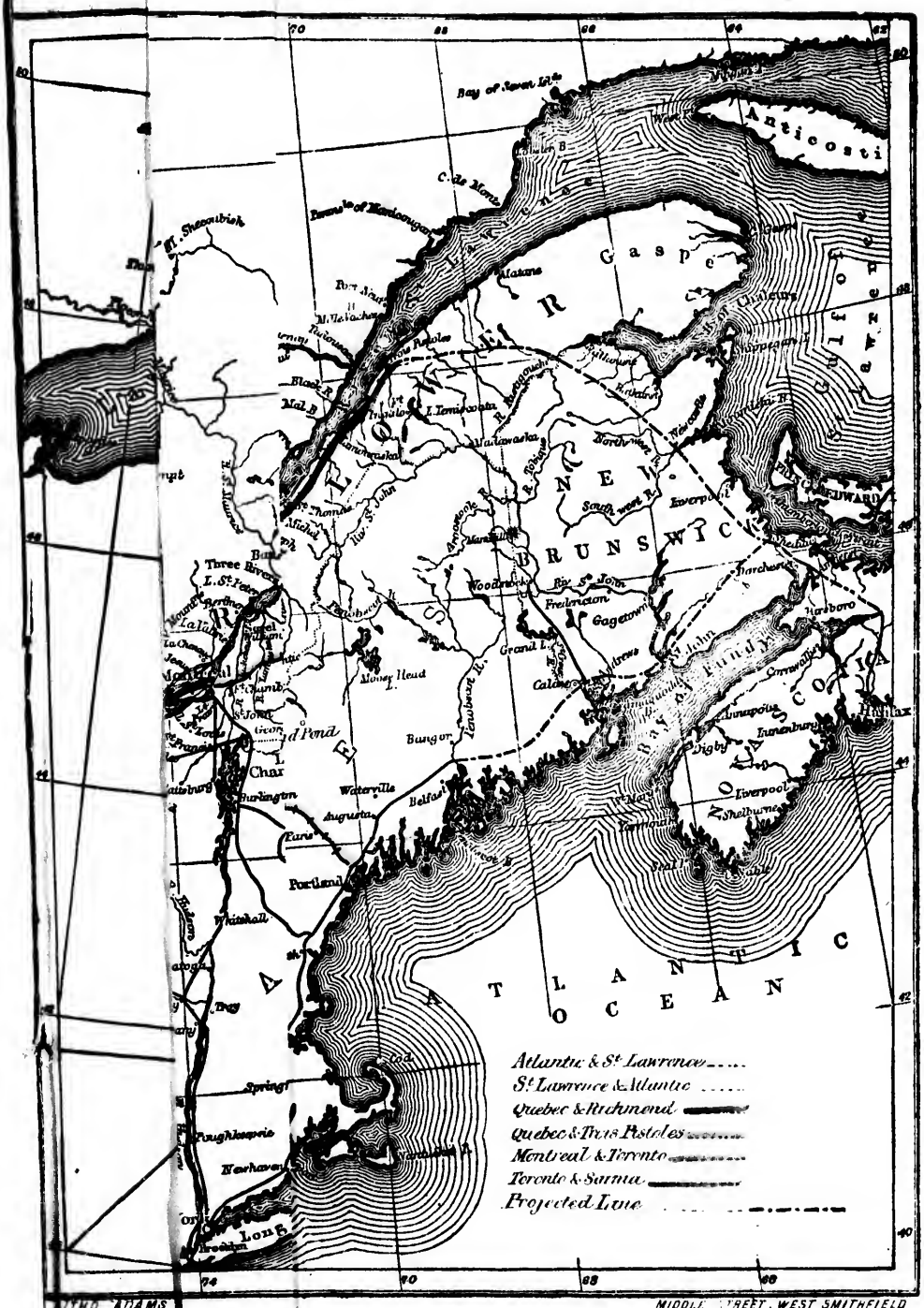
The assistance of your Secretary has been of particular service to me, and he has been most cordially seconded, in Canada, by the Manager, and his assistants, the Assistant-Secretary, and the Chief Accountant.

To your Engineer in chief, and Locomotive Engineer, and to the Contractors, both English and Canadian, I am greatly indebted for the perfect candour with which they met my inquiries, and for much personal labour in the collection of materials; and I must offer similar thanks to Mr. Shanley and Mr. Samuel Keefer, the Resident Engineers, as also to the chief Engineer's Secretary, and to his and to the Contractors' Assistants.

I have the honour to be, Gentlemen,
Your most obedient servant,
CHARLES HUTTON GREGORY.

1, Delahay Street, Westminster,
August 15, 1857.

THO. ADAMS



THO. ADAMS
MIDDLE STREET, WEST SMITHFIELD

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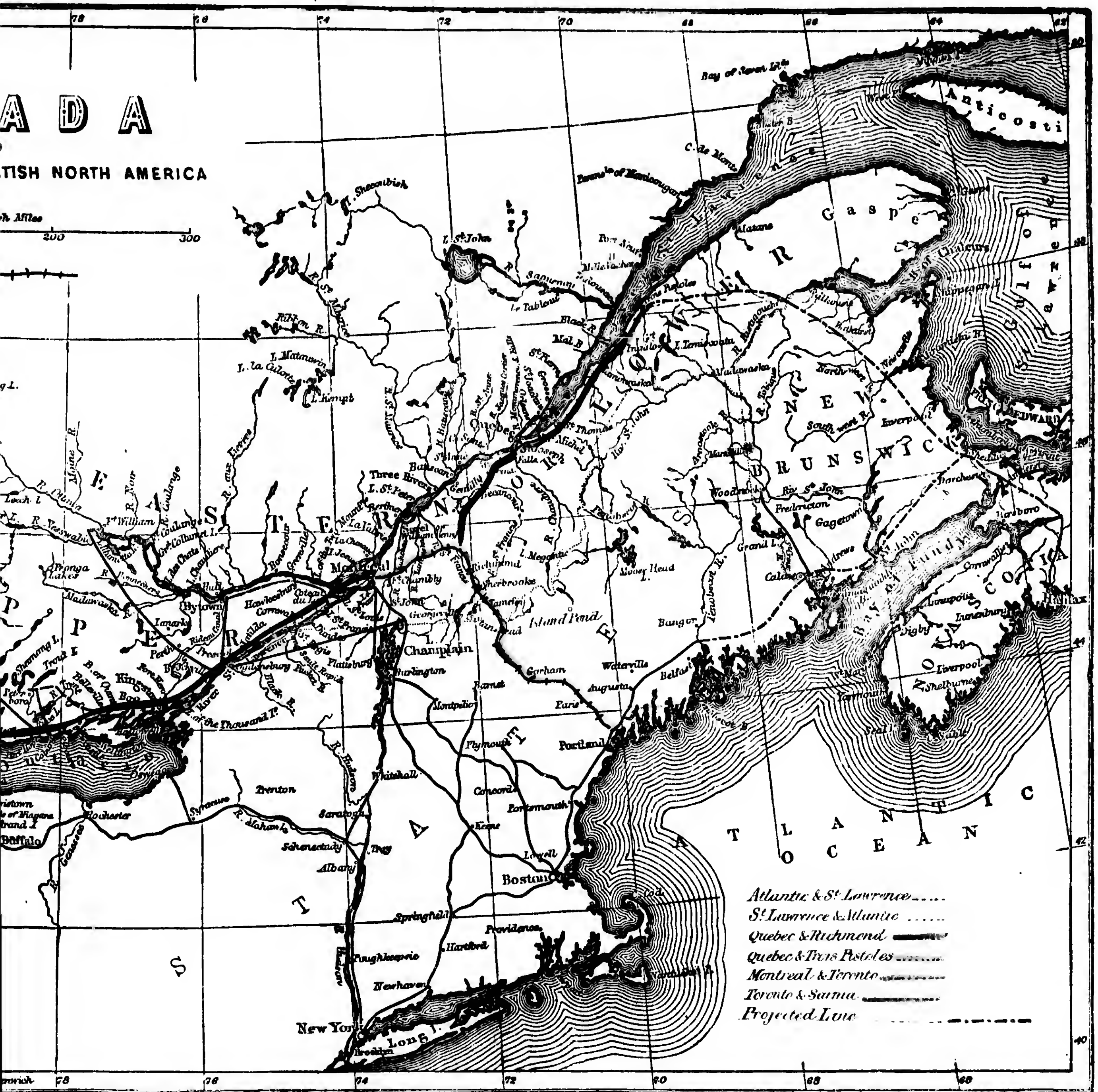

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