OPENING

OF THE

PICTOU RAILWAY

MAY 31st, 1867.

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PICTOU RAILWAY,

NOVA SCOTIA.

OBSERVATIONS, CORRESPONDENCE, &c.

SUBMITTED BY

SANDFORD FLEMING,
CIVIL ENGINEER,

MAY 31st, 1867.

HALIFAX, N. S.
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1867.

REMARKS ON THE PICTOU RAILWAY.

The formal opening of the Pictou Railway throughout its entire length seems a fitting occasion for the following observations :—

Since the writer first became professionally engaged in the Province of Nova Scotia, early in 1864, his name has occasionally been freely handled in discussions in the Legislature and in the press, and these personal references, as many are aware, have not always been of a complimentary nature.

The writer has not hitherto considered it necessary to enter any defence ; he has invariably persevered in the performance of those duties which he was called upon to perform, in the execution of the important work now about being brought into public use, and in the firm belief that the work itself would prove a more enduring defence than anything he could say or write.

Fully three years ago he was invited to accept the office of Chief Railway Engineer by the Government of Nova Scotia, and, amongst other duties, he was called upon to make the surveys, and conduct to completion the construction of a line of Railway from Truro to the waters of Pictou harbor.

In October, 1865, it was discovered that the works had not made that progress, under a system of small contracts, which the Government expected or desired; and at that period they had actually come to be in a condition of partial suspension. There seemed

little prospect of the line being available for traffic for many years without some decided change in the system of construction.

At this stage the writer was applied to by the Government to state whether, in his opinion, it was yet possible, under any system, to give the public the use of the line by the opening of the navigation, viz., the 1st May, 1867. In reply he submitted that as so much had to be done, and the working season was so short, it was hardly possible, even under the most advantageous circumstances, to do so, but that it might be managed by the end of the month, provided the weather proved favorable during the summer of 1866 for out-door operations. The *modus operandi* was also described.

An order in Council was thereupon passed authorizing the undersigned to carry out his plans in any manner which, in his judgment, would best secure the object desired, keeping the total expenditure within the limits of the estimate submitted by him to the Government in 1864; and the whole responsibility of having the work so far advanced as to admit of the line being opened for traffic by the end of May, 1867, was placed on his shoulders.

In a few months unforeseen legal and departmental difficulties arose, which threatened to bring the construction of the Railway again to a stand.

It appeared that the terms of the Provincial Statute which authorized the expenditure for this Railway, would not admit of the work being executed directly by the Engineering Department. The law prescribed that the line should be built under contract.

In order to find a solution to these difficulties, the Government asked the undersigned if he would be willing to resign his office and carry out under contract what he had so far accomplished as Chief Engineer.

To this proposition an assent was given, and a contract was thereupon entered into to complete the Railway for a specific sum,

which sum is $100,000 less than the original estimate made and submitted to the Government in 1864 by the undersigned.

The end of May, 1867, has arrived, and it only now remains to be proved how far the writer has carried out what he promised and undertook. Were "the works not sufficiently advanced to allow the line to be partially opened for traffic" for some months to come, the unfavorable weather during almost the whole of last season would have been a sufficient excuse, as all reasonable men will allow. The summer of 1866 was unparalleled in this Province for rain, as every farmer knows to his cost. This is a most important consideration; the condition of the weather is beyond human control, and the writer, from the first, fully understood how very much depended on it. In his report, dated October 30th, 1865, he alluded to it, and submitted that "moderate good fortune with respect to weather" would be needed to enable him to accomplish the object desired.

This matter is merely alluded to by way of apology for the very rough and unfinished appearance which much of the work as yet presents. It was necessary, owing to the excessive wetness of the past summer, to execute a great deal of the work during the winter, when of course it was done at a great disadvantage, and it has not yet recovered from the effects of the frost. Very much still remains to be done in the way of finishing up, but notwithstanding the retarding influence of the weather, the essential and substantial portions of the Railway are complete.

Having made these introductory remarks with regard to the time of opening for public use, the writer desires to submit some testimony respecting the Engineering character of the work so far accomplished. In doing so he has to express his great regret that the Government has not caused a minute examination to be made by one or more Engineers of the highest standing, from a distance,

and placed the results before the public. The writer has repeatedly asked for such an inspection, under the authority of the Government, as a simple act of justice to himself; for he has from first to last, notwithstanding all that may have been said on the subject, most conscientiously endeavored to perform his whole duty in connection with the undertaking.

Fortunately the undersigned has in his possession several letters which were kindly sent to him by well known professional gentlemen, who had opportunities of examining the work in process of construction. These gentlemen have had the advantage of an extensive experience on engineering works, embracing Railways in Canada, New Brunswick, and the United States, in India, in Great Britain; also in France, Spain, and other countries. Their opinions are, in consequence, to be highly valued, and the writer most fully appreciates the kind feelings which prompted these gentlemen to favor him with their professional views and sympathies at a time when the latter appeared to be much needed, and in producing the letters for the first time, he takes the opportunity of sincerely thanking them.

The letters referred to were written some six or seven months since, when only a portion of the work now executed was completed; feeling the importance of having a thorough inspection made of the works as they now stand, the writer determined, lest the Government should fail to do so in time, to secure the services of an Engineer of the highest standing that could be found, and who never had the remotest connection with this Province. He placed himself in communication with several gentleman, and at last secured the professional services of Mr. George Lowe Reid, of Hamilton, in Canada, who has since visited this Province, examined

the Pictou Railway, and presented the report which is herewith submitted.

It may here be observed that as a Railway Engineer Mr. Reid stands second to none. In addition to an English professional education and experience, he has had a valuable practice for fifteen years on this side of the Atlantic, and at this moment he is Chief Engineer of the following lines of Railway :—

The Detroit and Milwaukie,
The Great Western of Canada,
The Galt and Guelph,
The London and Sarnia,
The Petrolia,
The Toronto and Hamilton

These lines together embrace a total length of 542 miles of Railway.

It need scarcely be added that all who know Mr. Reid can bear abundant testimony to his high professional character, judgment, integrity and moral worth.

In addition to the documents above mentioned, the Report of Alexander MacNab, Esq., the present Chief Engineer, recently made and submitted to the Legislative Assembly, is referred to with much satisfaction. This Report has been printed in another form.

In concluding these brief remarks, the writer desires to express how much he feels indebted, and how much he believes the Province and the public are indebted, to those gentlemen who have so ably assisted him in the execution of the work ; their zeal and energy have at all times been unbounded ; they have overcome difficulties in pushing the work to a satisfactory issue, within a limited time,

and under exceedingly unfavorable circumstances, which the general public cannot understand and never will appreciate. To them is mainly due the credit of bringing forward, to its present stage, the important link of communication now about to be opened for public use, promptly on *this*, the very day originally appointed in October 1865.

SANDFORD FLEMING,
Civil Engineer.

HALIFAX, NOVA SCOTIA,
31st May, 1867.

CORRESPONDENCE AND REPORTS.

Letter from David Stark, Esq., Civil Engineer, lately in charge of the Grand Trunk Railway from Portland to Montreal, Quebec, and Revière du Loup.

HALIFAX, 3rd October, 1866.

MY DEAR SIR,—

Having returned from the gratifying tour I made with you over the line of railway you are constructing between Truro and Fisher's Grant,—the Pictou terminus,—I desire to hand you the following statement of my appreciation of the work both as regards the progress that has been made with it and its quality.

With respect to pregress, the nearness to actual completion to which the line has arrived throughout surprised me. I did not expect to find the heavy work I had heard of as existing in its centre, brought within the limits it has, or that I could have travelled over the great distance we did there on formation level. Indeed, with the exception of the heavy embankments at New Lairg, the arched culvert under which is entirely finished, and itself two-thirds so, and another further on towards New Glasgow similarly situated, there is little remaining to be done, save the laying down of the superstructure and the ballasting,—of material for the latter there seems to be a plentiful supply,—and this will, with anything like favorable weather, doubtless enable you to open the line by the time you contemplate.

As to the quality of the work done, I may state that I am intimately acquainted with the works on the Grand Trunk Railway of Canada, having been engaged, from the commencement, on the construction of its Eastern Division, and having had it under my charge as Engineer for several years after its completion. Upon the whole of that extent of Railway there is nothing, to select a single item, and a most important one, to equal the magnificent masonry with which you have been able to endow the Nova Scotia line from Truro to Fisher's Grant. This is seen equally in its largest and smallest structures, an unusual circumstance in Railway construction, and which in this instance is due to your ability as well as

determination to secure the best material for the work, at any cost within the bounds of reason.

The roadway is wider also than on the line quoted—at least a great portion of it—both in the cuttings and embankments, giving in the first greater room for drainage, and on the last a permanent supply of ballast under the ends of the ties, a matter of almost equal importance.

The mode you have adopted for the under drainage of long cuttings is admirably effective, and will do more to insure a dry and easily maintained road-bed, and a uniform rail surface than any other I have seen tried. I must likewise pay tribute to your selection of iron culverts for steep side hills, the ease and impetus with which the water runs through them, rendering them less liable to choke up than stone ones, by the accumulation of ice, or otherwise, and in such a position in every way more effective and durable.

The sleepers distributed along the line are of good quality both as regards their dimensions and kind of material, and I feel confident you will find the style of fastening you have devised for the rail joints come up to your expectations. I cannot but regard it as being most permanent in itself, and one which by its sustaining power will do more to protect the ends of rails from the constantly recurring blows which now so soon wear them down, than any other in use. This is my belief, and I trust you will find it well founded.

I look, in fact, to the completion of your line as the giving to Nova Scotia the finest half hundred miles of Railway in British North America, and I question whether in the whole continent anything to excel it will be found, and this I give as my opinion in all truth and sincerity.

There is of course a good deal to be done still; but the foundation is laid, the chief point of difficulty, and with the rest of the work in the same hands that laid that, there is little to fear for the coping.

With best wishes for your ultimate success in all ways in the undertaking,

Believe me,

My dear Sir,

Ever sincerely yours,

D. STARK.

SANDFORD FLEMING, ESQ.

Letter from Alex. Beattie, Esq., Civil Engineer, of London, England.

[International Contract Company—Limited.]

ACADIAN IRON WORKS,
4th October, 1866.

MY DEAR SIR,—

My attention has several times been called to articles in the newspapers, regarding the construction of the Pictou line by you; most of these articles condemning the work as inferior in quality, and some insufficient in water-way.

You are aware that, with Mr. E. A. Jones, I went over a great portion of the works about six weeks ago, accompanied by Mr. Tremain, who pointed out and explained to us the principal structures; and as from this visit I came to a quite different conclusion from the opinions stated in the newspapers, I think I ought to state to you what I thought of the works, although no doubt Mr. Tremain has informed you what Mr. Jones and I thought of the works when on the ground.

My visit was with the sole purpose of ascertaining the cost of construction of railway works in this Province, of course taking into consideration the quality of the work executed. I went over the first two sections, and there I found the work executed in a most substantial manner. The rock cuttings were not nearly completed, but where finished, was, in my opinion, very satisfactory. The masonry was exceedingly good, much better than any I have seen on the existing lines of railway.

Sections three and four I did not see, but went over the line from about three miles north of New Lairg to New Glasgow. Through the entire length I found every structure I examined of most substantial masonry, very much better than I could possibly have anticipated, especially the large culvert at New Lairg, which is one of the finest pieces of masonry I have ever seen in such a structure. The large bridge at New Glasgow is also a most substantial structure. The street bridge in New Glasgow which I have seen mentioned in the newspapers as of inferior workmanship, I examined, but only in a casual manner, and I saw nothing which would lead me to believe that the structure was not of a substantial character.

I did not see the works between New Glasgow and Fisher's Grant.

On the first two sections I could only judge in a general way as to whether the water-way was sufficient. I saw nothing to make me believe anything to the contrary. On the other portions of the line which I visited, I had ample opportunity of judging as to the water-way, as there had been heavy rains all the previous night and during the day of my visit. I found that the water-way was not only sufficient in every instance I examined the culverts, but in many instances I think far in excess of the requirements; and certainly in some instances a considerable sum of money might have been saved by reducing the work, more especially in the six-feet sloping culvert about ths of a mile, as we were able to walk through it, notwithstanding the heavy rains.

As to the large bridge at New Glasgow, I cannot speak as to the sufficiency of water-way, as I understood that it was only during the ice freshets that the large water-way was required.

After reading the most scurrilous and false statements I have seen in the newspapers, I feel that I could not do less than express to you my opinion of the works.

You may make what use you please of this, taking it for what it is worth; but I need scarcely say that I do not wish it to be seen in the newspapers, as my position preclude me from entering into any discussion in the public prints.

Yours sincerely,

ALEXR. BEATTIE.

SANDFORD FLEMING, Esq.

Letter from Joseph B. Moore, Esq., Railway Contractor, of Montreal.

PARK HOTEL, ST. JOHN, N. B.,
17th October, 1866.

S. FLEMING, Esq., Halifax, N. S.

My Dear Sir,—I purposed having this pleasure some days since, but unforeseen causes prevented me writing until the present moment.

Having visited Nova Scotia several times this summer, I have observed statements in some of the public papers commenting in the most unmeasured terms on the mode in which you are executing the works on the line of Railway from Truro to Pictou, and

making all sorts of statements as to the bad work and material you, as Contractor, are supplying in construction of said road; in fact one would suppose everything appertaining thereto, as per statement set forth, and in charges made, was of the worst possible description.

As a contractor, and having been concerned in construction of railways in this country, I cannot say that the charges preferred against you caused me much surprise—for I have seen the like made on so many occasions concerning other works of similar kind, without the shadow of foundation, that I was inclined to think they emanated from disappointed parties. I was, however, determined to see and judge for myself if any deviation or departure from the character and execution of the work had taken place since I saw and personally inspected a considerable portion of the line last year (1865), as it was progressing. I have again gone over the ground, and can unhesitatingly affirm the works are being executed in the most thorough, substantial, and workmanlike manner, and if you only carry out to the completion, in the same excellent mode, they will reflect great credit on yourself and all concerned. The masonry will rank among the best of its kind on this Continent. The steel scabbard joint fastening for rails for permanent way (though new to me) will, I believe, form a beautiful, smooth, easy, and substantial road; in fact viewing the undertaking in all its integrity, it will, if completed as begun, bear comparison with any road I am acquainted with in this country.

I beg you will excuse me for addressing you on a subject in which I am in no way concerned, but I feel you have been unjustly assailed, and that such attacks must be both painful and hard to bear; and I thought a few words from one practically acquainted with the construction of railways—honestly given after examination of the works—might not be unwelcome. Go on, complete the works as begun, and I feel assured the public will in the end, and after due inspection of the line, give an honest verdict in your favor, as they cannot fail to be otherwise than satisfied therewith.

Believe me to remain,

Very truly yours,

JOSEPH B. MOORE.

N. B.—The iron superstructure for the bridge at East River, appears to me well suited for this climate, and of good design. I like it much. J. B. M.

Letter from T. T. Vernon Smith, Esq., late Chief Engineer of the Barcelona and San Juan Railway of Catalonia.

TRURO, N. S., Oct. 23rd, 1866.

SANDFORD FLEMING, ESQ.

Dear Sir,—By your permission I have spent the last week, from Tuesday to Saturday, in a thorough inspection of the works on the line from here to Pictou, having either walked or ridden over the whole length of road once, and the greater part twice; and as you wished me to give you a candid opinion on the subject, I write you these few lines.

I believe I am correct in saying that this is the only railway in America in which all the works of art are entirely of permanent materials, either iron or stone. The Grand Trunk in Upper Canada has all the bridges of iron and stone, but culverts, farm-crossings and cattle-guards are of wood; and on the St. John line five or six iron bridges and a good number of stone culverts do not alter the fact that both in number and length the wooden bridges far exceed the others, whilst temporary piling and framed bridges are both long and numerous. One of these long pile bridges, in the neighborhood of Moncton, has recently been condemned, and is now being filled in with earthwork, whilst two or three others in the same vicinity must shortly be re-built, or superseded by permanent work. On the Pictou line, on the contrary, all these works, over 200 in number, bridges, culverts, and crosssings, are of first-class permanent work, equal in strength and durability to any of the English or French railways, avoiding only the ornament and finish, which would here have been entirely superfluous.

There are three points that have specially attracted my attention, and which are deserving of general imitation on any works similarly situated: the introduction, as a rule, of stone culverts instead of iron bridges; of tunnels driven in the solid rock, to supersede bridges of any kind; and the use of iron pipe drains of large diameter, instead of arch culverts. In at least twenty places on the line, the ordinary practice would have built iron girder-bridges instead of arch culverts or rock tunnels; and in more than thirty

places culverts or beam bridges would have been built instead of the iron drains that you have introduced, and in some instances, I believe, if time had not been an object, at a considerable saving in expense; but in every case the departure from the usual fashion, I am satisfied, has been an improvement, whilst the saving in point of time has been more than I dare definitely estimate. I must certainly congratulate you on the introduction of at least two new and valuable novelties in railway construction, both of them calculated to save a deal of time in the construction of lines where the communication by road is very indifferent, where suitable ashlar cannot easily be obtained, and where skilled labor in adequate quantity cannot be secured, and I am satisfied that the rock-tunnelled water-way, and the iron pipe culvert, as first employed on the Pictou railway, will be extensively employed hereafter in all similar localities where temporary work is not allowed. The large ten and twelve feet arch culverts at New Lairg and elsewhere are beautiful specimens of work, that will never be fairly appreciated. Large, bold, iron-girder bridges would have been much more attractive as works of art, would have commanded more attention, and challenged more observation, and their cost would probably have been even less than the works, unpretending and unornamental as they are, which now permanently span these difficult and formidable gorges.

On one other point I wish to bear testimony. The drainage of the works throughout is excellent; and I believe that the length of catch-water drains, blind water-ways, pole and other drains, many of them buried below the frost line, is ten times more than on any other railway in America, even when, as is not unfrequently the case, this drainage work is not entirely neglected and left to be completed after the work is finished; and the impossibility of doing it effectually is equalled only by the necessity of getting rid of the water by any temporary arrangement that can be suggested.

I shall at all times be glad if my feeble testimony can be of any service in bearing witness, as I can most conscientiously do, to the excellent arrangement of the works, and the strength and durability of all the parts.

Yours ever faithfully,

T. T. VERNON SMITH.

Letter from S. Fleming to Mr. George Lowe Reid, Chief Engineer Great Western Railway of Canada, the Detroit and Milwaukie, of Michigan and other Railways, relative to an examination and report by the latter of the Pictou Railway.

RAILWAY OFFICE,
Halifax, Nova Scotia, May 6th, 1867.

G. LOWE REID, Esq., C. E.

Sir,—I am much gratified to learn that you have been so good as to leave your other engagements, at my urgent solicitation, for the purpose of making a professional inspection of the Pictou Railway, in this Province.

I am anxious that you should make as thorough an examination of everything connected with this new line of Railway as the time at your command will allow, and I now place in your hands the contract, the specification, and the plans under which the work has been executed, together with all letters and reports referring thereto which were written by me to the Railway Commissioner and the Government while I held the office of Chief Engineer. These latter documents I conceive are necessary to enable you to arrive at the true meaning and spirit of the contract. You will also be furnished with a complete descriptive list of all the structures on the line, together with the plans of the buildings, the wharves, and the ferry-boat (now building in England) for Pictou harbor, as well as all other information respecting every portion of the work which you may deem necessary.

You will find that although the Railway is not completed, the great bulk of the work is done, and in reporting your professional opinion thereon, I shall be glad if you will refer to the following points:—

1. The Engineering character of all the works which are connected with or form the "road-bed" of the Railway.
2. The character of "the Permanent Way."
3. The character of the Station Accommodation.
4. The character of the Water Service.
5. The character of the Terminal and Harbor Service at Pictou.
6. How far, in your opinion, the spirit and meaning of my official reports, the plans, specifications, and contract have been carried out.

I am desirous, also, that you should make a sufficient examination of the main line from Halifax to Truro, and the line to Windsor, to enable you to say how far the Pictou Railway will compare with the lines previously built in this Province.

I shall be glad also to learn whether, in your opinion, the Pictou Railway, when all the works now being brought to a close by me are completely finished, will compare favorably or otherwise with other lines with which you are acquainted.

In making this proposed inspection, you will find that I have introduced one or two engineering novelties, which I may take this opportunity of alluding to, viz.:

1. "Thorough Underdrainage." This is not commonly done, certainly not on this side of the Atlantic. The object is two-fold, to secure a firm dry road-bed, and to neutralise as far as possible the injurious effects of frost on moist earth-works in this severe climate.

2. "Tunnels and cast-iron pipes as substituted for Masonry Culverts." The former are driven through the solid rock, along the side of the rocky gorges, at the level of the stream, and of ample size for the passage of the water, thus admitting of the crossing of the ravines on solid embankments. The latter are generally cylinders of twenty-four inches diameter, and are employed in place of ordinary box culverts. Both are expedients which I found it necessary to adopt, in order to save time in constructing masonry and in preparing and conveying to the spot the requisite material. I think you will admit that these expedients have proved so successful that they will in all probability be adopted hereafter under similar circumstances. Only one of the tunnels has failed to come up to my expectations, the rock through which it is cut having proved less durable than could be desired. I propose to line this tunnel under the Railway with hard burnt brick or stone.

Without these two expedients I am perfectly certain that the works of construction on the Pictou Railway could scarcely be so far advanced as they now are twelve months hence.

3. "Scabbard Rail-joints." From the results of experiments and investigations, which I first published in the winter of 1859–60, I was led to adopt a new description of rail-joint throughout the whole length of this line. This new rail fastening is simply a plate of steel, enveloping the adjoining ends of the rails (the top surface excepted), and I have had them made of various lengths

from 12 inches up to 20 inches. They have been most severely tested during the past winter, and they have stood the test far better than I ever expected. They are much more expensive than the fish-joints, but should they in the future prove as durable and efficient as I have reason to believe, they will, I am satisfied, be found in practice much more serviceable than any rail-joint yet in use. Taking everything into consideration I shall not be astonished to find that they will prove as much better than the fish-joint as the fish is superior to the common chair.

I should like to be favored with a report on your examination at as early a day as practicable.

I am, Sir,

Your obedient servant,

SANDFORD FLEMING, C. E.

Report of Geo. Lowe Reid, Esq., Civil Engineer, on his Inspection of the Pictou Railway.

HALIFAX, NOVA SCOTIA,
24th May, 1867.

SANDFORD FLEMING, ESQ., C. E.,

Sir,—In terms of your letter of 6th inst., I have, since my arrival in this Province, made a careful examination of the whole of the works of the Truro and Pictou Railway, and having also perused the correspondence and the contract entered into between yourself and the Government, I now beg to report the results of my inspection.

The location of the line having been made, and the gradients established (by yourself as the former Chief Engineer of the Railway) before the date of your contract, it is unnecessary for me to make any remarks upon this subject. I may, however, be allowed to say, as the result of my observations of the ground, and examination of the profile of the country, as between Truro and Pictou, that I consider the alignment and gradients to have been established with very great care, and with a due regard to the permanent interests of the Government in the future working of the Railway.

1st. GENERAL CHARACTER OF THE WORKS OF THE RAILWAY.

As a piece of engineering construction these fifty-two miles of railway are of a heavy character. The nature of the ground demanded many deep and long cuttings—for the most part in rock—and numerous high embankments formed across the valleys and gorges which occur at very frequent intervals throughout the whole course of the line. Permanence and durability having been kept constantly in view, you have wherever practicable preferred the construction of solid embankments with massive culverts underneath them to the erection of long bridges or viaducts; and you have reduced to the lowest minimum the length of perishable wooden superstructure by confining it altogether to the crossing of cattle guards, and to a very limited number of open culverts in shallow embankments. In this respect, I know of no Railway in the British Provinces, or in the Northern States of America, which is superior to the Truro and Pictou Railway; but as I shall discuss this subject in a more detailed manner in a subsequent part of this report, I shall here merely add that in all other respects, viz., in its mason work, its permanent way and structure generally, the Railway is characterized by the same features of solidity, strength, and durability which are so prominent in the embankments and the culverts.

2nd. EARTHWORKS, DRAINAGE, &c.

Your contract calls for cuttings 22 feet in width, and embankments 18 feet wide at the formation level, and for a thorough drainage of the road bed in all cuttings, and of the base of all embankments on ground of a wet or spongy character.

I paid particular attention to the manner in which you have carried out this part of your contract. I found the cuttings to be of the full specified width, and that you were widening out all those embankments which had been washed and abraded by the frosts, thaws, and rain of last winter and spring. You were also making preparations to remove from the bottoms of many wet cuttings the slips and accumulated *débris* of the past winter and spring, so soon as the water should have drained off. The proper slope has been given to all the sides of cuttings in rock or earth, or in a combination of both; and where the nature of the material seemed to

demand a flatter slope than that specified, you have not hesitated to remove the extra material at a considerable additional cost to yourself. Some of the cuttings are not yet finished in this respect, but I speak of those which are completed, and which the Chief Assistant Engineer of the line pointed out to me as the standard to which all others will conform.

I was particularly pleased with the system pursued in the matter of drainage, as applied both to the road-bed of cuttings and to the base of embankments on sidelong ground, and on wet, porous soils. This thorough drainage by means of trenches four feet in depth (with long poles or pipes, and stone and brush in the bottom,) is admirably adapted to secure a dry road-bed for the permanent way, and a firm, unyielding base for heavy embankments. I examined the outlets of a vast number of these drains along the whole extent of the Railway, and found them all in perfect working order, and producing very beneficial results. Numerous wet cuttings not yet completed, through which I observed ballast-trains pass at a high speed, would have been all but impassable after the recent heavy rains, but for this thorough underground drainage; and when the slips at the foot of the wet slopes shall have been removed, and the track fully ballasted, and side ditches at the foot of the slopes opened up, I anticipate that the effect of these drains will be found, for many years to come, to result in a large saving in the repairs of the track, and in the maintenance of a much smoother road in the wet seasons of the year than is to be found in the majority of railways in this climate. I may remark that, except in England, it has not been usual hitherto to carry out so complete a system of underground drainage in the construction of railways as I have found on the line between Truro and Pictou; and I think that you are entitled to much credit for voluntarily executing so much of this work beyond what even a liberal interpretation of your contract would have required of you.

In the formation of the numerous embankments across the bends of the principal river valleys, and across the ravines and gorges of the tributary streams, your work merits a special notice. It is well known to those who have had experience in the maintenance of railway works, that a solid embankment is greatly to be preferred to any bridge or viaduct, however well built, or however durable its component parts may be. In the latter case, the joints of masonry require frequent pointing, the iron work requires to be

painted every few years, and the timber floor is subject to inevitable decay. But in the case of a well consolidated embankment, no future expenditure is needed; and the exposed faces of the culvert which passes under it bear no comparison with the superficial area of a lofty bridge, with its abutments and wing-walls and piers, and its iron or wooden superstructure.

I observed several instances in which you have, at a largely increased cost, built a solid embankment and culvert, where, by a slight change of location and grade, you might have greatly reduced the amount of excavation, and have crossed the ravine by a series of spans, which would have not only saved you a large sum of money, but would have produced a very pleasing structure which an unprofessional man might suppose to be both more costly and more durable than a solid embankment with its accompanying culvert. Few persons besides the Engineer and the contractor know how much costly masonry is buried out of sight underneath one of those heavy embankments to which I refer, and fewer still know how much care and skill are required in their construction, and how much is saved by them in future years, in the general maintenance and repairs of the road.

I have already stated that in this particular feature the Truro and Pictou Railway is far superior to any Railway in the British Provinces or in the Northern States of America.*

I have only at hand the necessary information to enable me to make a comparison in this respect with the Nova Scotian Railways now open, which I find to be as follows:

	Total Length.	Lineal feet of openings of every description, inclusive of cattle guards and small open culverts.
Halifax to Truro.... } Junction to Windsor. }	93 miles.	4858 lineal feet of track.
Truro to Pictou.....	52 "	1072 " "

Of course there are cases in the construction of almost all railways where from the insecurity of the foundation a culvert and high embankment are impracticable, and I do not intend it to be

* The Engineer of the European and North American Railway from St. John to Shediac, in New Brunswick, states that there are on this line, which is 106 miles long, 4740 lineal feet of openings of every description, and of this—exclusive of cattle guards and small open culverts—there are in the aggregate 2650 lineal feet, or over half a mile of timber bridges and bridges with wooden superstructure. A comparison of the three lines will therefore stand thus:

RAILWAY.	Length in Miles.	Openings of every description, including Iron and other bridges, cattle guards, and small open culverts.	Wooden Bridging, not including cattle guards and small open culverts.
European and North American	106	4740 lineal feet of track.	2650 lineal feet of track.
Halifax to Truro and Windsor.	93	4858 " "	2999 " "
Pictou Extension.....	52	1072 " "	None.

inferred from the above comparative statement that the majority of the long bridges between Halifax and Windsor and Truro are engineering mistakes, but my object is solely to exhibit the superiority of the Truro and Pictou Railway in this important point.

Where your slopes of embankments skirt the Salmon River, East River, and other streams, I found you were protecting the foot of the slopes with stone "rip-rap" and pitched work in a secure manner; and when you had found it necessary to divert the courses of streams you had adopted all requisite precautions to confine the water within its new channel. After what I have stated above, it is hardly necessary for me to say that there is still a good deal of that class of work to do, which consists in the cleaning out of side ditches, and the removal of the slips of slopes, and making a surface finish of the earthworks generally, all of which I understand you are ready to complete whenever the water is more thoroughly drained off, and the soft material rendered easier of removal by a longer exposure to the sun.

3rd. MASONRY AND BRIDGING INCLUDING CULVERTS AND CATTLE GUARDS.

The most noticeable feature of the Pictou Railway works is the almost total absence of all timber work and bridges. There are no piled bridges, no trestle structures, no cribwork piers, and no wooden trusses of any description. The aggregate length of all the openings of every description embracing iron girders, open culverts, and cattle guards, amounts to 1072 lineal feet of track; and of this extreme length every opening of a greater clear span than 12 feet is spanned by iron girders. I do not know of any line of railway on this continent on which there is such a small proportion of wood work in the bridge structures; and I have already given it as my opinion (founded upon an experience of 15 years in the construction of railways in Canada and the States) that I believe there is likewise no railway on this side of the Atlantic (except perhaps on some of the Western prairies where the track runs along the surface of the ground), in which the aggregate length of all the openings bears so small a proportion to the length of solid road bed.

Of the above 1072 feet, there are 520 feet consisting of stringers of cattle-guards and small open culverts, leaving 552 feet of iron

girders. The principal iron bridges are those over the Calvary River and over the East River, near New Glasgow. The first consists of 3 spans of 40 feet each of solid iron girders, and the second consists of four spans of 80 feet clear each, composed of lattice girders, known as Warren's patent. The masonry of both bridges is of the best quality of first class ashlar work. The masonry of all the arched culverts, which range from 4 feet to 12 feet spans, is of a very superior quality of ashlar, a great part of which is laid in English cement. I made a minute inspection of nearly every culvert, and having examined the plans from which they were built, I have no hesitation in saying that no better examples of railway culverts are anywhere to be found.

A considerable number of box culverts, of small openings, are laid with dry ashlar masonry of excellent quality; and all the cattle-guards are of an equally good quality of masonry, laid in mortar. Your culverts and cattle-guards are greatly superior to the same class of structures which I have inspected on the line between Halifax and Windsor and Truro, where there are 26 cattle guards wholly of timber.

The total length of openings of every description on the 93 miles between Halifax and Truro and Windsor, including 70 cattle-guards, is 4,858 lineal feet, of which 3,528 lineal feet of track is wholly of timber. If cattle-guards and small open culverts of 12 feet span and under, be excluded from the comparison, we find that whereas on the Pictou Railway there is not a single opening which is not spanned by iron girders, on the line between Halifax and Truro and Windsor, there are no less than 36 different openings, ranging in length from 15 feet to 600 feet, all spanned by a superstructure of timber, and amounting in the aggregate to 2,999 lineal feet of Railway.

With reference to the quality of your masonry, I found that with the exception of a few coping stones of one or two culverts about six miles east of Truro, which were not perfectly sound, all the stones in the walls or arches to which I had access had been carefully selected, and consisted of either a hard compact lime-stone or a very fine grained sand-stone of close texture. The rock excavated from the Railway cuttings being unsuitable for ashlar, had only been used in one or two instances, to a very limited extent, in the backing of some small cattle-guards.

The outward finish of all the masonry affords evidence that no expense was spared in producing a quality of work which would stand the severest criticism. A culvert under the high embankment which crosses the valley of Middle River, at New Lairg, is deserving of special notice. You had a treacherous bottom of quicksand to contend with at this spot, which required an unusually strong foundation of piles and concrete to be prepared for the culvert. The span of the culvert is 12 feet, and it has to support the weight of an embankment 70 feet in height, which, on such a foundation, is a very severe test indeed; but I found that no perceptible settlement had taken place in the foundations. The quality of the masonry in this culvert, in all essential particulars, can hardly be surpassed, and it is built almost entirely with English cement. The great rapidity with which the bank was formed over this culvert exposed it to a very severe proof, and but for its great strength and the unyielding character of its artificial foundation, some serious injury would in all likelihood have been sustained by it.

In order to expedite the construction of the Railway, and to obviate the delays arising from the haulage of stone from quarries at a great distance, you had recourse to the happy expedient of substituting, in several cases, tunnels excavated through the spur of the rocky hill, for the culvert which was originally designed to be built in the bottom of the ravine. There are in all six of these tunnels, ranging from 5 to 12 feet in diameter, the execution of which I consider to have been very successful. The rock being in most cases of a tough and durable character, requires no lining whatever; but where a softer stratification formed a portion of the roof and sides of one of these tunnels, you are to line the whole or a portion of it with hard burnt bricks or clinkers, whereby permanency will be secured beyond a doubt.

I find you have also employed another substitute for the smaller class of culverts, consisting of strong cast iron pipes of 24 inches in diameter, all of which I found to answer admirably the purpose for which they were designed. In a few cases you have made use of glazed earthen pipes for some small springs or rivulets. These being carefully bedded in concrete, have proved all that could be desired.

4th. PERMANENT WAY.

The permanent way or track consists of the ordinary T rail, 4½ inches high, weighing 56 lbs. per lineal yard, spiked to cross ties of the usual size and number, with the rail spike in common use. The track is being well ballasted at five or six different points, as rapidly as circumstances will allow, the depth being not less than 12 inches under the cross ties where it is finished, and the quality of the gravel being the best afforded by the country through which the line passes.

The rails, I understand, were made under inspection in Wales, and ought to be good; but I need not inform you how frequently it has happened of late years, that rails sent out from England have proved very inferior in quality, notwithstanding that every possible precaution had been taken to secure iron of the best description. I merely allude to this fact here because, although I see no ground to fear that your rails will turn out of defective quality, at the same time I should not be at all surprised to learn that a moderate proportion of them began to laminate long before they had reached the proper term of their existence. Should they not do so, they will form an exception to all the rails imported into Canada during the past six or seven years.

But the important feature of your permanent way is your steel scabbard for the fastening of the joints. This consists of a sleeve or clip, which grips tightly around the bottom flange and centre stem of the rail, terminating on both sides immediately under the rail head. It is made of spring steel of ¼ inch thickness; and I find you have employed these scabbards in lengths ranging from 12 to 20 inches, but those of 14 inches in length, suspending the rail joints, seem to afford all the requisite strength and support. This scabbard is driven on the rail without difficulty, the elasticity of the steel allowing it to recover its form, and to retain a very tight grip of the rails. No bolts or other fastenings are required, and its extreme simplicity is undoubtedly of itself a very great recommendation. This form of joint is quite new on this side of the Atlantic, and we have no experience to guide us in arriving at any decided opinion as to its merits; but knowing the properties of steel plates, and judging from what I saw of the behaviour of your rail joints under heavy loads at pretty high speeds, I have no doubt in my

own mind that this form of joint is one of the best which has yet been invented. The strength of the joint is certainly very great, and I am satisfied that no other joint at present known to engineers could stand the tear and wear which yours have done on an unballasted road-bed, without any perceptible injury to any part of it; it is more expensive than the ordinary fish joint, but I can hardly doubt that you will be amply rewarded for the extra cost of this joint by its increased durability. Granting that it proves to be superior to the fish joint, then an additional benefit will accrue to the Government in the diminished tear and wear of the Rolling Stock, which will of course be one of the first results arising from an increased rigidity of the rail joints.

The switches and sidings, so far as complete at the date of my inspection, were of good quality and in conformity with the requirements of the specification. Taking into consideration the excellent character of your rail joint, the liberal style in which the track is being ballasted, the underground drainage of the cuttings, and the solidity of a large number of the banks made from the dry material of the rock cuttings, I am of opinion that the cost of the future maintenance of way will be exceedingly moderate. I may add that the line from Truro to Pictou is being ballasted in a far more thorough manner than are the lines from Halifax to Truro and Windsor.

5th. STATION BUILDINGS.

TERMINAL ACCOMMODATION, AND FERRY SERVICE AT PICTOU.

There are five Way Stations between Truro and New Glasgow. They consist of a combined passenger and freight house, measuring 60 x 30 feet over all, and they are built of good sound timber, and shingled in the best manner. Each station building is provided with a capacious waiting room, a ticket office, ladies room and freight warehouse. In front there is a solid platform, 200 feet by 10 feet, faced with a stone wall, and planked with 3-inch plank in a very substantial manner. The whole appears to me to meet most amply the requirements of the country which each station serves.

The station at New Glasgow is a well built stone building, 90 by 30 feet over all, with a platform similar to those above described in

front of it, but extending to a greater length. In addition to the above named stations, there is now preparing for the town of Pictou, on the opposite side of the harbor, a building which will be 80 x 30 feet, and adapted for offices, passengers, and freight.

The water service of the Railway will be, when completed, a very efficient one. It will consist of a gravitation supply at the Fisher's Grant terminus, at Glengary, at Londsburgs, and at Riversdale. The water at those stations will be conveyed from springs or streams, at a suitable elevation, in cast iron pipes imported for the purpose; and although the first cost of this system is greater, it will save the expenses of pumping in the future. At New Glasgow, where no gravitation supply is available, the water is raised by steam-power. The tank-houses are of wood, and I observed that you had taken particular precautions to secure the water from freezing. The sides of the tank-houses consisting of three thicknesses of boards, and a lining of felt interposed between. The windows and doors are made double, as an additional protection.

I was very greatly pleased with the terminal accommodation provided at Fisher's Grant. The natural position of the ground is admirably adapted for the purpose to which you have applied it.

I observed that although your contract allowed you to terminate the line at the "Ferry wharf at Fisher's Grant," you have carried it about a mile farther on towards the outlet to the Gulf, and that you are constructing a line of track along the bank of the Pictou Basin for an additional three-quarters of a mile beyond the new railway wharf; making in all an extension of one and three-quarter miles beyond the Ferry wharf.

I understand that your object in constructing this extension towards Moodie's Point, is to afford the means at a future day of building a series of branch tracks curving off from it to loading or discharging wharves in the Basin. The situation of this extension track relatively to the channel of the Basin is extremely favorable for this purpose, and will admit of an almost unlimited expansion of the shipment of coal in future years.

The wharf you have constructed as the terminus of the main track is situated on the line of the channel, in a depth of 20 feet at low water, at a distance of about 1000 feet from the shore. It is approached by a solid earth embankment, protected on both sides by rip-rap facing, and when perfectly consolidated it will form a durable trackway, much superior to any approach you could have

made of crib work or piles. The wharf itself consists of a combination of crib work and piling, and it is a very substantial structure. The great depth of water and mud has precluded you from building a wharf of a more decidedly permanent nature; but the present one can, in the course of years, be gradually converted into a solid structure, by filling in with stones or ballast. A freight shed for the through merchandize is erected on this wharf, covering an area of about a thousand square yards, and having the railway track extended through the centre of it.

Your contract requires you to furnish a "suitable steam ferry boat and the construction of proper landing wharves," at Pictou and at Fisher's Grant. I underrtand that you are having an iron boat built for this service in England, and I perceive from an inspection of the plans that you have not spared expense in providing a strong, powerful ferry boat, with every accommodation for a large passenger traffic.

At a point half way between the terminal wharf and the shore you are erecting a freight and passenger house for the local business. This building is 60 x 30 feet in size, and is built upon piles on the outer side of the trackway.

An engine house and turn-table under the same roof, with carpenter's and blacksmith's shops in combination with it, is being built of stone, in a very superior manner, on the solid ground near the junction of the wharf track with the main line. This engine house will possess stalls for six locomotives, and the tanks for the water supply are to be fed from a spring by gravitation. The turntable is of exceedingly good quality both in point of material and workmanship. The timber frame-work is of sound, well-seasoned, pitch pine.

Having now passed my opinion upon the character of the works of the Pictou Railway, under their respective heads, I shall merely add a single line to say, that taken as a whole, I can with the fullest confidence express my deliberate judgment that the Railway has been constructed by you under a conscientious determination to act up to the spirit and meaning of your official reports and plans, and in terms of your contract with the Government interpreted in the widest and most liberal sense.

I am Sir,

Your obedient servant,

GEO. LOWE REID.