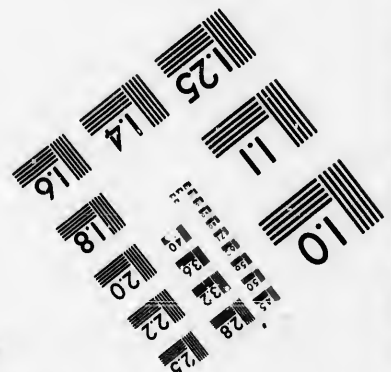
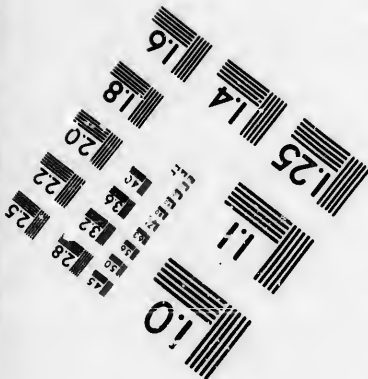
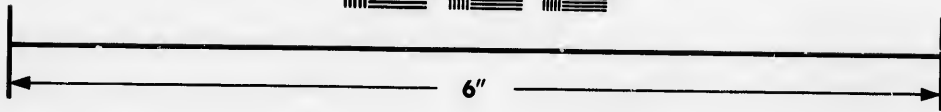
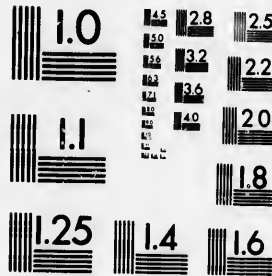


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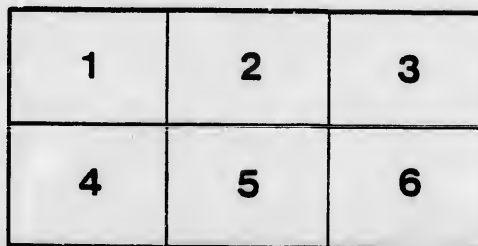
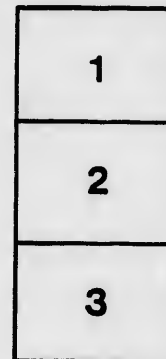
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NORTH SHORE RAILWAY.



OPINIONS

OF

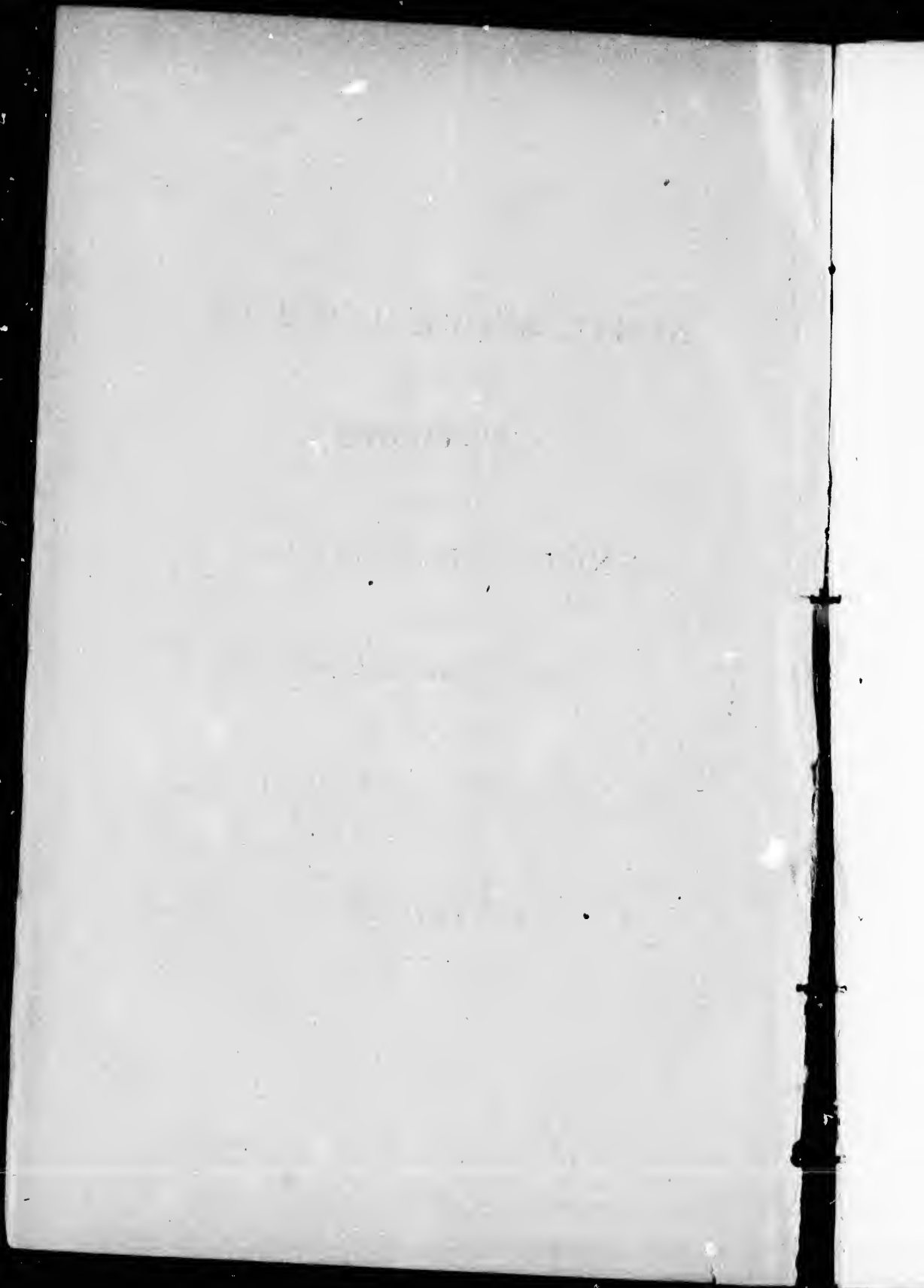
SEVERAL ENGINEERS

RESPECTING THE

SPECIFICATIONS.



1873.



NORTH SHORE RAILWAY.



OPINIONS

OF THE

ENGINEER IN CHIEF,

AND OF

SEVERAL CANADIAN ENGINEERS

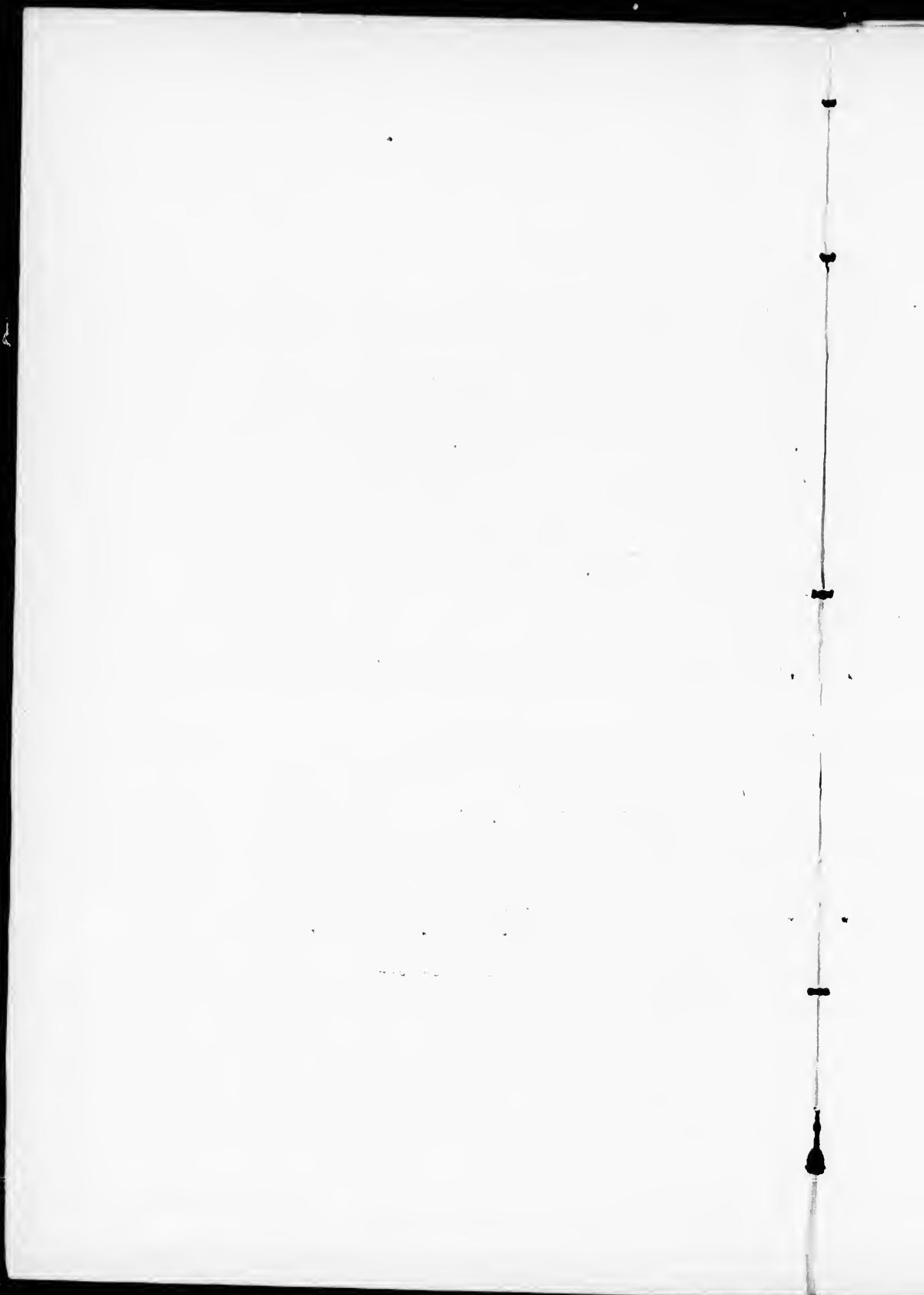
RESPECTING THE

SPECIFICATIONS AND CHARACTER

OF THE

RAILWAY.





NORTH SHORE RAILWAY.

LETTER from the ENGINEER in CHIEF to the
PRESIDENT of the Company.

OFFICE OF THE ENGINEER IN CHIEF,

Quebec, June 5, 1873.

Colonel Wm. RHODES, President, N. S. R.

DEAR SIR : I am informed that at the meeting of the Board of Directors, held yesterday, it was intimated by some of the Directors, that the existing Contract does not provide for a first class Railroad.

So long as these charges were confined to newspaper articles, written by unknown and irresponsible parties, who admitted that they had not even seen the Contract and specifications, I have not felt called upon to notice them, any farther than was done in my report of May 28, 1873. But inasmuch as the matter has now become a subject of serious discussion in the Board of Directors, several of whom are new members, it seems both just and proper that it should receive some attention at my hands.

During the negotiation of the Contract, and at the time of its execution, it was distinctly understood by the Com-

pany and Contractors, that the superstructure of bridges should be of wood instead of iron, and that the rails should be of iron instead of steel, and should weigh not less than fifty-six pounds per yard, upon the Main Line, and forty-five pounds upon the Piles Branch. The specifications were therefore made to contain these provisions.

The Contract provides : " That the most direct and practicable route, of which the capabilities of the Country will reasonably admit, shall be adopted, both for the Main Line and Branch." It also provides : " That the said materials, workmanship and fixtures required for the construction equipment, finishing and completion of the said Railway shall be *first class* in their character, and that they shall conform in every respect to the requirements of Law, to the General Railway Acts and other Statutes referring to the said Company, and to the annexed specifications."

The " requirements of law and of the General Railway Acts " referred to in the above paragraph, are such as relate to fencing, road-crossings, draw-bridges, &c., which are found in the General Railway Acts. And also to the following extract from the Act of December 24, 1870, relating to the grant of two million acres of land : " The Company shall be entitled to such grant on the following conditions only : 1st. The said Railways shall have been completed and put in operation *to the entire satisfaction of the Lieutenant Governor in Council* ; and steam navigation shall have been put into operation on the St. Maurice." Also, to the following extract from the Act of December 24, 1870, relating to the subscription of one million dollars by the City of Quebec ;

4. " The Corporation shall issue their capital, according to the progress of the work, *pro-rata* to the total cost of the

road between Quebec and Montreal, *on the certificates of the Engineer to be named by themselves.*"

It will be seen from the *italicised* portion of the above extracts, that the Company will not secure its land grant unless the road is "completed and put in operation to the *entire satisfaction* of the Lieutenant Governor in Council." And that the Contractors will not receive the Quebec City Debentures, unless the character of the work shall be such as to meet the approval of an *Engineer to be appointed by the Corporation of the City*, for the express purpose of guarding and protecting its interests.

With the above safeguards, contained, as they are, in the body of the Contract, I claim that the Contractors, without regard to the Specifications attached, are bound, *in self defence*, as well as by the legal obligations which they have assumed, to construct a first class Railway, according to the generally received acceptation of that term.

With reference to the Specifications which are attached to, and form part of the contract, I have only to say that they were prepared by myself with great care as to all the details of the work; and that they embody all the important conditions and safeguards that are to be found in the Specifications under which the most expensive and important Railways in Canada and the United States have been constructed.

They were revised and approved by a committee of the Board of Directors, on the 26th of February, 1872, at which time the Mayor of the City of Quebec went through them with me in great detail, and suggested some changes which were at once incorporated in the Specifications. The entire contract and Specifications were afterwards

approved by the Board of Directors ; and, so far as I am aware, the provisions which they contain relative to the character of the work therein contemplated and fully provided for, has never been questioned until the present time.

As stated in my report of 28th May, the Engineering House of Messrs. Sir Charles Fox and Sons, in London, under whose professional supervision several important Railways have been, and are now being constructed and equipped in Canada, has quite recently made a thorough and critical examination of the Contract and Specifications.

At the risk of appearing egotistical I will copy, for the information of the Board, some extracts from the report which was submitted by this House, to Messrs. Robert Benson & Co., of London, dated April 15, 1873.

In transmitting the report to Messrs. Benson & Co., Mr. Charles Douglas Fox, the present manager of the firm, in a private note says : " My Firm's report sent herewith, will give you the result ; but I desire more strongly than I could do in an official communication, to bear testimony to the very satisfactory manner in which the Documents have been prepared. Knowing the high character, and large experience of General Seymour, I am not at all surprised."

The following are extracts from the report itself.

" The Specification has evidently been drawn with great care, and generally provides for first class construction, the only exceptions being the width of the earth works, and timber superstructures for the Bridges. The permanent way, on the Main and Branch Line respectively, is well designed for the expected traffic, the gauge being 4

feet $8\frac{1}{2}$ inches and the provision for stations and rolling stock appears ample."

"The location of the Main Line appears to have been carefully studied, and the gradients are so arranged as to avoid cuttings as far as possible, a matter of the greatest importance in Canada, to prevent heavy drifting of snow in the winter."

"We have examined the details of the River Bridges, and having been informed by General Seymour as to the nature of the foundations, and the extent and power of the iceberfts in the several Rivers, we are satisfied with the designs, and consider them well adapted to their purpose."

"In conclusion we would remark, that, in making this examination, we have been impressed with the care and consideration which have evidently been bestowed upon the designs and estimates submitted to us by the Chief Engineer."

It will be seen from the foregoing extracts, that the only exceptions taken to the specifications by the eminent House of Sir Charles Fox and Sons, is as to "*the width of the earth works, and timber superstructures for the Bridges.*" The matter of timber superstructures for the Bridges has been explained. With reference to "the width of the earth works," I will say that the specifications provide as follows :

"The road-bed for single track will be not less than twelve feet in width at grade ; but will be increased on embankments, according to height, or character of material, at the discretion of the Engineer."

"The grading will be made of such extra width at stations and sidings, as the Engineer may direct."

"All excavations must be made sufficiently wide to allow of ample side drainage."

"The side slopes of excavations and embankments, which are composed of loose material, will generally be one and a half base to one vertical; but they will vary from this, according to height, or character of material, at the discretion of the Engineer."

The question as to the proper width of earth works upon a Railway, is one upon which Engineers never have, and probably will never fully agree. All will admit, however, that the chief requirements of a road-bed, whether it be upon an embankment, in an excavation, upon a structure of masonry, or upon a bridge superstructure, are, that it affords a safe and reliable foundation for the permanent way or track of the Railway, and an unobstructed passage for the trains. And, that in earth works these conditions should be attained with a due regard to drainage and the stability of the slopes.

My own experience and observation have satisfied me that a width of twelve feet at the grade line, upon embankments of moderate height, and composed of good material, is quite ample for the foundation required to support the ties, eight feet in length, which sustain all the weight of the engine and train as it passes; and that any greater width is not only surplusage, but actually injurious to the proper drainage and stability of the track. And I know that many first class roads, in the United States, have been, and are now being built upon this plan; and that in some cases the width has been reduced to eleven feet.

There was another important consideration, however, which had very great weight in my own mind, not only

in the location of the line, and in the establishment of the gradients ; but also in regulating the widths, at formation level, of excavations and embankments, which was, *the liability of serious obstruction from snow*. And in my opinion this should be a paramount consideration upon a Railway located in this portion of Canada, which must be operated from four to five months in each year, with a large body of snow upon the ground.

There can be no doubt that the track and roadway can be cleared of this snow with much greater facility upon a narrow than it could upon a wider road-bed.

I have thus answered the objection made to the width of earth works, for the reason that it comes from a highly respectable and responsible source. And I would be most happy to answer any other objection to the specifications, if it was definitely made, and emanated from a similar source ; but as I am not advised of the precise nature of objections made by Directors, I am unable to answer them, except in a general way, that I have no doubt they will be found quite ample in their provisions to secure in all respects a first class Railway.

Inasmuch, however, as it would probably be satisfactory to some members of the Board, to have the opinion of some of the most eminent Canadian Engineers, in relation to these specifications, I have taken the liberty of enclosing a copy of them to Messrs. Sanford Fleming, Walter Shanley, C. S. Gzowski and F. W. Cumberland, and of asking their opinion, in a circular letter of which the following is a copy :

“ NORTH SHORE RAILWAY,

“ OFFICE OF THE ENGINEER IN CHIEF.

“ Quebec, June 4th, 1873.

“ MY DEAR SIR,

“ I have the honor to enclose a printed copy of the Specifications attached to the contract for the construction and equipment of the North Shore Railway ; and to ask of you the special favor, that after examining them, you will inform me, at your earliest convenience, whether in your opinion they provide, so far as the Main Line is concerned, for a first class Railway, according to the present general acceptation of that term, with the exception perhaps of *iron bridges* and *steel rails*, which are now in use upon many first class Railways.

“ If you should be of the opinion that they are in any manner defective, you will oblige me exceedingly by suggesting such changes as you would recommend.

“ Yours very truly,

SILAS SEYMOUR,

“ Engineer in Chief. ”

Whatever may be the opinions of these gentlemen with reference to the character of Railway, which these specifications, if properly administered, will produce, the Board may rest assured that they will have a controlling influence in my own mind in the consideration of any matter that is left open to the decision of the Engineer, during the progress of the work.

I consider that my own character and reputation are too much at stake to allow me to depart from the clearly ex-

pressed and well established rules of the profession, in matters of this kind. And I know, from the high character, large experience and established reputation of the gentlemen who have undertaken in good faith to construct and equip the North Shore Railway as a first class road, that they will not hesitate to incur any expense that may be necessary to accomplish that object.

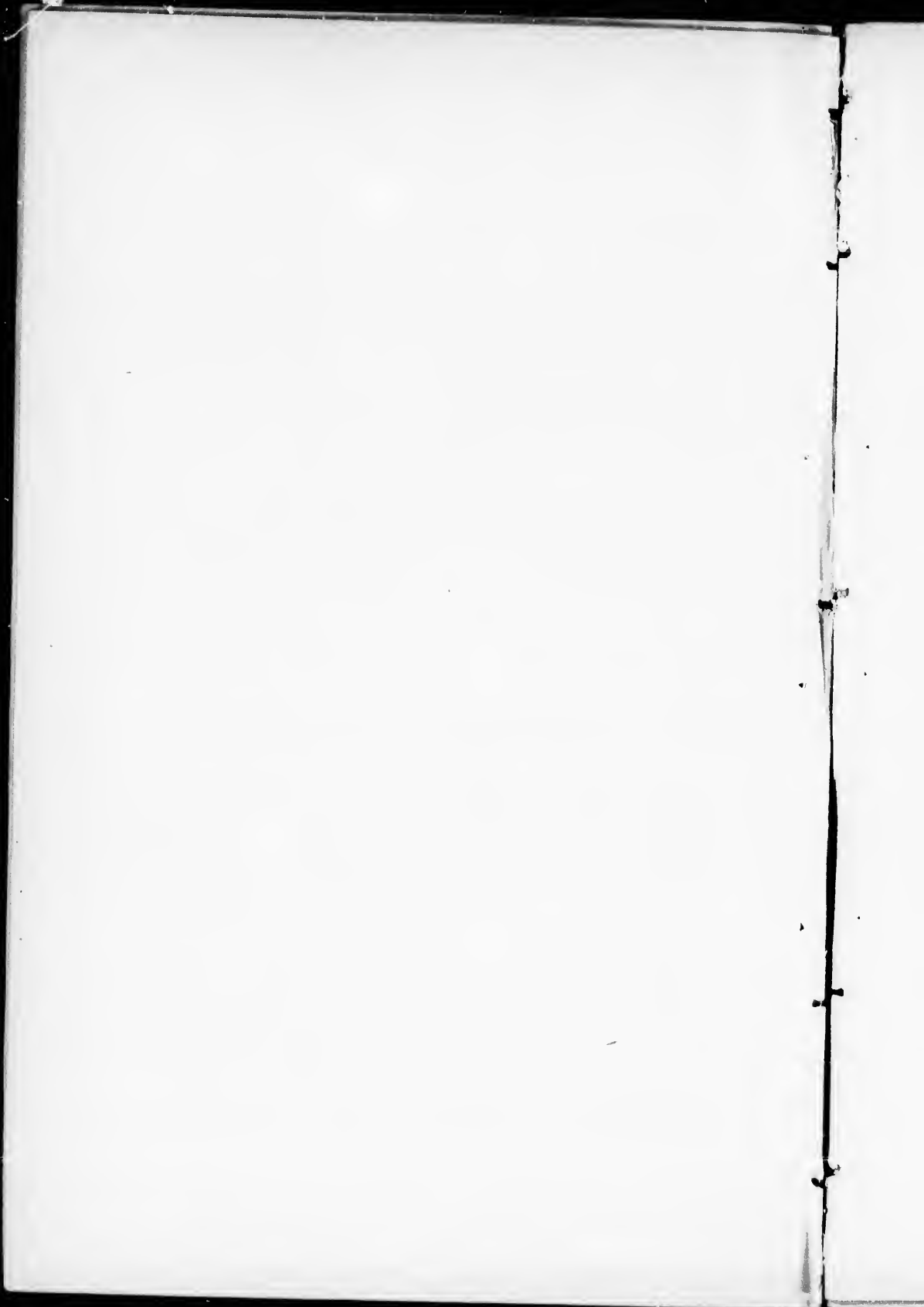
I have the honor to be,

Very respectfully,

Your obedient servant,

“SILAS SEYMOUR,

Engineer in Chief.



NORTH SHORE RAILWAY.

SPECIFICATIONS

For the Construction and Equipment of the MAIN LINE.

I. GENERAL PROVISIONS.

1. The Initial point of the Main Line of the North Shore Railway, will be at or near St. Pauls market, in the City of Quebec, at such point as the Railway Company may designate. And the Terminal point will be at or near the north-easterly limits of the City of Montreal, at such point as the Railway Company may designate. The location of the line and the arrangement of grades, between the initial and terminal points, will be made under the direction and supervision of the Engineer in Chief, and subject to the approval of the Board of Directors of said company.

2. The term *Engineer*, when used, either in the contract or specifications, will in all cases refer to the Engineer in Chief of the North Shore Railway, or to any subordinate Engineer, who, acting under instructions from the Engineer in Chief, may, for the time being, have the direct charge and supervision of the work particularly referred to.

3. The work will, in all cases, be under the direct charge and control of the Engineer; and his orders must be complied with in every respect, and under all circumstances. He will have power, and it will be his duty to reject, or condemn, at any stage or condition of the

work, all workmanship or material, which in his opinion may be imperfect or unsuitable; and the same must be immediately corrected, or replaced, to his entire satisfaction. He will also have power to discharge from the work, any foreman, mechanic, or laborer who may prove to be either incompetent, or disrespectful and riotous in his conduct; and the person so discharged shall not be employed thereafter upon any portion of the work.

4. The work of graduation will be divided into sections averaging about one mile in length, the sectional divisions being made to accommodate, as nearly as practicable, the economical distribution of the material found in excavations, or required in embankments. But this will not prevent the removal of materials required for the road-bed, or mechanical structures, from one section to another, whenever, in the opinion of the Engineer, it may be necessary or expedient to do so.

5. The right of way, or lands procured by the Railway Company for the roadway, depots, sidings, machine shops, &c., will not include private roadways to and from the work during its construction, nor lands required by the contractor, for storing and manufacturing timber, stone and other materials or fixtures, preparatory to their being used in the work. These must be procured by the contractor, at his own proper charge and expense.

6. It is intended that the materials and workmanship, both in the roadway, track, structures, buildings, and equipments, shall all be *first class*, so far as regards strength, durability, and practical adaptation. Nothing superfluous will be required; but every thing must be executed neatly, thoroughly and in good taste, so as not to offend the eye, nor convey an idea of carelessness or want of skill in execution.

7. Working plans, and specifications more in detail, for the more important mechanical structures, depot buildings, machine shops, engine houses. &c., will be furnished by the Engineer, as they may be required from time to time, during the progress of the work.

II. RIGHT OF WAY AND FENCING.

1. The lands required for the roadway, depot grounds, sidings, machine shops, and other appurtenances of the

Railway, must be of such width as the Engineer may direct ; and will embrace a width sufficient for a future double track, whenever the same may be required by the business of the road.

2. A good and substantial fence, to be composed of durable material, must be constructed along the boundary line of the company's lands, upon both sides of the Railway throughout its entire length : and convenient gates must be inserted whenever required for farm crossings or other purposes. In settled portions of the country, the fencing should be completed in advance of the commencement of work upon the road, in order to prevent damages to the adjoining land owners.

III. CLEARING AND GRUBBING.

1. The ground set apart for the railroad and its appurtenances, must be chopped and cleared to the boundary of the company's lands. The stumps, bushes and other rubbish which are of no value, must either be destroyed by fire, or otherwise removed, so as not to disfigure nor interfere with the work.

2. Trees that are of any value for wood or timber, must be neatly trimmed, and either chopped or sawed to such lengths as the Engineer may direct ; and piled in some accessible place for future use. Such portions of this timber as in the opinion of the Engineer may be suitable for bridges, foundations, cross-ties or other purposes connected with the work, may be used by the contractor free of charge ; but the remainder will be retained and preserved for the use of the company.

3. Over all excavations, and also under all embankments not exceeding two feet in height, the stumps and other perishable matter, must be grubbed out, and removed entirely from the road-bed, slopes and drains. Where embankments exceed two feet in height, it will be sufficient to cut the stumps low ; but in no case must they be left so high as to come within two feet of the grade line of the road.

IV. GRADUATION.

1. The road-bed will be graded for a single track, except where depots, stations or sidings occur.

2. The road-bed for single track will be not less than twelve feet in width at grade ; but will be increased on embankments, according to height, or character of material, at the discretion of the Engineer.
3. The grading will be made of such extra width, at stations and sidings, as the Engineer may direct.
4. All excavations must be made sufficiently wide to allow of ample side drainage.
5. The side slopes of excavations and embankments, which are composed of loose material, will generally be one and a half base, to one vertical—but they will vary from this, according to height, or character of material, at the discretion of the Engineer.
6. The materials composing embankments must be entirely imperishable.
7. Whenever the material found in road-bed, or side excavations is unsuitable for sustaining the permanent track, such other material shall be substituted as the Engineer may direct.
8. Material found in excavations will generally be placed in embankments ; but such material will be wasted, and other material borrowed for embankments, whenever directed by the Engineer.
9. Spoil banks, and borrowing pits will be so made as not to disfigure nor interfere with the permanent road-way and slopes ; and they must be dressed up in such form and dimensions as the Engineer may direct.
10. Highways, road crossings, and private roads, contiguous to the railroad, will be changed, constructed, or rebuilt, whenever directed by the Engineer ; and the work must be so carried on, as not to interfere with the rights and privileges of the public, or adjoining property owners.
11. Whenever stone are found, in rock excavations, that are suitable for masonry structures, or for slope, retaining or rip-rap walls required upon the work, they may be used for such purposes by the contractor ; but when such material is not so required, it will, at the discretion of the Engineer, be retained by the company for other purposes, and neatly piled up by the contractor, so as to be accessible from the track.
12. Retaining, and protection walls will be constructed ; and the slopes of embankments will be faced with rip-rap, whenever required for the safety of the work.

13. The road must be thoroughly drained in all places, so that no water will be allowed to accumulate and stand either in the cuttings, or along side of the embankments; and ample bridges, culverts, or sluices must be constructed across the roadway at proper points, for the purpose of leading the water away from the railroad to its natural channels.

14. In grading for a single track, care will be taken not to excavate side ditches and borrowing pits, nor to deposit waste material, where the same will interfere with the future construction of a double track.

V. FOUNDATIONS.

1. Foundation pits will be excavated of such size, and to such depth as the Engineer may direct. When below water, they must be kept dry by pumping, bailing, or extra draining, until the excavation is completed, the foundations prepared, and the masonry, or other structure brought above the surface line of the water.

2. Whenever solid rock is not found, the foundations will consist either of paving, concrete, piling, or platforms of timber and plank, as the Engineer may direct; the whole to be protected by sheet piling, rip-rap, crib-work, or coffer-dams, when necessary; and executed in the most thorough and substantial manner.

VI. MASONRY.

1. The different varieties of stone work required for abutments and piers of bridges, arch and box culverts, open drains, cattle guards, slope and retaining walls, &c., must be executed in a skilful and workmanlike manner, after the general plan of alternate headers and stretchers; and must be composed of durable well shaped stones, laid upon their broadest or quarry beds, and adapted to the formation of the different works or structures.

2. Bridge abutments and piers, arch culverts, and the side walls of open drains, road crossings, or cattle passes exceeding five feet in height, will be laid in hydraulic mortar; and will correspond in character to what is generally termed first class rubble masonry. The face stone must be hammer dressed to good beds and joints, and

pitched in, or scabbled, to a line, upon the beds and builds, corresponding with the finish line of the work. All angles that are exposed to view, must be cut clean and sharp with the chisel, to an arras of at least one inch in width, and laid to a perfect line. The work will be laid in courses, each of uniform thickness, when the quarry affords strata suitable for that purpose ; but when this is not the case, it will be sufficient to build and level up sections of from two to four feet in hight, as the Engineer may direct, with square well shaped stones of suitable size, brought to close joints, and free from spalls, both vertically and horizontally.

3. The coping must be of proper and uniform thickness, neatly hammer dressed upon the face, beds, and vertical joints ; the front angles must be cut square with the chisel, and the stone must be of sufficient width to give a good finishing bond to the work after projecting a few inches over the face of the wall. In cases where the coping forms the finishing course, or bridge seat for truss bridges, their upper surfaces will be dressed to a smooth and uniform plane ; and they will be securely fastened to each other, and to the main wall, by means of strong iron clamps and dowels, whenever directed by the Engineer.

4. The stones composing the arch, in culverts, must be placed perpendicular to the curve ; and extend entirely through the thickness of the arch, and be dressed throughout to close beds and joints. These must be laid in regular courses of uniform thickness, and the inner faces dressed smoothly to a line with the hammer. The outer, or ring stone, must have an extra finish ; and the key stone must be neatly cut with the chisel, and so placed as to project slightly from the face of the work.

5. The mortar used in masonry must be composed of the best quality of hydraulic cement, mixed in proper proportions, with clean sharp sand ; and applied to the work within the proper time for rendering the adhesion and solidification most perfect. When grout or concrete are used, they will be manufactured and applied under such special directions as the Engineer may deem applicable to the case.

6. Box culverts, and open drains, sluices, or cattle-guards, not exceeding five feet in hight, will be of rubble masonry, and will generally be laid dry. The side walls

must be laid up strong and well bonded throughout, the upper course bonding the entire wall. The covering stone of box culverts must be entirely sound, and wide enough to extend at least two thirds across either wall; and generally of a thickness equal to one half of the width or space to be covered. The end walls of box culverts must be laid with extra care and finish, the stone being of good beds and builds, with joints and angles clean and square, so as to be free from spalls. The coping must be of proper and uniform thickness, neatly hammer dressed on the face; and so laid as to have a slight projection over the front wall, and to extend back so as to give a good finishing bond to the work. The ends of the side walls of open drains, &c., will be composed of square well shaped stones, laid in regular steps or offsets to correspond with the slope of the adjoining bank; and so well bedded and fitted as to require no spalls or wedges to keep them permanently in place.

7. Slope and retaining walls will be laid at such angle, and of such thickness, as the Engineer may direct. The stone must be sufficiently massive and well bonded, to withstand the lateral thrust of the banks, and also any shock, or pressure to which they may be exposed upon the outer surface. The upper course must be as nearly uniform in thickness as practicable, and sufficiently wide to bond the entire wall.

VII. BRIDGING.

1. The timber composing the bridges, must all be of the strongest and most durable kinds; and must be properly adapted to the specific purpose for which it is intended. It must also be entirely free from sap, shakes, loose or black knots, or other symptoms of decay. The kind, length, and size required for the different structures, must conform to the bills furnished by the Engineer; and be framed and put together in the most skilful and workmanlike manner, in conformity with the plans and specifications furnished by the Engineer for the respective structures.

2. The iron required in rods, straps, bolts, nuts, washers, &c., must be of the best quality in use for such purposes; and it must be neatly and properly manufactured.

3. The truss bridges must be of a quality equal in strength and durability to the Howe patent truss, the proportions varying according to the length between bearings.

4. Bridges of smaller span, where full trussing is not required, will be built in accordance with the plan and specifications furnished for each particular structure by the Engineer.

VIII. SUPERSTRUCTURE.

1. The cross-ties must be of the best and most durable timber attainable within a reasonable distance from the line of the railroad. The particular kinds for each locality will be designated from time to time by the Engineer.

2. The ties will be eight feet long, six inches thick, and if flattened upon only two sides, they must have a bearing surface of at least six inches in width in the narrowest part; and they must be sawed or cut square at the ends, and of uniform length. The timber must be sound and straight, and either hewn or sawed to a line, with parallel surfaces, at top and bottom. If hewn or sawed upon four sides, they must be six by seven inches throughout their entire length.

3. The iron rails must be of the best quality of English or American Manufacture, weighing not less than fifty-six pounds per lineal yard; and of such form or pattern as the Engineer shall approve.

4. The joints must be properly secured by fish-plates of the most approved pattern, leaving sufficient space between the rails to allow for their contraction and expansion.

5. The track must be laid in the most thorough and workmanlike manner. The cross-ties will generally be laid two feet apart from centre to centre. They must be thoroughly bedded with a maul, and their upper surfaces brought to a perfect line with the straight-edge, so as to conform to the grade-pegs, as given by the Engineer. And the centre of each tie, when laid and properly bedded, must conform to the line of centre stakes as given by the Engineer.

6. The rails will be laid with a gauge of four feet eight and one half inches, and thoroughly spiked with two spikes in each cross tie upon alternate sides of each bar, so driven as not to split, or otherwise injure the tie.

7. After the rails are laid, spiked, and perfectly adjusted, the spaces between the ties must be filled in with proper material, and thoroughly tamped, so as to hold the ties

firmly in position, and, at the same time, secure as perfect drainage for the superstructure as possible.

8. Neither the slopes, nor the road-bed must be disfigured or weakened, by taking material therefrom for filling in or adjusting the track.

9. Whenever, in the opinion of the Engineer, the material composing, or contiguous to the road-bed, is unsuitable for ballasting the track, other suitable material shall be substituted therefor, and hauled in upon the track with gravel trains, until the same is thoroughly ballasted to the satisfaction of the Engineer.

10. Switches and sidings shall be put in, connecting either with the main track, or with other sidings, at such points as the Engineer may designate. And these sidings shall, if required, be equal in the aggregate to at least five per cent of the main line of track.

11. At all street, public road, and farm crossings, a suitable platform of plank, equal in thickness to the height of the rails, shall be laid and thoroughly spiked down between the rails, and also upon the approaches thereto, so as to insure a safe and convenient crossing.

12. A suitable sign board, painted in large letters, will be placed at each road crossing, indicating the danger of crossing the track while the engine bell rings.

13. Suitable and permanent cattle-guards will be constructed underneath the track, at all public road crossings; and the adjoining fences must be so connected therewith as to prevent animals from entering upon, or following the track.

Should the general plan of superstructure, for the whole, or any portion of the railway, be changed hereafter, by common consent, from cross-tie bearings, to continuous longitudinal bearings, the following specifications will be substituted for articles corresponding to the same numbers in the foregoing specifications.

1. The longitudinal sills must be of the best and most durable timber attainable within a reasonable distance from the line of the railroad. The particular kinds for each locality will be designated from time to time by the Engineer.

2. The sills may be of any convenient length not less than fifteen feet, excepting upon curves where they must

be of such lengths as will afford a perfect bearing for the iron rails throughout their entire length, and also a suitable margin outside of the rails for proper spiking. They will be eight inches thick, and, if flattened upon only two sides, they must have an available bearing surface of at least ten inches in width in the narrowest place. If hewn or sawed upon four sides, they must be eight by twelve inches throughout their entire length. The timber must be sound and straight, and either sawed or carefully counterhewn to a line with parallel surfaces at top and bottom; and must be sawed or cut off square at the ends. The sills will be connected together laterally, at proper intervals, by means of cross-ties neatly framed into their upper surfaces, in order to keep the rails to the proper gauge. It is assumed that these ties may be eight feet apart from centre to centre upon tangents, and six feet upon curves, but these distances may be varied, at the discretion of the Engineer, it being understood that the average number of ties will not exceed eight hundred per mile. The cross-ties will be six and one half feet long, five inches wide, and two and one half inches thick, and they must be of sound white oak, or other equally good and durable timber. When framed into the sill, their upper surface must be flush with the surface of the sill; and they must be firmly held in their places by means of a suitable spike or treenail driven through them into the sill at each joint.

5. The track must be laid in the most thorough and workmanlike manner. The sills must be thoroughly bedded with a heavy maul, and their upper surfaces brought to a perfect plane and line, so as to conform to the height of the grade pegs as given by the Engineer; and the longitudinal centre of each sill, when laid and properly bedded, must be in a line parallel with the centre line of the railway, and such a distance from it as to bring the centre line of the sill directly underneath the centre line of the iron rail which it is to support.

6. The rails will be laid with a gauge of four feet eight and one half inches, and so arranged as to break joints at least two feet with the sills upon which they rest. They must be thoroughly spiked to the sills at intervals of three feet upon each side of the rail upon tangents and two feet upon curves, and the spikes must be so driven as not to split or otherwise injure the sill or cross-tie. One spike must be

driven into and through each cross-tie, upon the outer side of each rail ; and if this spike is two inches longer than the ordinary railroad spike, and of proportionate size, it may be substituted at the tie joints for the fastenings specified at the close of article 2.

7. After the rails are laid, spiked, and perfectly adjusted, the space between and immediately outside of the sills must be filled in with suitable material to such depth as the Engineer may require, and thoroughly tamped, so as to hold the sills firmly in position, and at the same time secure as perfect drainage for the superstructure as possible.

IX. MACHINE SHOPS, ENGINE HOUSES, AND WATER STATIONS.

1. One large and commodious Machine Shop is to be constructed, either of brick or stone, at or near the station at Quebec, of such dimensions, and fitted up with such machinery and other conveniences, as the Engineer may deem suitable and proper for the ordinary repairs, building and rebuilding of the Engines and other rolling stock in use upon the road.

2. One Repair Shop is to be constructed, either of brick, or stone, at each of the stations Three-Rivers, and Montreal, of such dimensions, and fitted up with such machinery, as the Engineer may deem suitable and proper, for the ordinary repairs of rolling stock at those stations.

3. One Engine House with ten stalls, and a turn-table, is to be constructed, either of brick or stone, at each of the stations Quebec, Three-Rivers, and Montreal, of such dimensions and details of construction as the Engineer may deem proper.

4. Water Stations, with all modern improvements, shall be constructed, at each of the stations Quebec, Three-Rivers, and Montreal ; and also at such intermediate stations, or points, at intervals of not less than fifteen miles, as the Engineer may deem necessary and proper, for the safe and convenient working of the road.

X. PASSENGER AND FREIGHT STATIONS.

1. One large and commodious Passenger House shall be constructed, either of brick or stone, at each of the stations

Quebec, Three-Rivers, and Montreal, of such dimensions, and with such finish and furniture, as the Engineer may deem necessary and proper for the accommodation of the public ; and for such offices as may be necessary and convenient for the transaction of the business of the Company at those points.

2. One large and commodious Freight House shall be constructed, either of brick or stone, at each of the stations Quebec, Three-Rivers, and Montreal, of such dimensions, and with such offices and fixtures as the Engineer may deem necessary and proper for the convenient transaction of business at those points.

3. A Station House, with passenger and freight accommodations combined, must be constructed either of wood, brick or stone, at each of the intermediate, or way stations ; of such dimensions, and with such furniture and fixtures, as the Engineer may deem necessary and proper for the accommodation of the way business upon the road.

XI. LOCOMOTIVE ENGINES, AND ROLLING STOCK.

1. Nine first class Passenger Engines, and seven first class Freight Engines, shall be furnished upon the road, of such weight, and details of construction, as the Engineer may deem necessary and proper for their respective uses.

2. Ten first class passenger cars ; eight second class passenger cars ; seven baggage, mail, and express cars combined ; eighteen emigrant cars ; twenty-two cattle cars ; one hundred and ten box freight cars ; seventy-five platform cars ; and eighteen hand cars shall be furnished upon the road, of such dimensions, construction and finish as the Engineer may deem necessary and proper for their respective uses.

NORTH SHORE RAILWAY.

SPECIFICATIONS

For the Construction and Equipment of the PILES BRANCH.

The Specifications for the construction and equipment of the *Main Line*, so far as relates to the general character of work and materials, will apply, and be in force upon the *Piles Branch*, subject only to the following modifications:—

1. The lower Terminus of the Piles Branch will be within the limits of the Town of Three Rivers: and, if the principal portion of the line shall be located by the Railway Company upon the east side of the St. Maurice River, the point of Junction with the Main Line will be so fixed, that one bridge over said River will answer for both the Branch and Main Line. The upper Terminus will be fixed by the Railway Company at or near the Grand Piles, upon the St. Maurice River, where a convenient connection may be made with the navigable waters of said River.

2. The right of way will be procured, and the road-bed prepared, without any reference to the future construction of a second, or double track.

3. Trestle work may be substituted for embankments and masonry, in extreme cases, where, in the opinion of the Engineer, either on account of the scarcity of material, or other sufficient causes, it may be justifiable or expedient to do so. But the trestle work, when so substituted, must

be made to conform to the plans and specifications furnished by the Engineer.

4. The Iron Rails may be of not less weight than forty-five pounds per lineal yard.

5. An Engine House, with turn-table, must be constructed, either of brick or stone, at the terminal station at the Grand Piles, with stalls for two Engines.

6. A Water Station must be constructed at the Grand Piles ; and also one, if required by the Engineer, at some convenient point between the Grand Piles, and the Junction of the Branch, and the Main Line.

7. A Passenger and Freight station combined, must be constructed at the station at Grand Piles ; and also two or more, if required by the Engineer, shall be constructed at some proper intermediate points, between the Junction and Grand Piles.

8. The Rolling Stock will be of the same character as required for the Main Line : one passenger engine ; one freight engine ; two first class passenger cars ; two second class passenger cars ; one baggage and express car ; two emigrant cars ; three cattle cars ; fifteen box freight cars ; twenty-five platform cars ; and two hand cars must be furnished upon the Piles Banch.

9. A suitable and permanent Wharf or Landing, must be constructed at the Grand Piles, for the convenient transfer of passengers and freight, between the cars and steamboat.

10. A good and substantial Steamboat, such as the Engineer shall approve, and suitable for the navigation of the St. Maurice River, above the Grand Piles ; and having proper accommodations for the transportation of passengers and freight, must be furnished upon the St. Maurice River, at the terminal station of the Branch, at the Grand Piles.

RESOLUTION
OF THE BOARD OF DIRECTORS.

NORTH SHORE RAILWAY.

OFFICE OF THE ENGINEER IN CHIEF.

Quebec, July 14, 1873.

SIR,

The Secretary of the Company has placed in my hands the following copy of a resolution which was adopted at a meeting of the Board of Directors held on the 10th inst.

“Resolved.—That the Secretary be requested to ask General Seymour to place before the Board, the correspondence which has ensued in consequence of the letters which he informed the board he has addressed to Mr. Shanly, Mr. Gzowski and other Gentlemen, referring to the construction of the North Shore Railway.”

In compliance with the request contained in the above resolution, I have the honor to enclose, for the information of the Board, a copy of the correspondence referred to.

I am, very respectfully,

Your Obt. Servt.

(Signed,) S. SEYMOUR,
Eng. in Chief.

Colonel Wm. RHODES,
President.

CORRESPONDENCE

REFERRED TO IN THE FOREGOING RESOLUTION

CIRCULAR *from General Seymour to Messrs. Shanly,
Fleming, Gzowski and Cumberland.*

NORTH SHORE RAILWAY.

OFFICE OF THE ENGINEER IN CHIEF,
Quebec, June 4, 1873.

MY DEAR SIR,

I have the honor to enclose a printed copy of the specifications attached to the contract for the construction and equipment of the North Shore Railway ; and to ask of you the special favor, that after examining them, you will inform me at your earliest convenience, whether in your opinion they provide, so far as the main line is concerned, for a first class Railway, according to the present general acceptation of that term, with the exception perhaps of *iron bridges* and *steel rails*, which are now in use upon many first class Railways.

If you should be of the opinion that they are in any manner defective, you will oblige me exceedingly by suggesting such changes as you would recommend.

Yours very truly,
(Signed), S. SEYMOUR,
Eng. in Chief.

Mr. Shanly to General Seymour.

NORTH ADAMS,
MASS. U. S.

9th June, 1873.

MY DEAR SIR,

Your letter of 4th inst., enclosing, and asking my opinion of the Specification for the construction of the "North Shore Railway" (Quebec to Montreal) was received on 7th.

I have carefully studied the Specification (now returned) and find in it the requisite conditions for securing, in all the work provided for, a "First Class Railway" in the usual American (and Canadian) acceptation of the term.

There are a few points where, following my own line of practice, I would perhaps have been more explicit, as for instance in defining the minimum widths of cuttings and embankments at formation level or sub-grade, also as to the width and depths of dressed joints on beds and builds of Bridge Masonry. But then the power of deciding all "open questions" is placed so entirely in the hands of the Engineer (as it should be) that I do not think it necessary to formulate here my own particular views on those questions.

In respect to the Superstructure, you timber your track very amply, rather more than I have been in the habit of doing; a wise precaution in a clay country, subject to severe frosts. A 56 lb rail so timbered, is sufficient for a line with such grades as you are likely to encounter. I note that you adopt the "Fish-plate fastening" in which I entirely agree with you. It is the best rail joint I have yet used or seen.

From my own knowledge of the character of the country on the line of your road, I judge that good ballasting material is scarce, and am confirmed in my supposition by the mode of track laying you adopt. I never would *maul* my cross-ties where ballast was good and abundant, nor would I *tamp* the filling in the spaces between them. In clay countries such mode of track-laying may, of necessity, have to be resorted to.

The siding accommodation provided for, five per cent of main line length, is very small; insufficient for properly serving a large way traffic, such as is likely to be the chief dependence of the North Shore Railway. Whether it may not be sufficient in view of the means at command, and the price to be paid for the construction of the Railway, in the first instance, I have not the opportunity of judging.

The way stations are, of course, in the same proportion as the sidings, and, like them, will call for future increase. The water stations are required to be "at intervals of not less than, fifteen miles," This I think should read, "not more than &c.," much inconvenience, particularly in winter, would certainly accrue from having watering appliances so wide apart as more than fifteen miles.

The other buildings called for, appear to me to be sufficient for the requirements of a new road.

The Rolling Stock is on a very limited scale, but that too, is probably in accordance with the present financial ability of the Company. Such limitation is usual on this continent in the outset of most such undertakings.

No reference is made to *Grades*. They, I presume, are to be in reasonable conformity to the outline of the country, and, like all other questions not specially defined, in the discretion of the Engineer.

The specification, take it all in all, is full, clear and comprehensive; providing, in respect of all structural requirements, for *very good work*.

My observation on the superstructure of your road refers to the *cross tie* plan only. I would wholly eliminate from the specification the alternative proposition of continuous bearings; no track so constructed can, in my judgment, claim first class registration.

Yours very truly,
(Signed), W. SHANLY.

General
S. SEYMOUR,
Chief Engineer, &c.,
Quebec.

Mr. Sandford Fleming to General Seymour.

CANADIAN PACIFIC AND INTERCOLONIAL
RAILWAYS.

OFFICE OF THE ENGINEER IN CHIEF,

Ottawa, June, 11th 1873.

MY DEAR SIR,

I have been extremely busy for sometime back, and have not been able to reply to your letter of the 4th inst. sooner. I have now glanced over the Specification which you sent me, and agreeably to your request, remark my opinion thereon.

In this Specification, the character of the work to be executed is very indefinitely described. There are no plans

furnished or referred to, and no dimensions given except in one or two instances. Everything is vague and left to the discretion and directions of the Engineer.

It would be quite possible under this Specification, if both Engineer and Contractors were anxious and willing, to construct a sound substantial and durable road; on the other hand, it would be equally possible to produce an inferior Railway, with structures of very superficial character, quite unsuited for the rigors of this climate, and which would really require to be rebuilt in a very short time.

I enclose herewith a copy of my Specifications for the Intercolonial Railway; this line will, I think, approach the character of a first class road; the works of art, built to Specification, will far exceed in durability any thing which any Contractor would be likely to construct under the Specification which you sent to me; and yet I do not believe, taking *permanent* economy into consideration, it would be advisable to make the works much less efficient.

One of the few dimensions given in the Specification, is the minimum width of road-bed, viz: 12 feet. I am satisfied this is too narrow, it would leave no room for ballast; indeed I see no provision for ballast, beyond rather an ambiguous one under the heading "Superstructure," to the effect, that "if in the opinion of the Engineer, the material composing the road-bed is unsuitable, other suitable material shall be substituted until the road is ballasted to the satisfaction of the Engineer"; everything is left with the Engineer, he has very little to guide him; if he be easily satisfied, a very inferior description of road may be turned off the hands of the Contractors; and *vice versa*, if he be very exacting, and they willing to obey orders.

I need scarcely say that these remarks apply mainly to the road-way. The specification specially mentions the number of Locomotive Engines, cars and buildings of several kinds to be furnished. The question of equipment depends on the expected traffic ; and as I have no information at hand to guide me in forming an opinion on these points, I am not prepared to say much.

Yours very truly,

SANDFORD FLEMING.

Gen. S. SEYMOUR,
Quebec.

Mr. Gzowski to General Seymour.

Toronto, 11th June, 1873.

MY DEAR SIR,

In reply to your letter of the 4th instant, accompanied by the specification for the construction and equipment of the main line of the North Shore Railway, in which you ask, whether in my opinion the specification " provides so far as the main line is concerned " for a first class Railway, according " to the present general acceptance," with the exception perhaps " of iron bridges and steel rails," I beg to say, that I consider the specification a very cleverly prepared document ; but it is so vague, and general in its character and description of work to be performed, that a very inferior road could be built under the very general provisions it contains ; and the work done will be quite within its scope and meaning.

The point on which the specification is clear, is the width

NORTH SHORE RAILWAY.

of the road-way at grade, it provides that it should be "12 ft. wide at grade," that width in my opinion is *insufficient* for a first class railway of 4 ft. 8½ in. guage.

I remain,

My dear Sir,

Yours very truly,

(Signed)

C. S. GZOWSKI.

S. SEYMOUR, Esq.,

Chief Engineer,

North Shore Railway,

Quebec.

Mr. Cumberland to General Seymour.

NORTHERN RAILWAY OF CANADA.

MANAGING DIRECTORS OFFICE,

Toronto, June, 9th 1873.

DEAR SIR,

I have the honor to acknowledge receipt of your letter of the 4th June, enclosing a printed copy of specifications to be attached to the contract for the construction and equipment of the North Shore Railway, and inviting me to examine them, with a view to expressing an opinion whether they provide for the building of a first class Railway. I should have had much pleasure in complying with your request, but that I feel I should thus be invading the territory of those who are professionally acting as Engineers.

I have myself not been so practising for a long time, and

naturally prefer therefore, not to incur the responsibility of expressing an opinion such as that you desire to elicit.

I am sure you will not misunderstand my position in this matter.

Yours truly,

(Signed), F. W. CUMBERLAND.

S. SEYMOUR, Esq.,

Engineer in Chief,

North Shore Railway,

Quebec.

General Seymour to Mr. Keefer.

NORTH SHORE RAILWAY.

OFFICE OF THE ENGINEER IN CHIEF.

Quebec, June 18th, 1873.

MY DEAR SIR,

I enclose for your examination, a printed copy of the specifications for this road ; and also a printed copy of a letter addressed by me to the President of the Company, on the 5th instant, respecting the character of railway provided for in the contract and specifications.

This letter, as you will see, contains a copy of a circular letter which I addressed on the 4th instant, to the Canadian Engineers therein named, and I beg to assure you that your name would have been included, if I had known of your address.

I will now take the liberty of asking, whether in your opinion, the specifications, taken in connection with the extracts from the contract contained in my letter to the Pre-

sident, do not, if properly administered by the Engineer, and executed in good faith by the Contracting Company, provide for a first class railway, according to the general acceptance of that term.

The question having been raised as to the width of the road bed, it is proper that I should inform you, that the minimum width of 12 ft. referred to in the 2nd specification for graduation, is in all cases to apply to the width at the base of the superstructure, after the track has been properly ballasted, or where the native material is of such a quality as to require no ballast.

In case you should form an adverse opinion, I will thank you to specify as clearly as possible, your objections to the specifications, in order that I may act intelligently in the redemption of the promise made to the Directors at the close of my letter to the President.

Hoping to hear from you soon,

I remain, my dear Sir,

Yours very truly,

S. SEYMOUR.

THOS. C. KEEFER, Esq.,
Civil Engineer, &c.,
Ottawa, Canada.

Mr. Keefer to General Seymour.

OTTAWA, 23rd June 1873.

Gen. S. SEYMOUR,
Chief Engineer North Shore Railway,
Quebec.

MY DEAR SIR,

I have the honor to acknowledge your letter of 18th, enclosing specification of North Shore Railway, and your printed letter of 5th, asking whether in my opinion the Specification, taken in connection with extracts from the contract contained in the letter above referred to, do not, if properly administered by the Engineer, and executed in good faith by the Contracting Company, provide for a first class railway, according to the general acceptance of that term.

The expression "first class Railway" has been used over twenty years ago in contracts in this country, and has been therein specially applied to Railways which had neither steel rails or iron bridges.

The expression has generally been confined to the road-bed and superstructure, or what in England is called the permanent way; and means a road having a finished and so called permanent way, in which imperishable stone and earth works are substituted for the cheaper and more expeditious, but temporary and perishable structures of wood. It also is intended to secure, (where those matters rest with the Contractor) the best route and the best grades which the country affords.

I have not seen the contract or profile of the line, and

am not therefore able to appreciate the specification as fully as could be done in connection with these ; but I have no hesitation in saying that, the specification, taken by itself, properly administered by the Engineer, and complied with in good faith by the Contractor, will secure a first class railway, such as the Great Western of Canada, which has been referred to before in contracts as a first class railway, though it then had all iron rails and bridge superstructure of wood.

Taking the Specification as part of the contract, it is but justice to the Contractors, who are entirely unknown to me, to say, that in accepting it, they must expect to build a good substantial road adapted to the situation, and in which they will probably have a large interest as share or bond holders. The points in which Contractors get the better of the Company, and wherein the road and country suffers, are where they control the engineering, location and arrangement of grades. This was the fatal error with the Grand Trunk Railway. You have carefully guarded the interests of the railway in this most important particular by your specification, that the location and arrangement of grades shall be subject to the approval of the Board of Directors ; and in that provision of the contract, that the most direct route shall be adopted.

In this contract everything depends on the Engineer, who is the specification ; and, practically in every public work, everything relating to construction must depend on him. The important points referred to the Engineer here, are : 1st. The width of right of way.

2nd. The depth of ballast.

3rd. The width of cuttings.

As to the first, I infer from the specification, that the

Company are to procure the right of way, in which case the contract calls for no special protection to secure sufficient width between the fences, in view of snow obstruction.

The proper depth of ballast depends so much on the sub-soil ; and the facilities for obtaining proper material are so irregular, that a uniform depth is not desirable ; but wherever ballast is required, a minimum and maximum depth under the ties may properly be provided for.

As to the width in cuttings, I understand the width of 12 feet is that of the roadway " at the base of the superstructure after the track has been properly ballasted," or where no ballast is required. As some question might be raised as to whether ballast is a portion of the superstructure ; I think the 12 feet should be measured at the base of the tie. I consider this ample for the top width in embankment, and for top width of the low embankment formed by the ballast through cuttings.

As to the cuttings, a necessary evil in railways, which cannot be avoided, should be as short, as shallow, and as wide as possible ; and I would endeavour to throw up the grade when it is short, and increase the bank and the haul to secure these conditions.

The quantity of Rolling Stock and proportion of sidings I assume to be sufficient for the prospective business, and for these, the first class conditions depend on the quality rather than the quantity.

As you have already stated, the Contractors must, in self defense, build a road satisfactory to the Government and City of Quebec ; and as the question has been raised, I assume that in the interest of all, any thing which can now be settled as to the specification will be done. The

specification is one which contractors can only afford to accept when they have confidence in the Engineer, and appears to me to have been framed with a view to secure a railway to the North Shore at the earliest date; and that the best class of Railway which the condition of route, and the future of the Company and the country will warrant.

I remain,

Yours very truly,

(Signed), THOS. C. KEEFER,

General Seymour to Mr. Sandford Fleming.

NORTH SHORE RAILWAY.

OFFICE OF THE ENGINEER IN CHIEF.

Quebec, June 18th, 1873.

MY DEAR SIR,

Your letter of the 11th inst., containing your views respecting the Specifications for this road, which were submitted to you, has been received, and I regret exceedingly to trouble you again in a matter respecting which you can feel no very great personal or professional interest, particularly when your time is so much occupied with other and more pressing duties; but I find that my letter to you of the 4th inst. enclosing the Specifications and asking for your opinion upon them, did not state the case so fully as I now see from your reply, was necessary to a full understanding of the subject. And your reply therefore, very naturally fails to meet the exact condition

of the case as it exists here between myself, and a few of the new Directors of the Road.

I now take the liberty of enclosing for your information, a letter, which I addressed to the President of the Company, on the 5th inst., upon the same subject, in which reference is made to certain clauses of the contract, requiring the Contractors to build a first class road, in conformity with the requirements of law, to the entire satisfaction of the Lieutenant-Governor in Council, and subject to the approval of an Engineer to be named by the Council of the City of Quebec.

With the above specific conditions in the body of the contract, I claim that the Contractors are bound in self defence, if by no other obligations, and without regard to the Specifications attached, to construct a first class road, otherwise the land grant which forms the principal basis of the mortgage bonds, which they receive in payment, will not be granted by the Government; and the debentures which they are to receive from the City of Quebec will not be issued.

It was quite important therefore, that your attention should have been called to these provisions in the contract, as well as to the specifications, before you could be expected to form an intelligent opinion as to the probable character of the road.

The contract really places the Contracting Company in the position ordinarily occupied by Railway Companies themselves, for the reason that they pay the past expenditures and indebtedness of the Railway Company, as well as its future expenses.

They also negotiate the securities of the Railway Company, and provide for the interest on these securities until

after the completion of the road. They also, as before remarked, are bound to comply with all the provisions of law that are binding upon the Company. Upon the completion of the road they also become the owners of a majority of the Capital Stock of the Company.

In view of these important facts and considerations, it was not regarded as important that the Specifications should be as explicit as they ordinarily are upon such let in small contracts by railway Companies, who are prepared to pay cash upon monthly estimates of the Engineer; or upon a Government Road like your "Intercolonial," where every Contractor feels justified in doing the smallest possible amount of work for the largest possible amount of money.

A somewhat extended experience in matters of this kind has satisfied me that, so far as the character of work is concerned, much more depends upon the good faith and interest of Contractors; and upon the honesty and capability of Engineers, than upon any conditions or penalties that may be embodied in specifications.

The entire Union Pacific Railway was constructed without any specifications whatever, and yet it was accepted by the Government as a first class railroad; and it is even referred to as a model in the charter for your own Canadian Pacific.

The Specifications for the "Intercolonial Railway" which you kindly enclosed to me, are very full and complete in all their details; and yet I see that quite as much power is left with the Engineer in these specifications, as there is in those for the North Shore Railway; and I shall be greatly disappointed, if when fully completed according to the present contract, the general char-

acter of the work upon this road, is not found to come quite up to the standard of similar work upon the Intercolonial. In your letter of the 11th June, you make the following remark about the width of road-bed: "one of the few dimensions given in the Specifications, is the minimum width of the road bed, being 12 ft., I am satisfied this is too narrow, it would leave no room for ballast, &c."

It is perfectly well understood that this is to be the minimum width at the base of the Superstructure after the road has been properly ballasted, or when the native material is such as to require no ballast. And if you will read the 2nd and 7th Specification for "Graduation," and the 9th specification for superstructure, I think you will see that there can be no ambiguity either upon this point, or upon the question of ballasting.

You will observe, in the enclosed letter to the President, what I have to say respecting the width of road-bed, in reply to the objection made by Sir Charles Fox & Sons. And I will therefore not reiterate them here, any farther than to assure you that they are well settled convictions, after many years of experience and close observation upon the subject.

The matter is referred to on the 8th page of my gauge pamphlet (of which I believe you have a copy) in the following language "The road-bed for the wide gauge is generally fourteen feet in width at grade, *but I assume that twelve feet in good material is quite ample.* This was written in 1871, and long before the specifications for this road were prepared.

I am still of the opinion, that the persistency with which the Engineers and Railroad Managers of the present day, adhere to their stereotyped notions respecting the proper

dimensions of road-way and structures, as well as the weight and size of rolling stock upon four feet eight and a half inch gauge Railways, has given the advocates of the narrow gauge theory an undue advantage in their arguments in favor of the relative cost of these narrow gauge Railways.

Having thus placed the matter before you in a perfectly proper, although somewhat different light from the one presented in my letter to you of the 4th instant, which referred only to the specifications separate from the contract, you will oblige me exceedingly, if, after considering, in connection with the specifications, the quotations from the contract contained in my enclosed letter to the President of this company, you will take the time and trouble to inform me whether in your opinion, when taken as a whole, and upon the assumption that both contract and specifications are fairly and honestly administered by the Engineer of the Railway Company, and executed in good faith by the Contractors, the Board of Directors have any reasonable grounds for apprehending that the road will not come fairly up to the standard of *first class railways*, both in Canada and the United States, according to the general acceptance of that term.

If it should be your deliberate opinion that the road will not come up to such standard, please point out, with greater particularity than you have done in your letter of the 11th inst., the reasons for your opinion, in order that I may act intelligently in redeeming my promise to the Directors contained in the closing paragraph of the enclosed letter to the President.

I regret exceedingly that the facts and explanations contained in this letter, were not embodied more fully in

my letter to you of the 4th inst; and it is this omission on my part, coupled with a strong desire to act in full accord with prominent members of the profession in Canada, in their commendable efforts to keep up the proper standard for first class Railways, which must be my apology for troubling you again upon the subject.

Believe me, my dear Sir,

Yours very truly,

(Signed,) S. SEYMOUR,
Eng. in Chief.

SANDFORD FLEMING, Esq.,
Civil Engineer, &c.
Ottawa, Canada.

Mr. Fleming to General Seymour.

CANADIAN PACIFIC AND INTERCOLONIAL
RAILWAYS.

OFFICE OF THE ENGINEER IN CHIEF.
Ottawa, June 23rd, 1873.

Gen. S. SEYMOUR,
Quebec.

MY DEAR SIR,

I have been confined, for the last 10 days and am still confined in my room, with a badly sprained ankle; and hence some delay in replying to your letter of the 18th instant.

I cannot now undertake to do so, except briefly and I fear, not very satisfactorily.

You say that the Contractors are bound under certain clauses of the contract, to make a first class Railway; I could have understood this, had there been no specification whatever attached; first class would have then meant one of the best description of railways commonly made.

The specifications do not, in my opinion, indicate that the Railway must be of first class construction; as I said to you in my letter of the 11th instant, it would be quite possible under these specifications to build a railway of a substantial character; but apart altogether from the question as to who are the Contractors and who is the Engineer, I do not think that these specifications alone would be at all likely to secure to the Company a first class Railway.

First, with regard to the masonry, I do not think that you are likely to have such substantial work as would generally endure the rigours of this climate under the specifications which I have read, unless the Contractor makes the structures at a much higher standard than he is really obliged to do under the specification, this I think is not probable; then with regard to ballasting, the Railway cannot be considered even up to an ordinary standard, without a liberal supply of good ballast; I enclose our specification for ballasting on the Intercolonial Railway; less than the quantity here given, would not prove very efficient; and if this quantity is used, I am quite certain the width of roadway specified, would be too little.

I have thus given you in a few words, my honest opinion, regretting very much that I cannot go into the matter at greater length at the present time.

Yours very truly,

(Signed), SANFORD FLEMING.

General Seymour to Mr. Gzowski.

NORTH SHORE RAILWAY.

OFFICE OF THE ENGINEER IN CHIEF,

Quebec, June 18th, 1873.

MY DEAR SIR,

Your favor of the 11th inst., in which you express an opinion with reference to the Specifications for this road submitted to you, has been received.

I beg now to enclose, for your information, a printed copy of a letter upon the same subject which I addressed to the President of this Company, on the 5th inst.; from which you will observe I have promised that the opinions of yourself and the other gentlemen named, "will have a controlling influence in my own mind in the consideration of any matter that is left open to the decision of the Engineer, during the progress of the work."

You will also observe that this letter contains some important extracts from the contract, which, without regard to the specifications, it is assumed will compel the Contractors to construct a first class railroad, before the Company will be entitled, either to its land grant of two million acres, or to the million dollars of Quebec City subscription.

It was for this reason that the parties in London, who proposed to invest in the securities which were based mainly upon the Company's land grant, submitted the contract and Specifications, together with my plans, profiles and

estimates to the Engineering House of Sir Charles Fox & Sons, for an opinion as to whether provision was made for securing a *first class Railway* according to the general acceptance of that term. I have therefore embodied in the enclosed letter to the President, some extracts from their report, from which you will see, that, like yourself they take exception to the "width of the earth works."

In this connection I desire to say, that probably without intending to do so, you have given in your letter a somewhat unfair version of this portion of the Specifications. You say: "The point on which the specification is clear, is the width of roadway at grade, *it provides that it should be "12 feet wide at grade, that width in my opinion is insufficient for a first class railway of 4 ft. 8½ inch gauge,"* whereas, by referring to the specifications, you will see that the exact language used is this: "The roadbed for single track *will be not less than twelve feet in width at grade; but will be increased on embankments according to height or character of material, at the discretion of the Engineer.*"

This language, I think you will admit, conveys quite a different impression from that contained in the italicised portions of the quotation from your letter, for the reason that it evidently refers to succeeding clauses in the Specifications, the first of which provides that, "whenever the material found in roadbed or side excavations is unsuitable for sustaining the permanent track, such other material shall be substituted as the Engineer may direct." And the second provides that: "Whenever in the opinion of the Engineer, the material composing or contiguous to the road-bed, is unsuitable for ballasting the track, other suitable material shall be substituted therefor, and hauled in

upon the track with gravel trains, until the same is thoroughly ballasted to the satisfaction of the Engineer."

From your quotation it might, and probably would be inferred, that in wet or bad material, where one or more feet of good dry material was required for ballast, the width of roadway underlying this good material would be but twelve feet ; and that this would bring the width at the base of the cross-ties down to nine feet or less, according to the depth of ballast. Whereas, I maintain, that the specifications clearly provide for a *minimum* width of twelve feet at the base of the ties when, and only when, the material is "suitable for sustaining the permanent track." And that it is very properly left with the Engineer to decide upon the ground, and in view of the precise nature of the native materials composing the road-bed, upon which alone should depend the depth or quantity of "other suitable material to be substituted," as to what the width of roadbed should be at grade, in order to secure a finishing width of "*not less than twelve feet*," at the base of the superstructure when the same is thoroughly ballasted to his satisfaction.

Assuming that my views are correct in this particular, I will also assume that you intended to convey the idea that a roadway of twelve feet in width at grade, after being properly ballasted or when composed of material in every way suitable for sustaining the track or permanent way, "is *insufficient* for a first class Railway, of 4 ft. 8½ in gauge."

Having given in the enclosed letter to the President, the principal reasons which induced me to word the Specifications just as they are in this particular, I will thank you to point out the reasons why you regard the width provided for as insufficient.

You will also oblige me exceedingly, if after considering in connection with the Specifications, the quotations from the contract, contained in the enclosed letter to the President, you will take the time and trouble to inform me whether in your opinion, when taken as a whole, and upon the assumption that both contract and Specifications are fairly and honestly administered by the Engineer of the Railway Company, and executed in good faith by the Contractors, the Board of Directors have any reasonable grounds for apprehending that the road and its equipments, will not come fairly up to the standard of first class railways, both in Canada and the United States, according to the general acceptance of that term.

If it should be your deliberate opinion, that the road will not come up to such standard, please point out with greater particularity than you have done in your letter of the 11th June, the reasons for your opinion, in order that I may act intelligently in redeeming my promise to the Directors with reference to the "controlling influence" which your opinion, and those of the other gentlemen named would have "in the consideration of any matter that is left open to the decision of the Engineer, during the progress of the work."

In considering this subject, I trust you will give proper weight to the fact, that the contract with the Chicago Contracting Company has the effect substantially to substitute that Company for the Railway Company in all essential particulars, so far as the requirements of law, the negotiation of the Company's securities, the payment of interest, and the payment of the Company's past indebtedness, together with the present and future expenditures, are concerned; and that the Contracting Company are therefore

bound as the only means of protecting their own interests, and of giving any value to the securities which they receive for constructing and equipping the road, not only to comply with all the requirements of the law, but to construct a first class Railway.

It is for this reason that the "specifications attached to the contract appear so vague and general in the character and description of work to be performed" as you very justly remark in your letter of the 11th instant.

The Contracting Company, in sub-letting the work, are using specifications much more in detail, and more in conformity with those in general use with Railway Companies, who let the work in small contracts, and pay cash upon the monthly estimates of the Engineer.

I regret exceedingly that these facts and explanations were not embodied more fully in my letter to you of the 4th instant; and it is this omission on my part, coupled with a strong desire to act in full accord with prominent members of the profession in Canada in their commendable effort to keep up the proper standard for first class Railways, which must be my apology for troubling you again upon the subject.

Believe me,

My dear Sir,

Yours very truly,

(Signed),

S. SEYMOUR,

Engineer in Chief.

C. S. GZOWSKI, Esq.,

Civil Engineer, &c.,

Toronto, Canada.

Mr. Gzowski to General Seymour.

TORONTO, 21st June, 1873.

MY DEAR SIR,

I have to acknowledge your letter of 18th inst. together with your printed letter to Col. Rhodes, President of the North Shore Railway.

Had I been aware that my opinion upon your specification was intended to exercise in any degree a "controlling influence" upon your own mind as Engineer directing the construction of that work, I should have simply declined to express any.

As it was, I only referred to your specification very generally, except in regard to the width of the formation at sub-grade, considering that altogether insufficient, I said so.

My time is too much engrossed at present to enable me to discuss exhaustively the details of your specification, I have however read it again with your explanations, including the opinion of Sir C. Fox & Sons, and I must say that they have not in any degree changed my opinion.

A practical experience of over 30 years has taught me, that it is of the utmost importance, alike to Companies and Contractors, that the language used in specifications should be free from vagueness and ambiguity. The long explanation which you have felt called upon to give in your letter to myself in regard to the meaning of your specification, as to the width of the road bed at grade, is an illustration of the specification being not clear.

My opinion on this particular point is that, under no cir-

cumstances is a width of 12 ft. at formation level of grade sufficient for a first class railway of 4 ft. 8½ in gauge.

There are several other clauses in your specification, which from their indefiniteness are in my judgment open to serious objection ; but as I have already stated, I cannot spare the time necessary to discuss them at length.

In justice to myself however, I must say that it is my deliberate opinion, that under the specification you sent to me, a Railway may be built of a character far below that necessary to entitle it to be described as a first class road, and yet be quite within the requirements of your specification as ordinarily read.

I beg to remain,

Very truly yours,

(Signed,)

C. S. GZOWSKI.

To

General

S. SEYMOUR,

Chief Engineer,

North Shore Railway,

Quebec.

General Seymour to Mr. Blackstone.

NORTH SHORE RAILWAY.

OFFICE OF THE ENGINEER IN CHIEF.

Quebec, June 18, 1873.

DEAR SIR,

Will you please favor me with your views as to the most suitable width for a 4 ft. 8½ in. gauge track upon good dry material which requires no ballast. The width to be taken say, at the bottom of the cross-tie.

Your large experience in the construction and operating of railways in the Western States, will very justly entitle your opinion to great weight here, as it will be based upon practical considerations connected with the stability of the road, the proper drainage of the track, and the keeping it clear from snow.

Hoping to hear from you soon,

I remain yours very truly,

(Signed), S. SEYMOUR.

T. B. BLACKSTONE, Esq.,
Prest. Chicago and Alton R. R. Co.,
Chicago, Ill.

Mr. Blackstone to General Seymour.

PRESIDENT'S OFFICE,
CHICAGO AND ALTON RAILROAD COMPANY.

Chicago, June 27th 1873.

Gen. S. SEYMOUR,
Chief Engineer,
Quebec.

MY DEAR SIR,

Your favor of the 18th is at hand in which you ask my opinion, as to the most suitable width of road-bed for a 4 ft. $8\frac{1}{2}$ in guage track upon good dry material which requires no ballast.

A firm support for the cross-ties, and rapid and complete drainage, are the essential requisites in my opinion. The first can be secured by 12 feet in width, with necessary slopes to maintain this width, in such material as you describe.

Any increase of width renders drainage and the removal of snow more difficult, and is therefore in my opinion undesirable.

If the material is of such character as to require ballast, of course an increased width would be required.

Very respectfully yours,

(Signed,) T. B. BLACKSTONE.

REMARKS
OF THE CHIEF ENGINEER
UPON THE
FOREGOING CORRESPONDENCE.

It will have been noticed that the chief points of discussion in the foregoing correspondence are, the *width of earth works* ; and the *character of the masonry*.

Sir Charles Fox and Sons say :

“ The specification has evidently been drawn with great care, and generally provides for first class construction, the only exceptions being the width of the earth works, and timber superstructure for the bridges.” But no data are given by which their judgment as to what would constitute a proper width for earth work, can be determined. There can be no doubt, however, that a superficial reading of the specifications, left upon their minds the impression, as it seems to have done in the cases of Mr. Fleming and of Mr. Gzowski, that the width of all embankments was to be *twelve feet* at a point from one to two feet, according to depth of ballast, below the bottom of the cross-tie. In which case their remark is perfectly just and proper. I can only regret that, during my many discussions with Mr. Charles

Douglas Fox, upon the subject of this road, the matter had not come up in such form as to have called for a free interchange of views upon this particular point in the specifications.

Mr. Walter Shanly, than whom no Civil Engineer, or Railway manager stands higher in the profession, either in Canada or the United States, says :

“ I have carefully studied the specification (now returned), and find in it the requisite conditions for securing, *in all the work provided for, a first class Railway*, in the usual American (and Canadian) acceptance of the term.”

It will be observed, that the opinion of Mr. Shanly is based entirely *upon the specifications*, without any reference to the contract, or any clauses contained therein, which have a direct bearing upon the manner of constructing the road.

Mr. Sandford Fleming, who also stands deservedly high in the profession, as a constructing Engineer ; but whose experience in the care and management of Railways after construction is, I apprehend, not equally extensive, condemns the specifications as being too vague and general in their character ; and as leaving too much to the discretion of the Engineer. He also refers particularly, in his first letter, to the width of road-bed, as follows : “ One of the few dimensions given in the specification, is the minimum width of road-bed, : viz, 12 feet. I am satisfied this is too narrow, it would leave no room for ballast.”

After explaining to Mr. Fleming, in my letter of June 18th, 1873, that—“ It is perfectly well understood that this (12 feet) is to be the *minimum* width at the base of the superstructure, after the road has been properly ballasted, or when the native material is such as to require no

ballast," he still persists, in his second letter, in the assumption, that the width of 12 feet is at the sub-grade or formation level; and therefore that it is not sufficiently wide to hold the ballast.

By referring to the Specifications for the Inter-Colonial Railway, which were kindly furnished to me by Mr. Fleming, I find that "the width of embankments at *sub-grade or formation level*, is intended to be 18 feet;" and also that "the widths, slopes, and other dimensions above defined, may be varied by the Engineer at any time to suit circumstances." From which it would appear that the description is quite as general; and that quite as much is left to the discretion of the Engineer, in these Specifications, as in those for the North Shore Railway.

An examination of the diagram attached to the Specification for track laying and ballasting, upon the Inter-colonial Railway, also shows that the top of the ballast is only twelve and one half feet in width, for a cross-tie nine feet in length, and a track gauge of five and one half feet; which is narrower, in proportion to the width of gauge, than the contemplated width of completed road-bed upon the North Shore Railway.

With reference to the Specification for Bridge Masonry, referred to in Mr. Fleming's letter of June 23, 1873, and which he thinks not calculated to produce "such substantial work as would generally endure the rigours of this climate, &c.," I can only say, that the principal difference between these Specifications, and those of the Intercolonial Railway is, that in the latter, the work must be laid in *regular courses*; and in the former, a provision is made, by which this formality may be dispensed with, in cases where the quarry does not afford stone of suitable and

uniform thickness for that purpose. And I fail to see any good reason why the "rigours of climate" should have any more injurious effect upon one plan than the other, so long as the same degree of care is used in the other and more important details of construction.

In my earlier engineering days, I was quite in the habit of insisting upon matters of this kind, even though the Contractor and the Company were put to much greater expense thereby; but a larger experience has taught me the inexpediency, if not absolute folly, of useless expenditures for purposes of mere form, or ornament in Railway construction, except perhaps in Cities or large towns, where something of the kind is due to the taste of the people, or the surroundings of the road. Hence the sixth clause under the head of "General Provisions," in the Specifications for the North Shore Railway, which provides that the work and material "shall be *first class*, so far as regards strength, durability, and practical adaptation"; but that "nothing superfluous will be required."

Mr. C. S. Gzowski, whose Railway experience has also been quite extensive, although I apprehend that he has attained a much higher reputation as a Contractor, than as an Engineer, makes, in his first letter, the same objection to the vagueness and generality of the specifications, that Mr. Fleming does; and also to the width of the road-way at grade, which he thinks is quite clearly fixed at *twelve feet*; which width, in his opinion, "is insufficient for a first class railway of 4 ft. 8½ inch. gauge."

His second letter, written after he had received my explanatory letter of the 18th June, 1873, reiterates, somewhat abruptly, the same opinion; and closes with the remark that, in his opinion, under the specification, "a railway

may be built of a character far below that necessary to entitle it to be described as a first class road," &c.

The same remarks will apply to the objections made by Mr. Gzowski, that were made in reply to Mr. Fleming's letter; and they will therefore not be repeated.

As an effectual answer to all the objections made, and so earnestly *persisted* in, by both Mr. Fleming and Mr. Gzowski, it may not be improper to call attention in this place, to the important fact, which seems to have been entirely overlooked by both these gentlemen, that, by the terms of the contract, it is quite evident that the Contractors will not be entitled to receive, either the mortgage bonds of the Railway Company, the debentures of the City of Quebec, or the Government subsidy, which constitute the only consideration specified in the contract for the construction and equipment of the road, unless, in the opinion of competent and disinterested Engineers, the materials and workmanship are all fully up to the standard of *first class* Railways, according to the general acceptance of that term.

Mr. F. W. Cumberland declines to give a professional opinion upon the subject, for reasons stated in his letter. I regret exceedingly that his delicacy should have prevented him from speaking upon a matter respecting which his earlier experience as an Engineer, and his later experience in the general management of an important Railway, (of which I happened to be one of the original promoters,) would seem to have given him unusual facilities for forming an intelligent opinion, especially as to the proper and most economical width of road-bed, in a climate where thorough drainage, and protection from snow, are regarded as of the first importance.

Mr. Thomas C. Keefer, who is one of the oldest and most experienced Engineers in Canada, both in the construction and management of Railways, discusses the subject more at length, and in much greater detail than either of the other Engineers.

Mr. Keefer's conclusions coincide so entirely with those of Mr. Shanly, as well as with my own, that I will repeat them here by quoting the following extract from his letter.

"I have not seen the contract or profile of the line, and am not therefore able to appreciate the specification as fully as could be done in connection with these; but I have no hesitation in saying, that the specification, taken by itself, properly administered by the Engineer, and complied with in good faith by the Contractor, will secure a first class railway, such as the Great Western of Canada, which has been referred to before in contracts, as a first class railway, though it then had all iron rails, and bridge superstructures of wood."

Mr. T. B. Blackstone, President of the Chicago and Alton R. R. Co., was referred to, respecting the proper width of road-bed, for the reason that he has a large experience, both as a Civil Engineer, and Manager of railways in the Western United States; and his opinion is there regarded as very high authority. His reply is very short, but at the same time conclusive as to a width of twelve feet being quite ample for the top width of road-bed in good material.

It will thus be seen, that of the four prominent and very justly distinguished Canadian Engineers, who have been kind enough to express an opinion upon the subject referred to them, two have given a somewhat qualified

verdict against the Specifications ; and two have expressed an unqualified opinion in their favor.

Assuming that equal weight should be attached to the opinion of each of these Gentlemen, the case must be regarded as about equally balanced, so far as their opinions are concerned. But if the opinion of Mr. Blackstone, together with that of the Chief Engineer of the Company, are entitled to any weight in the matter, the scales would preponderate decidedly in favor of the Specifications.

In whatever light the result of the discussion may be viewed, by the Board of Directors, I trust it will be conceded that the points at issue have been presented by the Chief Engineer, in a fair and impartial manner ; and with a sincere desire to arrive at a just and equitable solution.

I can only remark in conclusion, that, so long as the work remains in charge of the present Chief Engineer, no pains or labor will be spared on his part, to produce a work that shall be creditable alike to the Company, the Contractors, and the Engineer ; and one that shall fully meet the just expectations of the Government, the City of Quebec, and the people at large, all of whom have so great an interest in the speedy, and proper construction of the Road.

SILAS SEYMOUR.

Quebec, July 14, 1873.

