the construction, erection and efficiency of which design all of them are ready to guarantee.

Paragraph 10. The Williot's diagram of design 'B' are for a 502 foot anchor arm built of carbon steel, and no comparison can be made with the Williot's diagrams for the 586-foot anchor arm of the board's design built of nickel steel, and as Williot's diagrams of the cantilever arm of design 'B,' which would have given a true measure for comparison, and should have been furnished as per paragraph 108 of the specifications, have not been submitted by the St. Lawrence Bridge Company, no comparison at all can be made.

The diagrams produced do not, therefore, show that there is less distortion in each case.

This whole matter has really very little importance as deformation is not a measure of strength; for if we compare two members of same length, but of different depths, the same amount of bending deformation which would be harmless in the shallower member may cause the failure of the deeper one.

It is, however, necessary to determine the deformations and the strains they cause. This has been done, with the greatest care, in connection with the board's design, as may be seen by referring to the drawings exhibited, and in all cases the strains resulting from the deformations have been amply provided for.

Paragraph 11. As the web members, as well as the bottom chords of the board's design, are erected in half widths they are just as easy to handle and to connect, if not easier, than the web members of design 'B.'

Paragraph 12. The opinion hereby given is contrary to the universal practice of bridge engineers in America. Very few instances could be shown where this has been done. This kind of connection has been limited in the board's design to as few members as erection would allow, especially for compression members, where its use was deemed inadvisable. An instance of it is shown at the end of the cantilever arm, where special precautions have been taken to avoid the objectionable features of such a connection. I have, however, always intended to change this detail, if possible, in the final drawings. The excellency of the connections used in the board's design has been shown conclusively by tests T4A and T4B, and T6A and T6B, made at Phœnixville. The connections proposed by the St. Lawrence Bridge Company have not been tested.

Paragraph 13. This statement is irrelevant unless it means that the chords proposed by the St. Lawrenec Bridge Company are better than the chords of the board. It is a bold statement in the absence of actual tests of the St. Lawrence Bridge Company's chords and in the face of the extremely satisfactory results obtained in the tests made at Phœnixville on models of the board's chords T1A and T1B, and T2A and T2B, and of a sentence in letter number one accompanying the tenders of the St. Lawrence Bridge Company, where we read:

> 'The results obtained in the tests of nickel steel columns made by the board were, in some cases, unusually and unexpectedly high and it is doubtful that so high values can again be reached unless the board's experiments are exactly duplicated.'

I would also remark that longitudinal splicing, as shown in the St. Lawrence Bridge Company's design, has been tested by the board and has given very inferior results, as shown by tests T7A and T7B.

The results of all the tests referred to were sent to you on August 1, 1910.

Paragraph 14. The first part of the sentence is in direct contradiction with clause 74 of the specifications. It is also in direct contradiction with the often expressed opinion of one of my colleagues that eyebars are the most reliable form of tension members. One might well hesitate, before accepting field riveted connections of tension members over five inches thick, not including splice plates.

A double line of eyebars is very much easier to assemble and less risky than a single line. The St. Lawrence Bridge Company propose themselves to use two lines of eyebars in designs 'M' and 'N.'

Paragraph 15. What does it matter if pins are carefully calculated according to American practice?

Paragraph 16. Any extras demanded by steel makers are included in the prices named in the tenders and there is no risk, since all materials will be inspected and must come up to the specifications. Any material, which it is impossible to get on account of length, may be spliced and I would remark that splicing has been resorted to by the St. Lawrence Bridge Company to a much larger extent than contemplated by the board.

Paragraph 17. This is certainly an unexpected argument, but I have no right to criticise the æsthetic judgment of my colleagues.

Paragraph 18. In view of all the preceding observations contained in this letter I cannot join in the recommendation of my colleagues,

(a) because it is contrary to the recommendation of the whole board,

(b) because the tender referred to on design 'B' is not according to the requirements of the board and the department, since it contains the words:

> 'This tender is based upon the specifications and draft contract as modified by our accompanying letter No. 1, of this date.'

According to the advertisement issued by the department on June 17, 1910, this tender should not be considered.

(c) because in letter No. 1 referred to above, we read, amongst many requests for changes in the specifications:

> 'The results obtained in the tests on nickel steel columns made by the board were, in some cases, unusually and unexpectedly high and it is doubtful that so high values can again be reached unless the board's experiments are exactly duplicated.'

This is certainly a high compliment for the board's design, but I do not see why anything not quite so good should be accepted.

(d) because amongst other clauses, design 'B' does not comply with vital clauses 68, 74 and 278 of the specifications.

The tender on any such design, if built according to the specifications of the board, would be the tender on design 'C' at an ex-