

broader and fuller discussion we could make a recommendation. I think we ought to make some definite recommendation as to what should be done for the engineering profession, and for manufacturers generally.

MR. JAMIESON: I might say that the committee will welcome suggestions from any members of the Society for any machines, or any testing apparatus that any one might think necessary to recommend. Personally, I think we should go rather further than testing, and that we should get them to put in appliances and men for special research work, that could be carried to much greater extent than any private engineer, or individual, or manufacturer could hope to do. I think that is why such a great degree of success has been attained in other countries, namely, by means of this special research work.

MR. HARKOM: The resolution I have offered is not intended in any way to hamper the committee in the work which it has to do for the Society, but it is simply to authorize them to co-operate with other bodies, which body may be the one I have mentioned or a university. Certainly, I would like to impress upon the meeting that concerted action of that description would be far more likely to lead to good results than individual efforts by the Society itself or by others.

THE PRESIDENT: You have heard the resolution proposed by Mr. Harkom, that the Executive or a Special Committee of the Society be authorized to co-operate with other bodies in bringing to the notice of the Government of Canada the desirability of establishing a Dominion General Testing Laboratory. What is your pleasure, gentlemen?

THE SECRETARY: I suppose Mr. Harkom means the Council when he speaks of a special committee.

MR. HARKOM: Certainly. This is merely a suggestion.

MR. DUGGAN: I would like to move an amendment, Mr. Chairman, to that resolution, namely, that the Committee on Tests be instructed or requested to request the Government to establish a testing machine of not less than one thousand tons capacity, and that they confer with representatives of other bodies to accomplish this, and to establish such other testing machines as may be decided upon, and that they be authorized to co-operate with other bodies.

MR. ST. GEORGE: How long do you think this will take, because the Committee on Testing Laboratories has been established since 1909? I think, if you have some platform to work on in suggesting that the Government establish larger testing machines than we have to-day, of you would give them an estimate of what it is going to cost, the Government will then know something about it.

MR. DUGGAN: The idea was to give the Committee definite lines to work on.

DR. GALBRAITH: Mr. President, I feel a little doubtful at this time about deciding on the size of a testing machine. I think that persons accustomed to make bridge tests and other tests, have very different ideas on the subject, and before we are ready to make a proposition of that kind to the Government, I think there ought to be an opportunity given to the Society to find out its own views.

Now, we know that one of the biggest bridges in the world—the Forth Bridge—was built without any large testing machines being used. I have assisted in making tests on the largest American machines, and I do not feel at all convinced that tests of that magnitude are necessary. Certainly, if the machines exist it is wisdom to use them. There can be no doubt at all on this point. They are more satisfactory than smaller machines. If you could make a machine that would break a fully constructed bridge, it

would give you a good deal more information than you could otherwise have about that bridge. (Laughter.) That, however, is hardly the point. I think that the scientific engineer has to do with the designing of the largest structures from a knowledge of the properties of material and of smaller structures.

Now, while in connection with the Quebec Bridge, our committee received from Australia some very enlightening letters from Professor Kernow, who is connected with the bridge department of one of the Australian states, and we were very much struck by them. He made experiments following the Quebec Bridge fatality, and built up compression pieces made with pasteboard glued together, and he derived from these slight experiments, that could be performed by any one with ordinary weights, and without a testing machine at all, he derived the proportions which seemed to our committee to be far in advance of the proportions that were in the large compression members of the Quebec Bridge.

Sir Benjamin Baker is said to have made experiments with stove pipes in deciding upon the form of the girders for the Forth Bridge. I think, sir, that there is a great deal of work of that kind to be done, and that we should make models of various proportions. We are not doing anything like the amount of work of that kind that we should do, simply because we have these great testing machines in the United States. We should know more about the behaviour of built up compression members if we were forced to make experiments with models—I do not mean models, say, for the Quebec Bridge of one-third size, which was the largest model that could be broken in the machine that was used at the Phoenix Bridge Works, and which, on the other hand, was the largest model that would give a reasonable sized rivet in the rivetting of the machine. It took a very small rivet. I am sure we can do with much smaller machines than a 1,200-ton machine that was used there, and by not attending to the rivetting proportions, but putting in what any engineer would call an over-proportion, so to speak, of strength in the lattice work, we would make experiments that I think most engineers would have a great deal of confidence in. I am sure that while it is convenient to have a big machine, there are many engineers, both in the United States and in Great Britain, and on the Continent, who might not quite agree with the idea that a machine that will break anything of real size is necessary. I should like to see this question discussed a little more fully before we make a proposition to the Government. I think it will be safer to do so. We might come to Mr. Duggan's conclusion. He has come to this conclusion already, but there are a great many others who have not come to it. And I think it is a question that is well worth considering before passing a resolution which practically says that the Civil Engineers Society has made up its mind on the subject.

MR. THOMSON: If you will permit me, Mr. President, Dr. Galbraith has referred to the Quebec Bridge, and I would like to say that if getting very large testing machines is going to result in a repetition of anything like the old Quebec Bridge disaster, we had better not have them. This reference to the Quebec Bridge makes me think of one of our principal engineers' papers, where the stand was taken that the engineers did not know how to design large columns, and that made me a little hot, and I sent them a column they had published some twelve years previously, for some twelve hundred foot span of my own, which I thought would stand the racket. The editors said that while Thomson evidently designed a column that would have stood, they doubted very much if he could say why or how he did it. The only rule I had was to make the column equally strong in every direction.

One objection to these testing machines is that they test a small section of a column and then try to enlarge that, using lattice parts where they have no business to use them. When I had the honour of working under Mr. Duggan, one of the things he always did was to figure out the excess metal in a bridge and keep it down to a minimum. I am not like the chap who put a clause in his specification that every full sized member shall be tested to destruction. (Laughter.)

MR. DUGGAN: I am afraid if we go in to the actual necessity of testing members of size, we might continue the discussion all afternoon. Dr. Galbraith, and Mr. Thomson, and I have evidently quite