Association, he offered his services most heartily, and would be glad to do all he could, not only in Parliament, but also with the members of the Government who have influence in these matters, to aid in the formation of the Association. Again thanking the Association for the honor of the toast so heartily and loyally drunk to the Government of the Dominion of Canada, the speaker resumed his seat amid applause.

Mr. Dick, rising to propose the toast of "Technical Education," which was coupled with the name of the principal of the School of Practical Science, said it was quite unnecessary that he should say a single word to convince any member of the Association of the necessity for technical education; perhaps there was no profession where it was so necessary that a man should be a good all-round man in order to succeed. If an architect be not a good all-round man, he must associate with himself others who would supply the branches in which he does not excel himself. There were many excellent examples in the United States of that kind of division of labor, which perhaps after all, was the very best thing which could be had at this day, for excellence in particular departments is the only sure road to success. A man may acquire the business element by rubbing up against his fellows; the artistic he would study for himself, but the technical he had to acquire. The School of Science was being gradually developed; it had not reached its full development, but it was hoped that through the liberality of our Government, and perhaps private munificence, it would yet be placed in a position to compete with the older institutions which had large endowments and were gradually being put in positions of first-class efficiency. It was not behind any of them in one respect. It had the men, if they were only provided with the means. Something had been seen to-day of what was being done in the School of Science in the matter of providing materials for forming tables of the strength of materials. Architects had been going largely upon tables which had been constructed from experiments on a small scale, and which were unsatisfactory. The first test made in the morning showed how very erroneous some of these tables were. It was on a beam, with a cross strain, a piece of pine timber 10 x 10 inches square and eleven feet long. According to the calculations made by different formulæ, in different text books, the beam ought to have stood, before breaking, from 30,000 to 40,000 pounds; while as a matter of fact, it began to give way under a strain of somewhere about 12,000 to 13,000 pounds. The rules were made by taking a piece of wood an inch square, with a certain pressure, and multiplying both by a certain number; thus saying that if a stick one inch square would stand a certain strain, a stick of twelve inches square would sustain a proportionately larger strain. The difference was largely caused by the fact that where a stick one inch by one inch was taken, it would be practically a perfect stick, free from knots, shakes, &c., while the pieces which have actually to be worked upon might have shakes and knots but which yet might not be so bad that the piece could be rejected and actually refused. Calculations must be based not upon the excellent quality of a piece of perfect timber, but upon the timber which actually had to be dealt with; and it was only when such machines as were now being introduced in the School of Practical Science were used so that a piece of timber might be tested, that tables could be got which would be of actual value. There was no doubt many buildings were now being subjected to greater strains than their designers intended; and that many buildings which were standing, and apparently safe, might be very near to the breaking point, but nobody knows of it until the crash comes. No doubt the testing of materials was in its infancy, and the School of Science had entered upon a career which would yet result in giving a great deal of valuable information which would be the means of enabling members of the profession to know definitely what they were doing, instead of trusting to empirical rules that might fail them at some very critical point, resulting in loss of property and, perhaps unfortunately, in loss of life, on account of the failure of some structure which, according to the calculations, ought to have been perfectly safe. The School, he was happy to say, had been organized under the care of a man whom all who knew him were thoroughly satisfied was entirely qualified for the position. They did not know where to find a better, and did not want to look for any better. The only regret they felt was that it was not possible for all the young men who proposed to be architects to put themselves under his care and go through the curriculum which has been laid down in the School. Most young men were a little too old when they left school to go through a course of technical training, and then go through another course in an architect's office. A problem which the principal and his coadjutors have to solve was how they could arrange the curriculum so as to give the young men that go into the School such a training that a comparatively short time would be all that would be necessary for them to pass in an architect's office, after they left the School, to enable them to go out into the world and announce themselves as full-fledged, capable and well-qualified architects. The company present were then called upon to drink the toast "Technical Education," coupled with the name of Prof. Galbraith.

Prof. Galbraith in the course of his response said that he had been reminded, since they had the opportunity of using the testing machine in the School of Science, of the very little that is known about the strength or elasticity of building materials. It was laid down in the curriculum as a science which could be taught and as a thing the results of which were pretty certain, much in the same way as the science of astronomy or chemistry or other sciences, whereas it was in a very different condition. In astronomy the positions of the various planets could be calculated beforehand, and in chemistry, the results might be known beforehand. But how little could be said about the strength of any member of construction! It seemed marvelous that a science so intimately connected with safety and comfort, and in which we have the experience of all the ages, should be practically no science at all. The principles that are settled in the science of materials can be summed up in a very few words. Then when they are applied you have to multiply your results by the thing called the "Factor of Safety," which has been well-called the "Factor of Ignorance." Instances of that were seen this morning. According to the formulas the beam should have been twice as strong as it really was. Very few who had not seen experiments conducted on the same scale, could have said anything about it at all. So it was throughout the whole range of the science of strength of materials. When a young man begins to study the strength of materials he asks, "What is the breaking strength of a certain material?" which shows the misconception which attaches to the whole subject. When he came to look into it a little more closely he would find there was no such thing as the breaking strength of any material, in the proper sense of the word. A piece of pine or steel might be broken in an infinite number of ways, and under all sorts of strains, while the question just spoken of implied there was only one. It was known that the rods in a railroad bridge or a roof truss, might last for years and then break down; that test of practical service and the test in a testing machine were entirely different. Strains can be applied to a piece twice, and a less strain will break it applied a second time, than when applied only once. Another strain could be applied three, four or ten times and be less than the strain which was applied once or twice. This could be multiplied an infinite number of times. He had no hope that the science of the strength of materials would ever be developed to such an extent as to enable them to build with the factor of safety of one, that is, that they would be able to design a piece to last under such conditions as those under which it would be intended to be used, a certain number of years and then break down. Although they knew all about the material, and had carried on the experiments that would determine the various breaking strains of the material, they were entirely ignorant of what force a structure would be subjected to after being built, so they would always have to apply the factor of safety—the factor of ignorance. They would, possibly, not be factors of ignorance at the end of a thousand years, as to the material, but would be still factors of ignorance as to the possible forces to which the material would be subjected. Machines had been invented in Germany by which repeated stresses could be applied to the same material. To give an example as to how often these repetitions take place, the speaker asked them to consider the case of one of the tie-rods in a Howe truss railway bridge. Suppose that in a bridge where, the traffic being very great, a train might cross the bridge every quarter of an hour through the whole day; that would make about 100 repteitions of that strain in the twenty-four hours, that multiplied by 300, to get the number in a year, would make 30,000 for the year; if the bridge should last twenty years, then it would be 600,000 repititions of the stress. To investigate properly the strength of that piece, it ought to be subjected to at least 600,000 repetitions of the stress caused by the train passing. To do that under the proper conditions would require twenty years; life is too short for that; and the Germans had repeated this strain every minute, instead of every quarter of an hour. Even that required over a year to make the one experiment on the one rod, and then you know only the result for that kind of material and nothing else. That would give some idea of what investigation into the strength of materials meant; they would never see the end of it; those who live generations after would not see the end of it. Then it had to be remembered that there were all kinds of strains and stresses to structures. The machines which they had in the schools were only the modern development of the old-fashioned machines which determined only one kind of breaking stress, the stress which is produced by a load which is gradually increased up to the breaking point, and only applied once. They were utterly unable with their equipment to make experiments like the German experiments; they could not be done very well by steam power, because the firemen and engineers have to be at work day and night; the only possible way of doing it is where they have water power which could be set going and would not require very much attention, but would run on until the piece broke. So that although they were making great advances, they were precluded, in the School of Science, from their position, from going into the question to the extent to which they could elsewhere and under other conditions. At the same time by a judicious use of the factor of safety, they could make great use of the results, in designing. They would no doubt be able to reduce the factor of safety on some materials. The speaker was pleased to see that professional men were taking an interest in the School of Practical Science, and felt that it could be of some use to them; the only justification of the expense to which the Government had gone in fitting out