the grade and curves and peculiarities of this particular section of the road. It might be judged from the evidence presented that so long as no accidents occur employees have assurance of immunity, and feel safe in disobeying orders. The Railway Commission should be required to use full power in providing means to detect violation of train orders, to carefully investigate safety appliances designed for the prevention of accidents, and to punish the railroad companies responsible.

EDITORIAL NOTES

A Western engineer in sending in a subscription to the Canadian Engineer during the week strongly endorses an article which appeared therein in the issue for November 1st p. 374, an extract from which reads: "Canadian money should be paid to Canadians for Canadian effort, especially if the result of that effort is as good as, if not better than, that of a foreign competitor." The writer is strongly of the opinion that this principle should be enforced, not only in the case of the Quebec Bridge, but in a great many of the engineering enterprises throughout the Dominion.

* * * *

What untapped sources of wealth exist in British Columbia will be known only when the transportation companies' steel rails have been laid in the fertile valleys of the Province. The railroad is the pioneer of civilization and prosperity. The people of British Columbia have suffered from the lack of labor and of railroad facilities; there are signs of a change in both directions. Visits of prominent Canadian Pacific officials to the coast would indicate that the company will assist soon in the opening up of a country, the extent of whose vast resources is but largely a matter of guesswork. The completion of the Kootenay Central too, will mean much for the north-eastern part of that district and for the Province as a whole.

* * * *

The question of the duty and responsibility of a consulting engineer towards his clients, and also that of inspectors who are employed to see that the work is properly executed, naturally arises from the clear and voluminous evidence of the engineer, Mr. Theodore Cooper, before the Canadian Commission in the recent investigations of the failure of the Quebec Bridge. It is not an uncommon practice on this continent for consulting engineers to entrust the actual detailed design of bridges in accordance with their specification, to the bridge companies, who in many cases have a staff employed for this purpose. If these powers are exercised properly there is no reason why the work, as the making of drawings, details of connections, and calculations, when entrusted to responsible manufacturers, and when afterwards subjected to rigid scrutiny by conscientious consulting engineers, should not be successful. Now that most of the facts are known, it will be shown whether the implicit faith Mr. Cooper appears to have had in the experience of the bridge company was fully justified or not.

* * * *

A letter appears in this issue from Mr. W. H. Booth, M. Am. Soc. C.E., of London, England, who visited the Quebec bridge shortly before it fell. It is the opinion of Mr. Booth that the mistake has been made of attempting to employ merchant sizes of material, that in all engineering work it is usually the best commercial practice to employ ordinary commercial material in construction. The question of a serious overrating of compression members and incorrect formulæ as a basis for their calculation is an uncomfortable thought suggested by the writer—formulæ that, so far have stood the stress of traffic, but when applied to a too large step as to size of bridge members result in failure. The case of the growth of various machines is cited—the gas engine, steam turbine, etc., where the progress has been comparatively slow, but followed by disaster in each case where immediate steps became too great and growth too fast. The experienced engineer should never let himself be caught too far off precedent. He should not allow himself to assume that things which hold good for smaller sizes will necessarily hold good for proportionately larger designs.

AN ENGLISH ENGINEER'S OPINION ON THE QUEBEC BRIDGE FAILURE.

Editor Canadian Engineer:

Considerable interest has been felt in England in respect to the failure of the Quebec Bridge. American engineers have so long been regarded as peculiarly experienced in long-span bridge construction that it is thought the present disaster must have arisen from some strange oversight in the design. The fact that one of the members of the lower rib of the cantilever was found doubled into an S bend has by some been taken to show that the damage sustained by this piece at the maker's yard, in transit through New York, and when unloaded at Quebec was responsible for the failure. The fact that the same member on the opposite lower rib was afterwards found to be similarly bent is no evidence against the view, for it is certain that if one rib began to buckle it was likely to cause the other side rib to buckle in the same place.

But the damaged member was probably but the first piece to fail, and if bridge parts have a factor of safety of five it is argued that this particular member could scarcely have been so damaged as to fail had it been really able to carry five times the load before failure. It could not have been reduced to one-fifth its strength of any damage that could have been overlooked. Then, if reports be true, many other compression members in the bridge showed signs or weakness, for they had lateral deflections, though "not to the same extent as the member that was thought to have failed first. The uncomfortable thought is thus raised that all the compression members were extraordinarily overrated, that the formula by which they were calculated must have been very seriously wrong. Let the formulae generally accepted have the imprimatur of the best bridge engineers. So far these formulae have given results in bridges that have stood the stress of traffic. Then a big step is made in advance as regard the size of bridge members and a failure ensues. Is it because the recognized formulae have given results which, for moderate dimensions, would plot along a curve apparently of the straight line order, but actually one that, like many of the curves of performance with which engineers have to deal, is nearly straight for a long range and then suddenly falls away to a quite sharp curvature.

To the writer, who saw the bridge in July, just before it fell, it appeared that the mistake had been made of attempting to employ merchant sizes of material. In all engineering work it is usually the best commercial practice to employ ordinary commercial material in construction. And usually the structures which are built from such commercial materials are themselves structures from ordinary kind. As structures such as bridges have developed in size the rolling mills have fitted themselves step by step to produce rolled shapes from which the bridge members could be built up. But when a huge step forward in the dimensions of a bridge is suddenly taken it finds the rolling mills unprepared to meet the demand for proportionate material. The huge compression members of the Quebec bridge are probably a case in point. They have been built up to a supposed sufficient section by the superposition of a supposed sufficiency of small sections. It seems extremely probable that such built up sections are inherently weaker than has been supposed and that for all abnormal structures there must be abnormal methods of construction.

In the Forth bridge, which had spans of only 1,710 feet or 90 feet less than the Quebec bridge, and carried nothing but a double-track railway, such abnormal methods of construction were adopted, for the compression members were all tubular and were built hard by the site of the bridge. No attempt was made to employ ordinary commercial sizes of