there is another at River a la Graisse, with only one line of tubes. One of the reasons why this plan has been adopted is, that under certain conditions which might occur, the culverts would be subjected to considerable bursting pressure. The tubes take the place of the centres, which would be required either for a stone or concrete arch; and, in brief, the plan seems to answer very well.

7. On the Beauharnois Canal the lift of 82½ feet between Lakes St. Louis and St. Francis is overcome by nine locks. The guard lock is always a lift lock. The lifts are generally nine feet. This suits the configuration of the ground on the south side of the river. But on the north side the land continues for a long distance eastward from the head of the canal, pretty much at the same level as Lake St. Francis, so the summit is about 10½ miles long. There is then a descent by one lock of variable lift, and about 2½ miles further down the land pitches off on the right bank of the Ottawa, so as to suggest the idea of concentrating the lockage there as much as possible. When the canal was first located, the rise of 70 feet was proposed to be distributed amongst five locks. This was subsequently changed to four, and, finally, upon full consideration, I recommended that the rise should be made by three locks, each of 23⅓ feet lift. In this view of the case I was supported by Walter Shanly, M. Can. Soc. C.E., and T. C. Keefer, Past President Can. Soc. C.E., who were consulted by the Government on this important point. The advantages of high lifts, when possible, are obvious. The number of locks is reduced. A considerable saving, both in first cost and subsequent maintenance, is effected, and the navigation of the canal rendered easier and quicker. But it must be remembered that it is entirely dependent upon the profile of the ground as to what lifts can be judiciously given to the locks. All the advantages claimed for the plan adopted in the particular case above referred to might disappear if the line adopted had to follow a long flat slope. Here, as elsewhere, judgment and experience are of course necessary in arriving at a proper conclusion.

8. As to the locks themselves, it may be stated that on the Soulanges Canal they will be faced with cut stone, but the mass of the wall will be of concrete. They will be filled from the sides through a number of short cast-iron pipes, leading from the culverts into the chamber. There will be no timber in the foundation as heretofore. One of the chief sources of accident is that through a wrong or mistaken signal, a vessel coming into the lock from below, may go ahead instead of reversing, and so run against the upper gates, if on the same level,—striking them about the mitre, and from behind, in which case they are jumped off the pivots by the force of the water, and are swept into the lock, damaging the canal and the vessels also. But when there is a heavy breast wall, upon which the upper gates are placed, it is the vessel that comes to grief, and the gates are left intact. There are a number of details in the construction of these locks, which have been thought out, and are believed to be improvements on the old style; but it is not considered necessary to refer further to them in this brief address.

It appears to me that on the Welland and St. Lawrence Canals, where the supply of water is practically unlimited, and for lifts of from 20 to 25 feet, there is no simpler or safer device for passing vessels from one level to another than the form of lock now in common use. If the gates are properly constructed and balanced, they can be operated quickly and with ease. An ordinary lock can be filled from the sides in four or five minutes. This avoids the surging of vessels, so much complained of when the water is admitted through valves in the gates—and, in short, there is no reason why a lockage cannot be made in from 12 to 15 minutes under ordinary circumstances.

9. It may, however, be well to draw attention to the facts concerning the proposed application of electrical power in opening the locks and bridges, and generally operating the Soulanges Canal. A power-house will be established about mid-way of the line, and where it nearly touches the St. Lawrence at River a la Graisse. Here the surface of the river is about 20 feet below that of the canal. The ordinary water cross section of the prism at mean level of Lake St. Francis is about 2,700 square feet. The fall in the summit level will, if necessary, give a current in the canal of, say, 100 feet per minute, or 270,000 cubic feet flow. Ten per cent. of this on a 20-foot fall would give 1,000 horse power gross, or, say, 750 effective. This would obviously cover all requirements as to locks, bridges, weirs, etc., and possibly provide power to haul the vessels into and out of the three lower locks without using their own steam at all. Experiments were made, under my direction, at Lock No. 9, Beauharnois Canal, on a simple plan for opening and shutting the gates by means of a rigid girder, worked by rack and pinion movement, and driven by an electric motor. The girder was attached to the top of the gate, and the machines were placed on the copings of the lock. The gates were easily opened or shut in less than one minute, and there is no reason why both the gates—filling and emptying sluices, etc., should not be operated from a single switch-board in a small wooden house or box, placed on whichever side of the lock may be considered necessary. The cables to the motors on the opposite side to be taken across in grooves in the foundations. It is intended that the weirs shall operate automatically, and advantage will be taken of all the improvements made by electrical engineers to render the working of the canal as efficacious and economical as possible. It is evident that the adoption of this plan will greatly reduce the present cost of operating the canals.

10. Incidental to this question of canal location, it may be said that much confusion has arisen in reference to the available depth of canals by the mistake of referring their draught to the *mean water* of the river or lake by which they are alimented. This should be carefully avoided. The depth on the mitre sills should be referred to the *lowest known stage* of such lake or river, and not to any deceptive mean derived from statistics. In such a case statistics won't do—it is *water* that is wanted, as the late Mr. John Page used to say. This lesson has been forcibly inculcated by the late unprecedentedly low water in Lake Ontario and the River St. Lawrence.

11. I had almost forgotten to say, before closing that, in my opinion, all canals, especially those taking their supply from lake or river subject to the effects of storms, or the unusual variations of surface due to heavy rainfall, should have a guard lock at or near the upper entrance.

If the summit or feeding level is very long, and the head of the canal is in such a position as that of the Welland at Port Colborne, where there is a funnel-shaped harbor leading out of the funnel-shaped end of Lake Erie, the effect of a violent storm upon the water