and the other arm made to swing partly over the land. Behind this pivot the prism can be enlarged, so as to give more than the full sectional area of the canal, and entirely obliterate cross currents at the bridges. In this way a double source of accident will be avoided. Vessels will have no tendency to sheer, and there will not be the same danger of collision with the bridges as when a narrow channel on either side of the pivot has to be passed through at such speed as will enable the vessel to be safely steered, especially in high winds. With this arrangement the eastbound and heavily laden craft need not slack up, neither the lighter ones coming west, so that there will be no detention whatever at the bridge crossings. In addition to the safety of this plan, it is by far the most economical. Some of the road bridges on the Welland Canal cost from $40,000 to $50,000. There is no reason why, under ordinary circumstances, a bridge, to serve the same purposes, if built according to the plan above described, should cost more than say from $25,000 to $30,000.

3. The reduction in the cost of masonry previously referred to, when discussing the question of the enlarged Welland Canal, is founded in the firm belief that for the purposes of lock walls, weirs, retaining walls, and other hydraulic structures, concrete made of sound and properly tested Portland cement, good clean broken stone and sharp silicious sand, is in all respects better than the expensive masonry hitherto in vogue. A monolithic water-tight mass is obtained of such shape as may be desired, and at a cost which will vary from about one-half to two-thirds of that of dressed stone, according to circumstances. Where, for example, the line of a canal passes through a rock formation, which, whilst not suitable for masonry, yields excellent material for concrete, what valid reason can be given for rejecting this mode of construction? Take, for example, the case of the new Welland Canal. Its line is in heavy rock cutting at the pitch of the Niagara Escarpment at Thorold, and close to where the bulk of the masonry is in the ladder of locks and weirs descending to Lake Ontario. Within a distance of about nine miles there *are over 325,000 cubic yards of this masonry. And the* rock excavation in the vicinity amounted in the solid to over 150,000 cubic yards. This, instead of being chiefly thrown to spoil, would, if broken to proper size, have made nearly 300,000 cubic yards of concrete. If the structures had been built (as might have been done in this particular case) of native cement, through a stratum of which the canal line passed—a vast mass of the work could have been executed at one-half or less than one-half of the masonry prices paid—which were from $10 to $12 per cubic yard. These are of course only approximate statements, but will serve to show the great saving which might have been effected by adopting the use of concrete under such favorable circumstances.

4. Recent experience in the use of properly made concrete places its economy and desirability for canal works in every respect beyond reasonable doubt. The Manchester Ship Canal examined by me in 1891, just previous to completion, afforded a convincing proof of this. The cost of this work even now is enormous. But what would it have been if the 1,250,000 cubic yards of masonry in its locks, quay walls, etc., etc., had been built of cut stone, instead of concrete?

Conclusive evidence of the durability of concrete in this climate, under the most trying conditions, is afforded by the present state of the breakwater at Buffalo harbor. This structure is exposed to the violent storms at the east end of Lake Erie, which entirely destroyed its old wooden superstructure. This was replaced by a solid mass of concrete—and the waves have dashed up against it for years, and masses of ice have clung to it for many rigorous winters, without effecting even the least degradation of its surface. It is, however, superfluous to multiply proofs of what is now a universally acknowledged fact. But it is also a fact that the reputation of concrete has suffered greatly by the use of cement in public works, which can only properly be described as "trash." There is nothing that requires so much care in testing as cement, although the duty is simple and easily performed, but without it there is no guarantee whatever of quality. The choice of cement should not be left to any contractor. Such a course is almost sure to result in failure; and it may here be observed *en passant* that there are several cases of this kind in canal works of recent construction.

5. There is another position in which concrete may, with advantage, be used as a substitute. Of recent years, the increasing cost of timber, its inferior quality, and comparatively short life, have directed attention to the plan of using concrete instead of it in the superstructure of entrance piers, dock walls, etc. On each side of both the upper and lower entrances to the Soulanges Canal, the cribs are finished to low water line, and along their inner faces concrete walls are built about 8 feet high and 6 feet wide at the base. These will be coped with cut stone and backed up by material of heavy class, well rammed in layers. The cribs are 25 feet wide. The wall is protected by oak fenders 18 x 9 inches. Its face is vertical. The cost of the crib superstructure is approximately about three-fifths of that of concrete, which is about $5.50 per cubic yard, with Portland cement at $2 per barrel of 400 pounds. The aggregate length of piers at both entrances is about 3,900 feet.

6. None of the other St. Lawrence canals is crossed by a stream of such size as the River Delisle, which intersects the Soulanges at Coteau du Lac. The flood measurement of this was found to be about 300,000 cubic feet per minute. The river is passed under the canal through four lines of cast iron tubes, each of 10 feet inside diameter, and having an aggregate area of 314.16 square feet. The length of the culvert is 290 feet. The banks of the river for some distance above it are flat, and then there is a rise of about 7 feet at what is known as "Sullivan's Falls." The spoil from the canal is used to raise these low flat banks, so that when the river at flood time rises to get the necessary head to pass such a large volume, the land on either side is not overflowed, and the effects of back water are not felt. The tubes are one inch in thickness, strengthened with fillets or bands three-eighth inches thick, and four inches wide at the centre and ends of each ring. The weight is about 1,300 pounds to the running foot. They are cast on end in lengths of five feet, and were laid on cradle pieces of white oak placed at five feet centres. They were butt-jointed and surrounded with about two feet of concrete.

At the Delisle they are laid in a rock trench 50 feet wide, and the whole trench is filled solidly up with concrete nearly to the level of canal bottom. The cost of this structure when completed will be about $85,000. At the River Rouge there has been a similar culvert built, but with only two lines of tubes. This is finished, and the stream now passes through it. Further down,