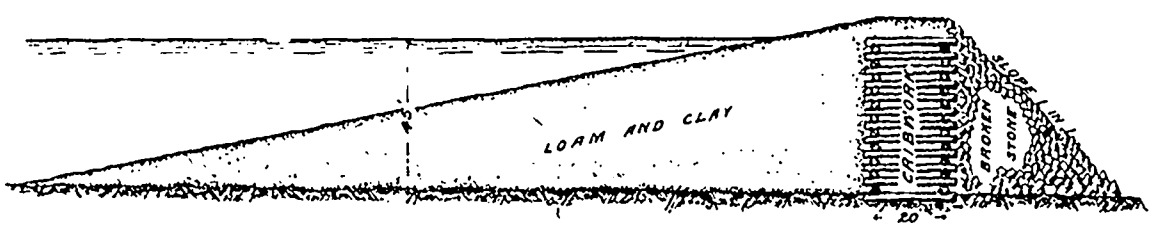
THE CANALS OF CANADA.*

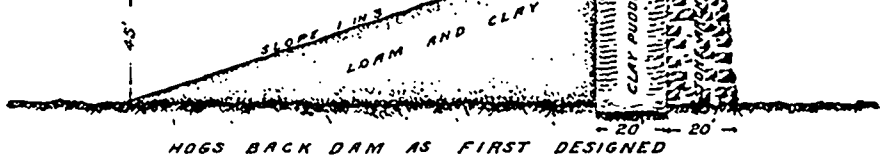
(Continued from last issue).

Again with a regular canal in times of flood the engineer simply closes his guard gates and lets the angry river sweep by, but if he has dammed right across it he must be prepared to cope with and tame its fullest strength. More than one dam, built in the most approved materials of modern engineering, has gone down before such floods, and the best method of building such structures is still a matter of controversy. The boldness of these pioneer engineers can be best judged by their own recital of the disasters that befel their first dam. This was the Hog's Back dam, which is situated close to Ottawa, and at a point where the level of the water had to be raised 45 feet. The river was 170 feet wide, and in 1827 a dam was constructed half way across the river. It was built on the authorized plan: that was, an earth structure which was rendered water-tight by clay puddle and supported on a great dry stone wall built in an arched shape of large stone set on edge. Then the contractor attempted hurriedly to block the other half of the river by a dump of what



HOGS BACK DAM AS COMPLETED

the Royal Engineers called rubbish, but no provision was made for the water, and rising, it swept over the rubbish and carried it all away. A rough timber dam was then thrown across the opening in order to protect the finished part of the arch, but the spring floods overtopped this, swept it also out and cut a new channel around one end of it. The gap was again closed in the simple method followed by our lumbermen in building their driving dams, and under this protection the great arch was at length completed, and by March, 1830, the dam seemed safe. But the river rising in spring flood worked through the ill packed clay and puddle, and on April 3 the stone work fell with a great crash, and the river swept on its course once more. The Royal Engineers write that they saw that day an extraordinary exhibition of the power of Canadian frost, for while the turbulent stream swept through, the top of the dam remained standing, an earth arch of over 50 feet span. The dam was finally completed by building the lumbermen's cribs right across, backing



HOGS BACK DAM AS FIRST DESIGNED

them with broken stone, and dumping earth and clay in front, and providing ample by-passes for the flooded river. The lessons its construction taught have been well learnt, and no man would to-day build an earthen dam that the river could overtop, nor attempt any construction without providing ample by-passes while his works were in progress. The still recent failure of the dam on the South Fork of the Conemaugh river was caused by the blocking up of its waste weirs or by-passes, and the destruction of Johnstown and of the railroads in the Conemaugh valley was a terrible demonstration of the power of a flooded river that has broken its dams. The Rideau Canal is a succession of pools formed by dams like that at the Hog's Back, lift locks being built near the end of the dams. These were of rubble masonry laid in lime mortar and faced with cut stone. Considerable difficulty was experienced with the masonry owing to the poor quality of puddle used around the walls, and the total unsuitability of lime mortar for such work. This was finally overcome by making a special cement at Hull, for our modern hydraulic cements were then unknown, and grouting the finished walls with it through long tin tubes let down in holes drilled in the masonry. The vertical lift of these locks varied considerably, but it was necessary at some places to place several locks together to overcome the rise at those points. Thus at Ottawa a rise of 81 feet is overcome by eight locks in a flight.

The delay and inconvenience to traffic of such an arrangement has been found to be very considerable, and in the canals now building it is carefully avoided. The Trent Navigation is a system of canalized rivers connecting natural lakes, very similar to the Rideau, but on that work the engineers are building hydraulic lift locks where a great rise is to be overcome at one point. These are a distinctly modern device, and pending the completion of the Trent lock, the most notable of them in service is that at La Louviere on the Belgian State canals. The upper and lower reaches of the canal are closed by vertically sliding doors, and the lock is simply two great steel troughs, carried on girder work very similar to that of a railway bridge. The troughs are closed at the ends by doors like those on the ends of the canal, and each trough runs up and down between braced steel guide towers. Under the centre of each trough is an enormous ram, and the cylinders in which the rams work are connected together so that one lock in descending forces the other to rise, and in practice the lock is actually operated by allowing the water in the upper trough to become a little deeper than that in the lower, the weight of this extra water supplying all the power required for the lift. The trough becomes part of the upper or of the lower reach according to its position, the gates being run up far enough to clear the barges. The rise at La Louviere is 50½ feet, and the lock will lift barges carrying 400 tons. The Trent lock will have 15 feet more rise and will handle much heavier boats. The time of passage through one of these locks will not differ materially from that required for a gate lock, but it has a much greater lift, the maximum on the Canadian gate locks being that recently adopted for the Soulanges canal, 23½ feet; it has also the advantages of giving a passage up and a passage down at the same time, and of requiring very little water to operate it; a feature which recommends it strongly to the Erie canal engineers, that work being badly handicapped by lack of water. It is not at present considered suitable for the great locks of the St. Lawrence system.

That the Royal Engineers were wise in their decision to raise the levels of their rivers rather than attempt to excavate canals, seems to be proved by the history of the first Welland canal, which was built at the same date. It was proposed that there should be no locking up from Lake Erie, and the "deep cut" near Allanburgh was undertaken with that end in view. An excavation varying from 30 to 55 feet was required for about a mile and three quarters through a heavy clay, underlaid with treacherous unstable material resembling quicksand. When this was about two-thirds completed tremendous slides occurred blocking the canal and rendering necessary the raising of the summit level, and the building of a 21 mile feeder to obtain water to operate that level. Those slides remained an obstacle

*From a popular lecture by J. G. G. Kerry, B.Sc., before the Applied Science students of McGill University.