Please read and send in as full a discussion as possible at earliest date.

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Canadian Society of Civil Engineers.

INCORPORATED 1887.

TRANSACTIONS.

N.B.—This Society, as a body, does not hold itself responsible for the facts and opinions stated in any of its publications.

THE STORAGE OF WATER IN EARTHEN RESERVOIRS.

By Samuel Fortier, M.Can. Soc. C.E.

To be read Thursday, 8th October, 1896.

The large number of earthen reservoir embankments in use, the widely differing opinions held by engineers in regard to the best method of constructing them, and the fact that the subject has not heretofore been considered by the Canadian Society of Civil Engineers, must plead as an excuse for this paper.

Very many earthen embankments, chiefly known as tanks, have been built in India to store water for irrigation purposes. The high prices of structural materials, the inability to procure and operate modern machinery and the low wages paid to workmen have favored this kind of construction.

* It costs but little to build an earthen embankment of even large dimensions where the materials are abundant and convenient, and where laborers can be procured for eight cents a day for each man, four cents for each woman, six cents for a donkey and fifteen cents for a pair of bullocks. A structure requiring skilled labor and modern machinery, with coal at $20 per ton, timber scarce and iron and steel from $8 to $15 per cwt., would be much more expensive. These peculiar conditions may, in a measure, account for the 37,000 tanks to be found in Mysore, and the 53,000 in Madras, besides smaller numbers in the other presidencies. The past history, however, of these tanks, many of which were built centuries ago, seems to prove the suitability of this material to retain water, and where failures have occurred they were in nearly every case traceable to imperfect outlet conduits or to faulty design. +

Not only in India, but in all regions where the rainfall is insufficient to mature crops, and where water has to be artificially applied to make up for the natural deficiency, it is only a question of time when the storage of water becomes a necessity. In the Western States of the Union, for example, the average annual run-off from the drainage areas, not to speak of the flood discharges, is from five to ten times greater than the run-off during the dry period of summer, when it is most needed for the raising of agricultural products. It is thus evident that only a small percentage of the total water supply can be utilized without the aid of storage reservoirs. For many centuries these reservoir dams have been built of earth, and there is good reason to believe that in the centuries to come the same material will be used. Upon this assumption the irrigated countries of Cape Colony, Egypt, Spain, Italy and France, and on this continent those of South America, British Columbia, and two-fifths of the United States are, and will continue to be, more or less dependent upon earthen dams to conserve and equalize the flow of the scanty water supply.

In reference to the use of earthen dams to store water for domestic purposes, it may surprise some to learn that the increase in the number of water-works plants in Canada and the United States has been greater than that of railways. In 1830 there were in the United States only 31, and 58 years latter there were 1701, while in Canada during the