February 6, 1913.

REPORT OF THE COMMITTEE ON CONSERVATION OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

The field of conservation, so far as it affects the engineering prolession, is so vast that it was deemed inexpedient to deal with more then One phase of it. At the last annual meeting a communication from N r. Sauder was addressed to the Society and, later, referred to the Committee on Conservation. Mr. Sauder wrote:

"Whereas the water supplies, water powers, navigation of our rivers, irrigation of our semi-arid lands, drainage of our over-flow and swamp lands and the sanitary conditions of our streams and "their water sheds generally are a great asset.

"Whereas an accurate knowledge of a flow of water in nearly "all important streams is essential for the solution of many problems in connection with navigation, water power, irrigation, domestic "and industrial water supplies, mining, bridge building, river cha nel protection, flood prevention and storage for conservation of food "waters.

"Whereas it is the opinion of the Society that the matter of tle "topographical and hydrographic surveys to determine the location and quantity of water supply and the proper methods of conserving "it should be undertaken by the Federal Government.

"Therefore be it resolved: That this Society, while recognizing "the work already done, urges strongly upon the Dominion Govern-"ment the importance of making the necessary appropriations and providing the necessary staff to undertake in an intelligent and systematic manner, the gauging of all streams of water supply and the "location and survey of all sites suitable for reservoirs for the storage "of water."

This letter was referred to the members of the Committee and the $c_{oncluding}$ statements of the report embody the substance of the replies received from them. In view, however, of the importance of the subject Was deemed advisable to take this subject—Water Supply and its

Conservation in Canada—as the special subject for this year's report. When planning to develop a water power or a navigation channel, the first consideration is: What is the minimum flow? The speed of a squader squadron is: What is the minimum now. The generally, the minimum is the speed of the slowest vessel and, speaking generally, the minimum flow is a determining factor in a water-power or a navigation project Project. The minimum flow may often be increased by storage in reservoirs but the initial step is to determine its amount and the maximum period that it may be expected to continue.

In arriving at anything approaching a reliable estimate of the minimum In arriving at anything approaching a reliable estimate of the r_{0_W} of a stream, a series of continuous gaugings extending over a con-siderable Coorge W. Rafter, in Water ^{ol a} stream, a series of continuous gaugings extending other water Supply period is absolutely necessary. George W. Rafter, in Water

Supply Paper No. 80, published by the U.S. Geological Survey, says: "Further, it can be stated that, for records from twenty years "to thirty-five years in length, the error may be expected to vary "from 3.25 per cent. down to 2 per cent., and that, for the shorter periods of five, ten and fifteen years, the probable extreme deviation from the mean would be 15 per cent., 8.25 per cent. and 4 75 per cent. respectively." Rafter says, further, that with less complete records,

Mr. Henry reached the conclusion that at least 35 to 40 years' observations are required to obtain a result that will not depart hore than ± 5 per cent. from the true normal. The average variation ation of a 35-year period was found to be \pm 5 per cent. and for a 40-year "40-year period \pm 3 per cent."

^r fom the foregoing, it is evident that unless the engineer basis and the foregoing it is evident that unless the engineer basis allow a margin on the safe side, he should have continuous de an example of an erroneous ^{gaugings} extending over at least ten years. As an example of an erroneous ^{estimate b} ^{sungs} extending over at least ten years. As an example of an error may ^{estimate} based on insufficient data, the Rainy River at Fort Frances may be cited b_e cited. Three engineers, reporting separately, estimated the power at 30,800,32 core ^{30,800}, ^{33,000} and ^{34,741} horse power respectively. In the summer of ¹⁹¹¹, then 1911, they were able to generate less than 11,000, and, to do this, it was hecessary to be able to generate less than 11,000, and this stopping navigation. ^{hecessary} to keep the stop-logs in all day Sunday, thus stopping navigation. H_{ad} gaugings extending over, say ten years, been available, no such over estimate over, say ten years, been available, we dry dry season of 1200 a_{son} of 1895, they would, probably, have shown as small a flow as in

Canada is particularly favoured as regards reservoir possibilities. The whole of the northern portion of the Dominion is occupied by a series of granitic rocks, which have a U-shaped form and surround Hudson Bay. This area has been called the Archaean nucleus and, considered in the large, it forms a great plateau. To quote the words of the late Dr. G. M. Dawson,

"It constitutes, moreover, a gathering ground for many large "and almost innumerable small rivers and streams, which, in the "sources of power they offer in their descent to the lower levels, are "likely to prove, in the near future, of greater and more permanent "value to the industries of the country than a great coal-field "

The foregoing was written sixteen years ago, and, with the tremendous strides in electrical engineering, is even truer to-day than then.

The most remarkable features of this Laurentian area are the innumerable lakes which serve as natural reservoirs to regulate the run-off and which can, in many cases, have their storage capacity increased by damming

In considering the work of stream-gauging in Canada, the provinces have been dealt with in geographical order from East to West.

In the Maritime Provinces, the streams are small and very little gauging has been done except on the St. John River and some of its tributaries. The work on the St. John has been undertaken as a result of differences between Canada and the United States respecting the provisions of the Ashburton Treaty affecting this stream. The St. John above the Allagash and at Fort Kent, the Allagash, St. Francis, Fish, Madawaska and Aroostoock have been gauged. Measurements have also been taken on the St. Croix River which forms the Southern boundary between New Brunswick and Maine. So far as ascertainable, nothing has been done in the way of investigating sites for reservoirs except the reconnaissance surveys made by the Commission of Conservation in 1911.

In Quebec, the more important power companies keep records of the streams on which they are operating. Between lake St. Francis and Sorel, the Department of Public Works has at present nine gauges. Two of these gauges are of the self-recording type and four others of the same type will be in operation next summer.

The Department of Public Works has sixteen gauges on the Ottawa River, and also maintains gauges on its important tributaries. The Engineers of the Georgian Bay Ship Canal, appreciating the importance of stream measurements, made in their report the following recommendation:

"That it is of great importance to continue every year the flow "measurement of the Ottawa, Mattavia and French Rivers, at low, "ordinary and high water stage, in order to have continuous records "of same, which will prove invaluable in the further development "of the canal problem, in case of construction, and a better knowledge "of the water-power possibilities."

On the Richelieu River, the depths on the lock sills of the Chambly cana', at St. Johns, have been recorded daily since 1869 and the level of take Champlain has been noted daily at Fort Montgomery, N.Y. since 1871. At Montreal, the depths of water on the lower lock sill of the Lachine canal have been measured at noon each day since 1851.

The Province of Quebec has appointed a Commission with the Hon. N. Parent, as Chairman. They have recommended the construction of a large dam on the upper waters of the St. Maurice to regulate the flow and have three parties in the field making topographical and hydrographic surveys of various rivers in the Province.

On the St. Lawrence above Montreal the depths on the lock sills have been recorded since 1860. These, therefore, give an excellent series of gauge readings for the river at lake St. Louis, lake St. Francis, Long Sault rapids, Farrans Point, Morrisburg and Cardinal. Similarly, the anal records at Ste. Anne, Carillon and Grenville determine the regimen of the Ottawa since 1870, while the lock depths at Ottawa extend back to 1844. For lakes Superior, Huron and Erie, the records cover the period since 1860, while the Toronto gauge records of lake Ontario extend back to 1854.

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