give a bond of sufficient size to guarantee fulfilment of contract provisions. There is also the necessity for the adoption of uniform practice in this respect by all waterworks operated under the same general conditions.

The next problem which confronts the waterworks executive is that of meters, and there is little question but the selection of water meters is a problem to every waterworks executive. This problem is more complicated in a municipality where the charter and ordinance provisions are in force similar to those in St. Paul, where the central purchasing agent is required to award a contract for purchases exceeding in amount $500, upon formal bids, to the lowest responsible bidder. This makes it necessary for the executive to prepare specifications which will either represent the water meter his judgment considers the best, which would be considered discriminatory, or else prepare an open specification which shall permit the manufacturers of all water meters to bid and be satisfied to accept that meter which will be furnished for the lowest price. Two years ago, when this provision was first in effect in St. Paul, bids were received for water meters upon a general specification, and after tabulation, the contract committee asked the writer to make a recommendation. Knowing full well the provisions of the charter with respect to purchases of all supplies, the following recommendation was made:—

"It is my judgment that the city should buy that meter which, in addition to complying in all respects with the specifications, represents the lowest unit cost during its life, the determination of which involves an equation having only one known quantity (first cost) and several unknown quantities."

For both service connections and meters, history cards are started when the service connection is installed or the meter is purchased. Upon these cards are recorded all that happens to the service connection or the meter, including all elements of expense. These cards are found of great value because they represent the life history of either the service connection or the meter.

The problems involved in the material and supplies division are very interesting. Time will not permit their analysis in this paper.

The accounts division is of great importance, but is not always given the attention it should have.

The water revenue division, as you well know, represents the activities of the department of the waterworks which come in direct contact with the public. On this account many problems are involved, particularly in its organization and administration. You will note that the organization of the St. Paul waterworks is administered by a registrar who directs all of the subdivisions. These sub-divisions are made so that each man has a separate and distinct branch of business to transact, affording the person who has business with the department the facility of transacting it rapidly and avoiding what is so common, being referred from one division to another. Information and complaints are given very careful consideration in our organization, and the heads of these sub-divisions are trained and cautioned to always assume that every complaint is real to the complainant and not to take uncomplimentary remarks about the department as personal. It is here that calmness and courtesy count; our slogan is "Service."

In making up the organization chart to which reference has been made, it is intended to classify and group the different functions logically, making a single officer responsible to the general superintendent for the direction of each function. The functions of each sub-division have been clearly defined by bulletin and the duties and lines of authority of each position have been standardized and defined. While experience has shown that this organization has operated smoothly and accomplished very definite and satisfactory results, it is also shown that slight readjustment in some of the divisions will give better results and these changes will be made at an early date. An executive must train himself to be awake, to make changes in his organization when experience shows that the change is necessary and will effect an improvement in administration.

OTTAWA AND ST. LAWRENCE RIVER REGULATIONS.*

By C. R. Coutlee, M.Can.Soc.C.E.,
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THE St. Lawrence valley extends as far into America as the Mediterranean extends into Europe—two thousand miles. The St. Lawrence River, of which the Ottawa is a tributary, has a basin of about half a million miles. Montreal is about half-way of the river's length, and also marks about half the basin area.

The basin produces trees, grain, grasses, iron, minerals and water power. It is probably the best home in the world for whites, but owing to the severe winter practically half the year is lost in the Canadian part of the basin.

Excepting the Ottawa, none of its tributaries are very large. The Great Lakes form natural storage, amounting to one hundred thousand square miles, but the connecting channels require to be dammed and throttled in order that the storage may be used to full advantage.

The river is an international stream, and consequently suffers from divided ownership. Again, it is bordered by provinces, states and powerful municipalities, so that harmonious work towards betterment is impracticable.

Besides its natural use for water supply and recreation it is artificially used for navigation and water power and is misused as a cesspool.

Power bids fair to become the most important use of the river, because the navigation from Niagara to Montreal is a comparatively small tonnage of one or two million tons against sixty million tons between Lake Superior and Lake Erie.

The river now produces about half a million horsepower, but at the end of this century it should produce six or seven million horse-power. This could be brought about by co-operation between the United States Federal Government and the Canadian Federal Government.

(1) By buying out all the powers along the main river at present situated at the Sault, Niagara Falls and Massena.

(2) By constructing regulating dams at each change of level from Lake Superior to the sea.

*From paper read before the Ottawa Branch Canadian Society of Civil Engineers, March 15, 1917.