Relation of Precipitation to Run-off.—If the records of precipitation are compared with those of the run-off on the basin, it will be found that the recorded run-off exceeds the precipitation as recorded at Banff, by as much as 25 per cent. This condition is by no means uncommon for mountain districts. Mr. John R. Freeman, in his report on the Hetch Hetchy water supply for San Francisco, says:—

"In regard to the excess of run-off over precipitation, the fact that depth of run-off exceeded depth of rainfall at outlet simply proves that the average precipitation for the catchment as a whole was far greater than at this comparatively sheltered spot of lower altitude at the outlet of the valley."

This condition holds in the Bow basin, and emphasizes the need of more stations for the recording of precipitation.

On account of the short period over which complete run-off data are available, and the few precipitation recording stations in the catchment area, no definite relation can be established between run-off and precipitation. The only conclusion that can be arrived at from a study of these data is that for the water years from 1909 to 1911, the mean precipitation has been nearly equal to the mean yearly precipitation for the last sixteen years, as recorded at Banff. It is fair, therefore, to assume that the run-off during the same years represent approximately the mean run-off conditions during a like period.

Division of the Year.—In considering the relation of precipitation to run-off, a period known as a "water year" is made use of, instead of the calendar year. This period for the Bow Basin district may be assumed as extending from October 1 until September 30, for practically all of the water is obtained from the mountains, and from October 1 on, the precipitation in the form of snow is stored in the mountains to be held until the warm sun of the following early summer releases it, to form the summer freshets which occur during May, June and July.

Temperature.—Temperature in the Bow River drainage area is one of the great factors influencing the discharge of the river. In the upper part of the catchment area there is not a month in the year in which frost can not be expected. The range of temperature is great, the range of mean temperature at Banff is from 56°.9 in July to 13°.7 in January, or 43°.2 of difference; at Calgary, the range of mean temperature is from 70°.7 in July to 14°.2 in January, or a range of 66°.4; and the maximum and minimum temperature greatly exceed these. From these two records it will be seen that the one at the higher altitude registered the lowest temperature. At the higher altitudes it is to be expected that low temperatures will be encountered, and that the period during which conditions of low temperature obtain will be longer than at the lower levels. The records are taken at an altitude which is low, considering the drainage area of the Bow River as a whole, and hence do not represent truly conditions in the upper part of the valley of that river. They give, however, an indication of the conditions to be found and, upon study, reveal some interesting facts with regard to the bearing of temperature upon the discharge of the river.

Influence Upon Evaporation.—The influence of temperature upon evaporation is one which is constant and unmistakable, but is one for which, so far, no relation has been established. Sufficient data are not available for a study of the question in the district, but in passing it seems well to note the work that has been done in this regard, and which is well summed up in a paper by Mr. Rafter, published by the United States Geological Survey. In this paper Mr. Rafter had made a careful analysis of the available data, and he reached the conclusion that no definite relation exists between evaporation and temperature, but that the influence is a constant one, and cannot be disregarded.

Influence of Temperature on Discharge.—There is no other single condition which plays such a vital part, or has such a direct influence upon the discharge of the rivers of the district as temperature. A diagram (Fig. 1) has been prepared, showing graphically this relationship—the daily discharges of the Bow River at Banff have been plotted continuously, and on top of this has been plotted the mean daily temperature as recorded at Banff from April, 1910, to December, 1912. Another diagram (Fig. 2) has been prepared for the period November 6, 1912, to March 6, 1913, showing the mean daily discharge for the Bow River at Horseshoe Falls, and the mean daily temperature as recorded at Banff.

A study of these diagrams will reveal how direct is the influence of temperature upon the discharge of the river; during months of low temperature the discharge is shown to be low. On the other hand, high temperature corresponds to large discharge, although within the limits of the record, the highest temperatures occur in the month following the highest discharge. This can be explained by the fact that, except upon the mountains permanently covered, the snow has nearly all been melted during June and the early part of July.

The second diagram shows clearly that the influence of low temperature on the discharge is unmistakable. The period selected is that covering the low-water stage of the river, which corresponds to the period during which extreme low temperatures are most encountered throughout the interval covered by the curve. It will be noted that the mean temperature is above freezing on only eighteen days, consequently it affects not only the source of the river but also the actual flow in the river itself.

PORT ARTHUR WATER SUPPLY.

The new water supply for the city of Port Arthur, Ont., was turned on last week. The installation includes two 24-inch steel intake pipes supported by piles and extending from a point in the lake 2,550 ft. from the shore, and in 45 ft. of water, to a well at the pump house. The intake is 10 ft. above lake bottom. The plant is equipped with 3 pumps each of 2,880,000 gallons per day capacity. Each pump is operated by a 250 h.p. motor. Two 24-inch mains extend from the pump house to the corner of McDougall and Algoma Streets, and from here the water is conveyed by 12-inch pipes to the city mains. The 24-inch pipes provide for ample extension of the distribution system as future needs may require.

The system is equipped with a chlorinating plant. As to the quality of the water, the provincial board of health reports it to be free from bacteria, and in every way satisfactory.

The total cost of the work has been $585,000. It was divided into a number of contracts, the chief of which was awarded to the Thunder Bay Construction Co. This contract included the construction of the pumping station, the laying of the intake, and the driving of a 530-ft. tunnel through rock between the pumping site and the lake.

The work has been executed under the supervision of Mr. L. M. Jones, city engineer.