of: $V = C\sqrt{rs}$ where C is obtained from the equation:

$$C = \frac{41.6 + \frac{.00281}{S} + \frac{1.811}{n}}{1 + \left\{41.6 + \frac{.00281}{S}\right\}\frac{n}{\sqrt{r}}}$$

Where r and S have the same significance as in the Chezy formula, the factor n is known as the coefficient of roughness.

The Bazin formula, often considered to be one of the best for the determination of flow in open channels, takes the form: $V = C\sqrt{rs}$ where

$$C = \frac{157.6}{1 + \frac{c}{\sqrt{r}}}$$

the coefficient c depending upon the roughness of the channel; values being determined for different classes of material by experiment.

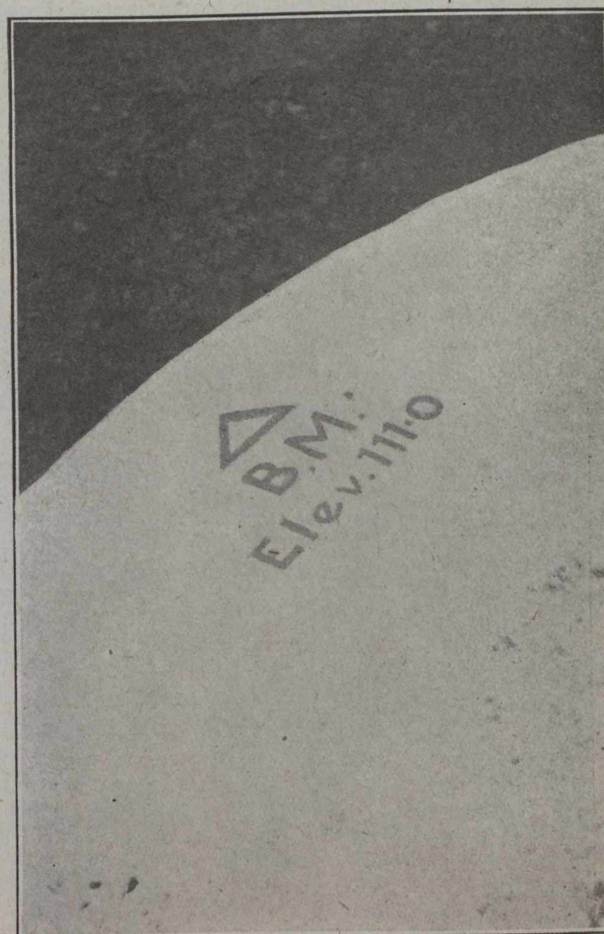
Humphreys and Abbott made determinations of C from which they also derived a formula. As the first-named formula depended on experiments carried on in small channels of various natures, and the latter upon observations made on the Mississippi River, the governing conditions were of a widely different nature. It is therefore to be expected that neither of the formulæ could be considered as generally applicable. The diversity of the results obtained from the use of these two formulæ was the subject of investigation by Kutter and Ganguillet and undoubtedly influenced the final determination of Kutter's formula.

Tables have been prepared giving values for the coefficient n in Kutter's formula and c in the Bazin formula, and are to be found in practically every handbook. It is, however, very difficult to choose the correct value for these coefficients, and it is therefore advisable that whenever possible the value of n and c in the two formulæ be computed from a measured discharge.

In the Manitoba work it is seldom necessary to make use of the slope method of determining the discharge; in fact, about the only application of the method is in the determination of flood discharges, or, in conjunction with meterings on rivers where the gauge height does not always bear a constant relation to the discharge. For the Kutter formula it is, however, possible in each of these cases, to arrive at a value for the factor n since from a determination of the hydraulic radius at the time of metering, the slope and the mean velocity, the value c may be found from the equation: $V = C\sqrt{rs}$; then, having found the value of C, this may be equated to Kutter's formula and the value of n derived, or may be found in the tables prepared for this purpose in any engineering handbook. A value for the coefficient c in the Bazin formula may be found in the same way.

Weir Method.—The weir method of determining discharge may be made use of in connection with widely varying discharges. Very often estimates of flow both under conditions of flood and of extremely low water may be arrived at by this method. Where funds are available, and the value of the records warrants the expense of installation, a permanent weir undoubtedly provides the best method of determining discharge. When the stream flow to be measured is of a comparatively small volume (a few second-feet), and the discharge is to be determined from time to time, a temporary weir may be utilized in conjunction with a gauge in the natural river channel.

This temporary weir would consist of a standard sharp-crested weir fastened for convenience to a wooden plank, the method of using it being as follows: A point in the stream below the gauge is selected and, after reading the gauge height, a temporary dam of earth and sods is thrown across the stream, in which dam the weir is placed; care being taken to place the crest absolutely level. Sods and earth are tamped about the weir to prevent leakage. The site of this small temporary dam should be so selected that the depth of water above will be at least twice the head on the weir, while the pond created should have a total width of several times the length of the crest. On the downstream side care must be taken to permit free access of air below the napp when the weir is discharging.



Assiniboine River, Brandon, M.H.S. Bench Mark.

When the weir is installed, readings with the level are taken upon the crest, a gauge is placed 8 or 10 feet upstream from the dam and is set to the same datum as the weir crest. Readings of the water level on this gauge will then indicate the head on the crest of the weir.

In computing discharges by this method, a modification of the Francis formula may be made use of, these modifications being in the nature of corrections for end contraction and elimination of velocity of approach, the formula taking the form of: $Q = 3.33\,(L - .2H)\,H^{3/2}$, in which:

Q = discharge in second-feet.
L = length of crest in feet.
H = head in feet.

As mentioned before, where the value of the records warrants it and accurate continuous discharges are re-