quired, a permanent weir may be built. This, however, is seldom necessary, as dams, if suitably situated and constructed, may be utilized. The main features governing the use of such structures as a means of determining the discharge are those relating to the characteristics of the dam itself, and also the consideration of the possible diversion of varying quantities of water around or through the dam. The physical requirements, in order that good records may be obtained, are as follows:—

1. Crest all at the same elevation or divided into sections of the same elevation.
2. Sufficient beight to eliminate backwater effect from below.
3. Absence of leaks.
4. Crest of such type that the coefficient of discharge may be readily arrived at.
5. Absence of flash boards or careful records of the use of same.

Whitemouth River, M.H.S. Bench Mark.

There are many things that may be said both for and against the use of dams as a means of determining discharge, which, generally speaking, may be summarized as follows: The use of a weir or dam has every advantage of continuity of records through the period of ice formation and flood discharge, while, on the other hand, it has the disadvantages of the uncertainty in connection with the proper coefficient to be used and the effect of debris, logs, etc., gathering on the crest, and the possibly varying amounts of water diverted for other uses.

Velocity Method.—The quantity of water flowing past a given point is derived from the product of two factors: (*a*) the mean velocity of the water past the point, and (*b*) the area of the cross-section of the river at that point. The area of the section depends upon the contour of the bed of the stream and the fluctuation of the water surface, the mean velocity being a function of the wetted perimeter, the roughness of the stream bed, and the slope of the water surface.

There are two principal methods of determining the mean velocity: (*a*) by current-meter, and (*b*) by float measurement. The requirements of these two methods are essentially the same, the method being to observe the velocity of the stream at a number of points throughout the cross-section. In order that good results may be obtained, care should be exercised in selecting the metering section. The section selected should be situated at a point in the stream where the banks are nearly parallel for a considerable distance both above and below the section. Also, the cross-section of the stream throughout this distance should be as nearly uniform as possible, the bottom free from projections, holes, large boulders, etc., and the banks of sufficient height to obviate the possibility of overflow under flood conditions. In selecting the site, due regard should be paid to its relation or proximity to tributaries of the stream, or to lakes, in order that sudden changes in the surface level or stage may be eliminated, the object being to secure a location where the stage or gauge height will truly indicate the discharge. In this northern country the stations are preferably located adjacent to the crest of a rapid or fall, so that backwater effects from tributaries lower down may be to a large extent eliminated, and open-water conditions may obtain under a greater range of temperature.

The equipment of a metering station usually consists of a gauge for determining the fluctuation of the water surface referred to a permanent bench mark, in order that any change in datum may be checked, and a permanently referenced initial point of measurement of the cross-section so that the same points at which the velocities are determined may always be found. Very often these points are located by stretching a tagged line across the river, or where a bridge is made use of, the points are marked upon the structure. Where the stream is swift or deep and no bridge is available, a cable or boat station may be established. The velocity at different points throughout the cross-section of the river is ascertained by either of the two methods mentioned, and the mean velocity over the whole section is then determined. Applying this mean velocity to the cross-sectional area gives the discharge of the stream at that point.

Chemical Method.—The most recent method of determining discharge in a stream, and possibly the most accurate, is what is known as the chemical method. In many cases, especially in turbulent mountain streams, determination of velocity and discharge by the float or current-meter method is impossible, owing to the difficulty in securing a station where the stream bed is uniform and the velocity sufficiently low. On the other hand, an application of the weir method would very often involve considerable expense on account of the necessity of rugged construction. In such cases the chemical method is particularly applicable.

Another purpose to which this method can be favorably applied is the rating of power stations. Owing to the advance in the art of water-wheel design and construction, the high degree of efficiency obtained and the premium placed upon such efficiency by purchasers, it is necessary that very careful determination be made. For wheels of large capacity the volume of water involved is great, and hence there is a possibility of errors of considerable magnitude creeping in, if the ordinary methods of determining discharge are used. With a view to eliminating these errors and securing the degree of ac-