

Hydrographic Manual of the United States Geological Survey, House of Representatives Document No. 693; Water Supply and Irrigation Paper No. 94, U. S. G. S. Washington, D.C., U.S.A.

Accuracy of Stream Measurements, House of Representatives Document No. 694, Water Supply and Irrigation Paper 95, by E. C. Murphy, U. S. G. S. Washington, D.C., U.S.A.

Weir Experiments, Co-efficients and Formulas, Water Supply and Irrigation Paper No. 200, by R. E. Horton, U. S. G. S. Washington, D.C., U.S.A.

Equipment for Current Meter Gaging Stations, Water Supply Paper No. 371, by G. E. Lyon, U. S. G. S. Washington, D.C., U.S.A.

River Discharge, by Hoyt and Grover, published by Wiley and Sons, New York City.

Essential information is also given in condensed form in the annual reports of the Hydrometric Surveys (Stream Measurements), published by the Dominion Government at Ottawa.

Besides the meter and the weir, there are two methods of river or canal measurement that are used to slight extent when the equipment for the more accurate method is not at hand. The first of these is the float method which will be described further along in connection with canal measurement methods. The second is used to estimate flood discharges under conditions that preclude the use of the current meter, and river discharges when a meter is not available. This method consists in solving the Kutter or Manning formulas for V , signifying the mean velocity of the water in feet per second, when the other hydraulic elements, except the value of the friction factor, n , are known. These other elements are: the slope or rate of fall of the water surface, and the average area of the water cross-section. These elements are determined from measurements made in time of low water and preserved for just such uses. The value of the friction factor, n , is a matter of judgment, and may so vary from the actual value that discharges determined by this method should only be considered as accurate, say within, 25 per cent. When the value of V has been determined by one of these formula, then the discharge, Q , is found by multiplying the value of V by the mean area of the water cross-section in square feet. This gives the discharge in cubic feet per second. The Kutter and Manning formulas will be again spoken of in connection with canal measurements.

The Measurement of Water in Artificial Channels.

It may be stated in passing that the Division of Irrigation of the Bureau of Public Roads, U.S. Department of Agriculture, has included the measurement of water as one of its more important lines of investigation for the past six years. Some of his work has verified and confirmed similar investigations made throughout the world by various agencies, while other results have refuted the opinions of eminent hydraulicians who have attempted to apply one set of conditions the principles developed under other conditions.

This work has included the following special subjects:

- (1) The determination of the carrying capacity of artificial channels.
- (2) The capacity of weirs and submerged orifices under irrigation and power conditions, and the development of special measuring devices, based upon known hydraulic phenomena.