Moss, tree roots, rock ravellings, sand, etc., all tend to make the va[illegible] "N" high and are difficult to anticipate in design, but where conditions are such that these retarding elements are to be expected, a correspondingly high value of "N" is to be used; or better still, use a value of "N" as close as may be judged, but design for a large overload as a factor of safety.

In connection with the measurements of irrigation and power canals, described in Bulletin No. 194 as mentioned above, it was necessary to make a great number of gangings by current meter. As most careful measurements were desired, the meter was held in a great number of verticals and in many points in each vertical. From the velocities at these numerous points could be developed the vertical velocity curves for a great number of verticals across the water section. The vertical velocity curve method is conceded by all authorities to be the most accurate means of operating a current meter. In the various verticals the meter was held at .2—.4—.6—.8 etc. of the depth and in many verticals, was also held near the surface and near the bottom of the channel. Holding the meter at these particular points enabled a comparison to be made between the results as obtained by vertical velocity curves and the results had any one of the so-called point methods been used. The most commonly used of the point methods are the "6-tenth" method and the combination of two points one taken at 2-tenths and the other at 8-tenths of the depth of the water.

Simultaneously with, or immediately following the basic measurements for the vertical velocity curves, the canal was measured by the so-called "integration method," in which the meter is moved slowly from the surface of the water to the bottom of the channel and back, a definite number of round trips. There is probably no type of engineering measurements that has the opinions of so many qualified men on diametrically opposite sides regarding its accuracy. There appeared to be ample ground for discounting the accuracy of this method for the reason that it is well known that the meter most used in irrigation and power work will revolve if moved in a vertical direction in still water, and the results of such movement are mentioned in "The Behaviour of Cup Current Meters Under Conditions Not Covered in the Standard Ratings," by Fred C. Scobey, published in Journal of Agricultural Research No. 2 (1914), page 77. Our findings in regard to the use of the current meter in the measurement of artificial channels may be summed up as follows:

In 96 measurements of the 0.2 and 0.8 depth, or the two-point method, gave results averaging 0.73 of one per cent high, while the 0.6 method averaged 4.8 per cent high. In 53 measurements the vertical integration method averaged 0.76 of one per cent too high. In other words either the two-point or the integration method is quite accurate, while the 0.6 method gives a discharge about 5 per cent too great. This last result is confirmed by some of the engineers of the U.S. Geological Survey. The results of these current meter method comparisons are described in an article: "Experiments in the Use of Current Meters in Irrigation Canals," by S. T. Harding, found in the Journal of Agricultural Research for November 8, 1915.

Mr. E. J. Hoff, of this Bureau, has recently invented a cup meter, similar to the type of the Price Meter, which does not revolve when moved up or down in a body of still water. With such a meter the integration method may be still more strongly recommended. As has been stated, the integration method when used with the old type of cup meter gives results sufficiently accurate