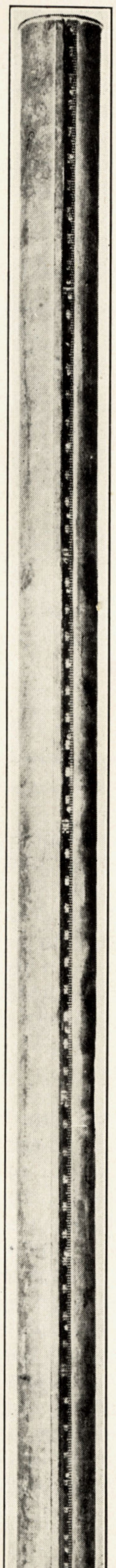

FIG. 1.—Snow tube and cutter assembled.

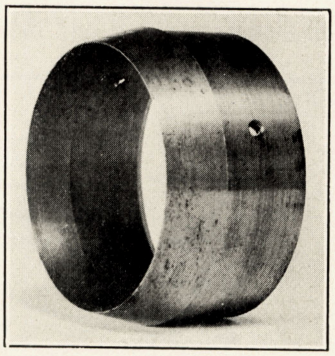

FIG. 2.—Photograph of cutter.

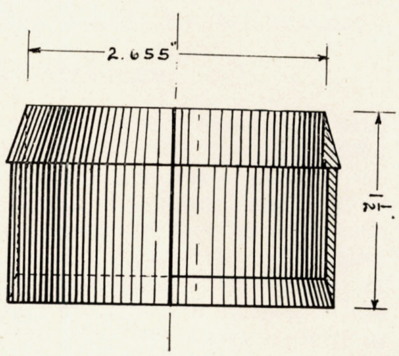

FIG. 3.—Line drawing showing section th: ough cutter.

FIG. 4.—Weighing balance.

AN IMPROVED FORM OF SNOW SAMPLER.

By Benjamin C. Kadel.

[Dated: Weather Bureau, Washington, Dec. 3, 1919.]

Observations of the whole snow layer deduced from weighed sample sections have been made more or less generally in the Weather Bureau since the first introduction in 1905 by Dr. Frankenfield of a form of sampler designed by Horton. The forms heretofore described are as follows:

1. The sampler designed by C. F. Marvin and described in Circular E, Instrument Division, Weather Bureau, page 31. The cutter proper is a piece of iron tubing several inches long, with inner diameter 2.65 inches, the lower edge being beveled and serrated in saw-tooth fashion. The main tube is of well-made tinners' spout about 4 feet long.

2. The sampler designed by Prof. J. E. Church, jr., is made of long narrow tubing, in separable sections, with smooth edged cutter 1.5 inches diameter. Length can be made 21 feet. (Described in Scientific American Supplement, Sept. 7, 1912, p. 152–155.)

3. The sampler designed by B. C. Kadel, and described in Monthly Weather Review, May, 1915, **43:** 221, was of large diameter, 5.94 inches, and was equipped with an auger to be screwed down through the snow to form a bottom so that sample and tube could be withdrawn together.

The improved sampler now to be described was designed by the writer with a view to including such features as his own experience in snow surveying had suggested, and at various stages of its development was sent to the snow fields for actual trial. Suggestions made by the men who used the several experimental forms have been incorporated, as far as practicable, and desirable features of those above mentioned have been retained.

There are three parts to the device: the tube for holding the sample while it is being weighed; the cutter for bounding the area of the sample; and the spring balance.

The main body of the sampler (fig. 1) is of 3-inch drawn steel tubing, 20-gauge wall, in integral lengths varying from 2 feet to 6 feet, according to the depth of snow prevailing in the vicinity, several lengths being advantageous at some stations. No practicable means of joining two lengths has appeared, and while the tubing can be manufactured in 10-foot lengths, it is doubtful whether greater lengths than 6 feet can be successfully handled in the field. The instrument is intended for surveying such snow layers as are found over wide areas, rather than for the deep drifts of the timber line region. Longitudinal slots about $\frac{3}{16}$ inch wide by 8 inches long are cut on alternate sides to permit cleaning out the snow in case of sticking. The tubes have inch graduations and appropriate numbers to show snow depth, and after having been made up they are finished by sherardizing, a process resembling galvanizing, but leaving a smooth finish that does not destroy the etched graduations as would galvanizing, and furthermore offers less resistance to the free movement of the snow core through the tube because it is smooth. Observers report that oil or lacquer applied to the inner surface is an additional help. During the war, manufacturers were unable to supply the special tubing, and we had to substitute galvanized iron tinners' down spouting, 3-inch by 24-gauge, with a graduated metal tape riveted in place longitudinally.

The cutter (figs. 2 and 3) with its special shape, constitutes an extremely important part of the device. The inside diameter is turned true to 2.655 inches, which makes one-fifth of a pound of snow equal to 1 inch water equivalent, this relation being selected for convenience in calibrating the spring balance. The diameter selected is the result of a number of carefully made experiments in the field, which showed that cutters of too small diameter take up a sample that is too small to be representative of the layer from which it is cut, while samplers of larger diameter, such as described under No. 3, are too large and clumsy for use, particularly when they must be transported on snowshoes, although they possess the advantage of giving precise results. An examination of the illustrations will show that the cutter is sharply shouldered off at a point $\frac{1}{2}$ inch above its cutting edge. This shoulder is found in practice to wedge the snow so that in the great majority of cases the entire core can be withdrawn without losing the sample; although in some instances of extremely light, dry snow, observers report that it is necessary to tamp the snow into the bottom of the tube by means of a long slender stick, in order that it may be somewhat packed before the tube is withdrawn. The essential diameter of the cutter is practically the same as that of the Marvin cutter described under No. 1, but the difference between the diameter of the cutter and the diameter of the main tube has been made much greater, in order to allow ample clearance for the ascending snow core and thus avoid undue friction upon the walls of the tube, with resultant deficient pickup. The cutters have smooth edges and are made interchangeable, so that in case of damage a new one can be easily attached.

The spring balance (fig. 4) as shown in the illustration has grown out of experience. The graduations, which are engraved directly upon the case of the spring balance, give inches and tenths of water equivalent direct. The indicating hand is rigidly pinned to its arbor, thus eliminating the chance of accidental displacement. The bent aluminum wires are intended to hold the filled tube in a horizontal position for weighing, while the hook at the top is intended to be placed across a limb of a tree or other means of support. The entire balance is built of aluminum for lightness.

The spring balances have been specially constructed for us by John Chatillon & Sons, New York. The tubes and cutters have been made up in the Weather Bureau shop. A blueprint can be supplied to anyone who wishes to construct a sampler. Valuable suggestions and assistance have been given by my colleagues in the Insrument Division.