this surface if one walks upon it. It takes more than a bird's flutter or an echo to start a slide of this kind. A slide like this may possibly occur on a 35° slope provided it be only a short distance above a steeper slope, that is, near a ledge or a steeper declivity.

A slide of this kind can not be foreseen, and there is only one evidence of reasonable safety that presents itself, as a sign of security, and that is the protrusion of a great many shrubs, saplings, and trees through the snow. The snow very seldom slips along the ground where there are a great many small trees or saplings, and reasonable safety nearly always lies among the protruding bushes. About the only exception to this rule is where the snow surface is crusted and recent deposits of fine dry snow have accumulated in limited drifts or patches on the crust; these powdery deposits are sometimes treacherous, even among the trees, and may slip under one's weight, carrying the entire drift, perhaps an acre or more in extent, down the slope to be shattered among the trees.

A tendency for the entire snow layer to lose its hold and go dashing down the slope may be expected on almost any slope, timbered or bare, that is steeper than 40°, after a period of warm rainy weather. It is true, there are very few outward evidences of the downward creeping of the snow layer that will serve to warn the traveler, except that among the thinner, smaller bushes protruding through the snow layer, the bushes will have begun to lean a little; though a very slight leaning probably signifies imminent danger. Also, one may hear the occasional slumping or settling of the layer when in a dangerous region. Either of these evidences should be accepted as a warning to quickly seek flatter and safer territory.

Business taking one into the mountains where there are many long steep slopes carrying several feet of snow must be very important to justify the risk, if there have been a few days of unusually warm weather, with perhaps some rain; for such weather conditions are sure to cause the melting snow and the falling rain to leach down through the snow layer and break up its texture, leaving it a heavy, mushy, insecure mass, or, to use the common expression for this condition, the snow is "rotten." A great weight of this kind of snow, eaten full of vertical and criss-cross drain seams, and no longer held together in a tough, tenacious body, is very insecure and is especially dangerous if the ground and surface leaves and shrubbery underneath are unfrozen, and are wet and slippery from the snow drainage. Conditions of this kind are readily detected by alpenstock examinations and by the supporting strength of the snow.

Most of the heavier avalanches, judging from old avalanche trails in the bent and broken timber, go down the ravines and gullies. These natural drainways are often quite steep sided and deep, and when filled to the level of the adjacent regions with heavy, rotten snow, having in them very little obstruction in the way of sharp curves or stones, and of course no trees, the snow appears to let go quite suddenly, without noise or warning, and go piling and crashing down the gulch. A mass of wet snow is very readily compacted under pressure into the consistency of ice, and, as the avalanche gains momentum, these ice masses can not come to rest until comparatively level land has been reached; therefore, trees and stones, and often large jutting portions of the earth, are carried away by them.

The presence of these danger-lurking ravines is always indicated by a swale in the mountain side, centering somewhere near the gully, and by the general absence of trees and shrubs directly over it, and occasionally by side cliffs showing above the snow.

In the springtime after a winter of heavy snow, when warm weather and rains are frequent, snowslides are quite numerous, though not always large, and not always reaching the bottoms. During such conditions as these the mountain traveler will find it to his interest to avoid the untimbered or bare slopes, and even the timbered slopes whose surfaces point downward more than 35° from the horizontal.

MEASUREMENT OF SNOW IN BIG COTTONWOOD CANYON, UTAH.

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The investigation of the source of the water supply and the probable quantity available for each season in any community is of prime importance. The matter of the supply available for Salt Lake City, particularly during the late summer, fall, and early winter is worthy of careful consideration. Among the sources from which this city derives its water supply Big Cottonwood Creek assumes considerable prominence both because of the purity of the water and the quantity discharged. Of all the streams draining into the Jordan Valley this creek has the largest run-off. Besides the water used by Salt Lake City this stream furnishes water for the irrigation of a large portion of the land on the east side of the valley, and for power purposes. Although not the largest watershed draining into the valley, the Big Cottonwood has a larger maximum flow and a more constant discharge.

With the idea in mind of obtaining information relative to the probable supply for the season, and for the purpose of making comparisons of conditions from year to year, the measurement of the snow in Big Cottonwood Canyon was instituted in April of this year. It was undertaken by the engineering department of Salt Lake City, with the advice and cooperation of the local office of the United States Weather Bureau.

In commencing the work of measurement in this watershed it was found that, owing to the greater depth and density of the snow, the equipment which had been effectually used by the Weather Bureau in Maple Creek Canyon was not suitable; so special equipment was made. This consisted of a spring balance of a total capacity of 10 pounds, a jointed galvanized iron tube 2 inches in diameter, in two sections of 5 feet each, and a jointed, graduated wooden pole in two lengths of 6 feet each, shod with a sharp iron point on one end.

Big Cottonwood Canyon is characterized by a number of fairly long branches or forks draining into the main canyon from either side. Different portions of the watershed are distinguished by certain features. For instance, the forks on the north side of the canyon from the mouth up to Maxfield Gulch are very narrow, steep, and rocky, with some straggling pine timber; those from Maxfield Gulch up to Brighton Basin are more open, with gentle slopes and rolling hills covered with quaking aspen and underbrush; and practically all of those on the south side are wider, with steep slopes covered in great part with pine timber. These forks all head in a lofty ridge with peaks rising from 10,000 to 11,600 feet in elevation, which divides Big Cottonwood from Little Cottonwood watershed. In various places on the side slopes of the south forks bare spots occurred, which afforded starting points for snowslides. Most of these forks have been the scene of glacial action. In Mill B South Fork and Mill F South Fork, as well as in the Brighton or Silver Lake

Basin at the head of the canyon, are found some beautiful glacial lakes.

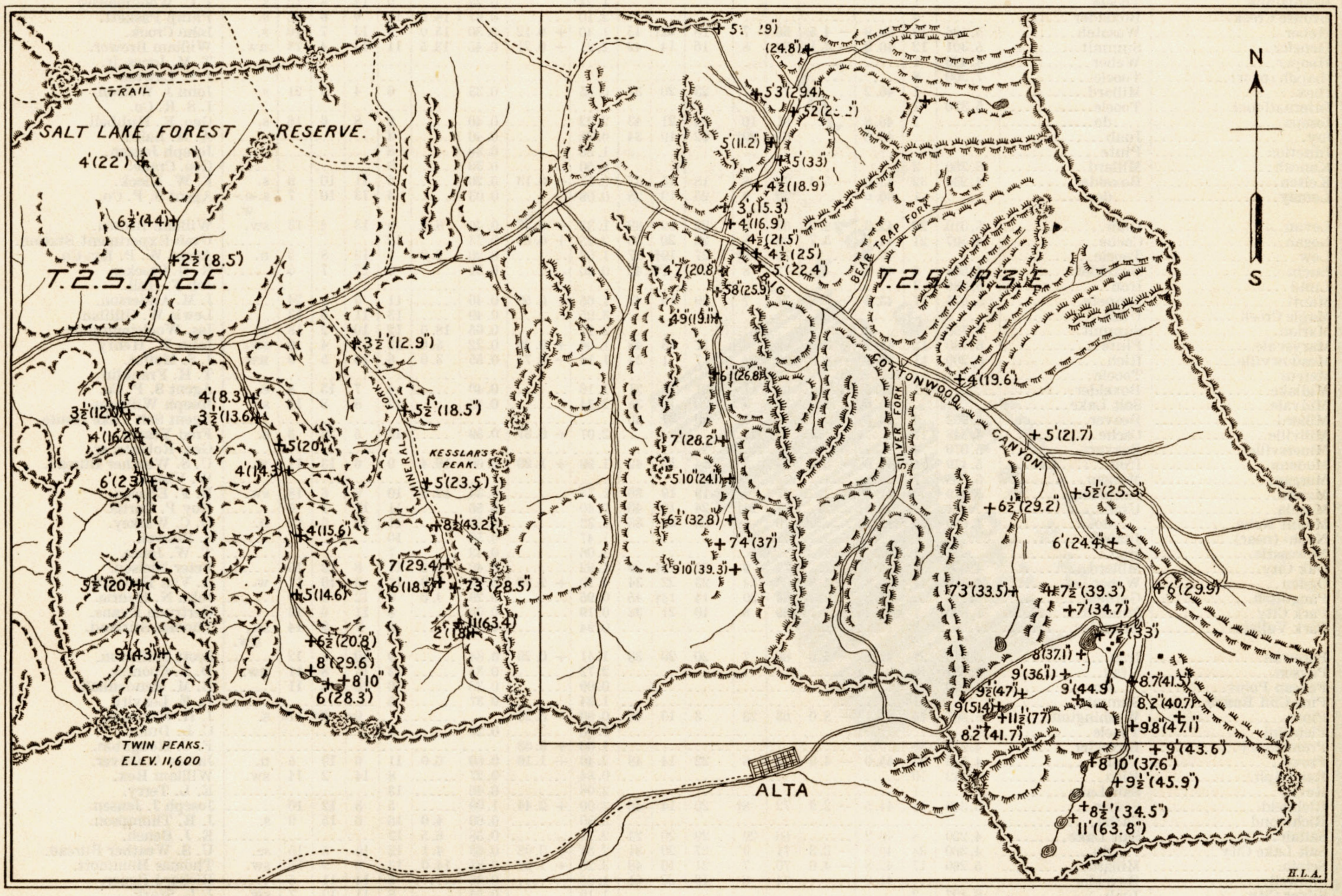
The work of making the measurements of snow covered a period of two weeks. In order to measure every section of the watershed sufficiently to obtain a fair average over the whole, more time is necessary. Because of the length of the various forks, the steep grades, and the condition of the snow, it required a day to cover each fork. Some snow fell every day but one during the trip and made snowshoeing difficult. Having so far to travel and such heavy ascents to make daily, time would not permit of many density measurements of the snow. Further, because of the danger of snowslides, very few measurements could be made on the side slopes in the south forks. For lack of time measurements in Butler, Bear Trap, Willow Patch, and Mill F East Fork on the north side, and Stair Gulch, Mill D South Fork, and Silver Fork on the south side, with some other small gulches, had to be omitted. But as these forks are similar in form, length, and altitude to those adjoining in which measurements were made, a fair estimate can be obtained of them all. Measurements of density were made, as far as possible, at points that can be located from year to year and where the snow was of an average depth. In all 74 density measurements were made, besides numerous soundings of depth with the graduated pole. At each density measurement the altitude was determined with an aneroid. Of these measurements 52 were in the forks on the south side, including Brighton Basin, 13 in the forks on the north side, and 9 in the upper portion of the main canyon. The average depth, density, etc., of the soundings of each locality are given in the accompanying table:

	Elevations.	Number of soundings.	Average depth.	Water equivalent.	Density.
			Ft. in.	*Inches.*	*Per cent.*
Mill B North Fork	6440-8150	3	4 4	24.8	48
Broads Fork	6300-8950	5	5 7	22.8	34
Mill B South Fork	6640-9050	8	4 10	19.0	33
Mineral Fork	6880-8530	9	6 2	27.4	37
Mill D Flat	7440	3	4 8	19.6	35
Mill D North Fork	7320-8600	10	4 9	22.6	40
Days Fork	7470-8940	9	6 7	28.5	36
Main Canyon (Willow)	8000-8750	6	6 4	30.0	42
Mill F South Fork	8280-8970	5	6 8	31.7	40
Brighton Basin	8700-9540	16	9 0	43.0	40
Total		74			
Average			5 11	26.9	38

The past winter and spring have been marked by rather unusual conditions in the matter of precipitation. In the early part of the winter the snowfall was comparatively light; but in February, March, and April, especially the last two months, a great deal of snow fell in this canyon. At the time of this reconnoissance the snow conditions were as follows: Along the north face of the main canyon, from the mouth up to Butler Fork, was practically bare; above Butler Fork the snow increased gradually in depth. Along the bottom of the canyon the first snow was encountered at Mill B North Fork. On the south side there were traces of snow below Broads Fork, with a gradual increase from there toward the head of the canyon. In Whipple Fork, Mill B North Fork, and Maxfield Gulch there was some snow, mostly in patches and irregular masses from drifting. In Mill D North Fork, Bear Trap, Willow Patch, and Mill F East Fork the snow lay pretty evenly, distributed with comparatively little drifting and no slides. In all of the south forks the snow lay deeper in the bottoms than on the slopes. In many places much drifting and many snowslides have occurred, so that the snow layer was very solid and covered every natural feature. Where snowslides had occurred it was difficult and sometimes impossible to force the snow tube through the various frozen layers. Even the iron-pointed pole could scarcely be driven down. One measurement in a slide for a depth of 11½ feet gave a density of 56 per cent. From measurements, made roughly by the watchman of the Brighton Hotel, of the snowfall, it appeared that from October 1 last to April 23 approximately 47 feet had fallen. On April 23 the depth of the snow layer at the Brighton Hotel was 7½ feet with a density of 37 per cent.

Information obtained from various persons living in the canyon indicated that the depth of snow at the time of the survey was much greater than for years past. No means are at hand for a comparison of the density of the snow with that of past seasons. Generally speaking, the early snow furnishes the late summer supply. This would make it appear that the lateness of the main snowfall during the past season would, under ordinary conditions, produce high flood conditions. At the same time, because of the many snowslides which have resulted in packing and freezing the snow in extensive masses, it is probable that a considerable part of the run-off will be retarded until late in the season and thereby prove of the greatest benefit to the water users on the stream.

Typical view of condition in Cottonwood Canyon; average depth of snow, 6 feet 8 inches and water equivalent about 32 inches.



First figures indicate depth of snow in feet; second figures (in brackets) indicate water equivalent (in inches) of the snow.