

TABLE 6.—Floods in the Hudson River and tributaries, April, 1916.

River.	Station.	Flood stage.	Above flood stage.		Crest—	
			From—	To—	Stage.	Date.
		<i>Feet.</i>			<i>Feet.</i>	
Hudson.....	Troy, N. Y.....	14.5	1	3	19.3	2
Do.....	Albany, N. Y.....	12.0	1	3	15.8	2
Mohawk.....	Utica, N. Y.....	11.0	1	2	10.8	2
Do.....	Schenectady, N. Y.....	15.0	1	2	19.8	2

TABLE 7.—Floods in various rivers during April, 1916.

River.	Station.	Flood stage.	Above flood stage.		Crest—	
			From—	To—	Stage.	Date.
		<i>Feet.</i>			<i>Feet.</i>	
Red River of the North.	Moorhead, Minn.....	26.0	2	11	30.2	6
Delaware (West Branch).	Hale Eddy, N. Y.....	12.0	2	2	12.6	2
Delaware (East Branch).	Fishes Eddy, N. Y.....	10.0	2	2	11.8	2
White.	White River Junction, Vt.....	15.0	2	2	16.4	2
Connecticut.	do.....	13.0	1	5	16.8	2
Do.	do.....	13.0	23	27	14.7	24
Do.	Holyoke, Mass.....	9.0	1	7	8.9	3
Do.	Hartford, Conn.....	16.0	1	7	20.8	3
Do.	do.....	16.0	26	26	16.3	26
Pemobscot.	West Enfield, Me.....	12.0	1	1	11.9	5
Neuse.	Neuse, N. C.....	12.0	8	10	13.5	10
Do.	Smithfield, N. C.....	13.0	9	9	13.1	9
Cape Fear.	Elizabethtown, N. C.....	20.0	10	11	22.9	10
West Pearl.	Pearl River, La.....	13.0	1	3	14.0	1
Gunison (North Fork).	Poncha, Colo.....	8.0	23	29	8.3	29
Kings.	Piedra, Cal.....	12.0	1	1	11.9	28, 29

Hydrographs for typical points on several principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.

DATES OF OPENING OF NAVIGATION THROUGH LAKE PEPIN.

Dates of opening of the Mississippi River (through Lake Pepin), as reported to the United States Engineers, St. Paul, Minn., by owners of the ferryboats, at Lake City, Minn., for the years 1861 to 1916, inclusive. The dates are when Lake Pepin was sufficiently clear of ice not to impede or endanger boats passing through.

Year.	Dates.	Year.	Dates.	Year.	Dates.
1861.....	Apr. 7	1880.....	Apr. 10	1899.....	Apr. 20
1862.....	Apr. 8	1881.....	Apr. 13	1900.....	Apr. 7
1863.....	Apr. 5	1882.....	Apr. 6	1901.....	Apr. 6
1864.....	Apr. 14	1883.....	Apr. 15	1902.....	Apr. 8
1865.....	Apr. 15	1884.....	Apr. 12	1903.....	Apr. 4
1866.....	Apr. 19	1885.....	Apr. 20	1904.....	Apr. 22
1867.....	Apr. 19	1886.....	Apr. 15	1905.....	Apr. 10
1868.....	Apr. 4	1887.....	Apr. 15	1906.....	Apr. 16
1869.....	Apr. 20	1888.....	Apr. 13	1907.....	Apr. 4
1870.....	Apr. 15	1889.....	Apr. 12	1908.....	Apr. 5
1871.....	Apr. 17	1890.....	Apr. 14	1909.....	Apr. 12
1872.....	Apr. 25	1891.....	Apr. 16	1910.....	Mar. 24
1873.....	Apr. 17	1892.....	Apr. 3	1911.....	Mar. 28
1874.....	Apr. 22	1893.....	Apr. 12	1912.....	Apr. 11
1875.....	Apr. 20	1894.....	Apr. 3	1913.....	Apr. 14
1876.....	Apr. 22	1895.....	Apr. 15	1914.....	Apr. 14
1877.....	Apr. 17	1896.....	Apr. 17	1915.....	Apr. 13
1878.....	Mar. 9	1897.....	Apr. 6	1916.....	Apr. 10
1879.....	Apr. 4	1898.....	Apr. 1	Average date.....	Apr. 11

¹ Reported as Mar. 3, but evidently an error as to month, as the river was not open at St. Paul until Mar. 8, and at Red Wing until Mar. 21.

[J. N. R.]

SNOW SURVEYS IN CITY CREEK CANYON, UTAH, 1914, 1915, AND 1916.

By ALFRED H. THIESSEN, Meteorologist.

[Dated: Weather Bureau, Salt Lake City, Apr. 12, 1916.]

Snow surveys were made in City Creek Canyon by the Weather Bureau office at Salt Lake City, Utah, in March of 1914, 1915, and 1916. The accompanying map, figure 1, shows Salt Lake City with the creeks which furnish the city water. These creeks rise in the Wasatch Mountains east of the city, flow in a general westerly direction, and empty into Jordan River.

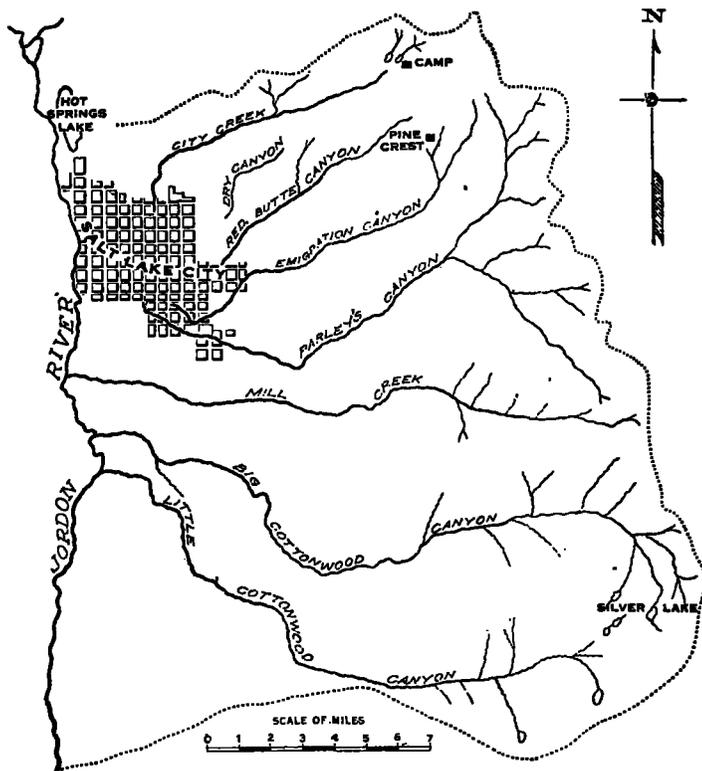


FIG. 1.—Salt Lake City, Utah, water supply is obtained from City Creek, Parleys, Emigration, and Big Cottonwood Canyons.

[Jordan River should be Jordan River.]

Salt Lake City has a right to all the water in City Creek, to 35 per cent of Big Cottonwood, to 85 per cent of Parleys, and to a small amount of Emigration canyons. It has been necessary in the past for the waterworks department to issue proclamations in the summer to the residents advising economy in the use of water, and at certain times to restrict its use for lawns to certain hours of the day or night. Under these conditions, it can be imagined how necessary it is for the waterworks department and the city engineer to know something about the available supply. The city engineer's office undertook surveying the snow in Big Cottonwood; no surveys have been made in Parleys, as it was thought that the measurements obtained in Big Cottonwood and City creeks would furnish a basis upon which the amount of water available in Parleys could be estimated.

All surveys in City Creek Canyon were made in substantially the same manner. The instrumental equipment consisted of an alpenstock graduated in inches and a Marvin snow-density tube with a balance. The region was carefully mapped, and the observations were entered in a notebook in regular sequence and also noted on a small map at the place of observation. By this method a comparison of the snow layers at the same places in different years could be made.

The method of procedure was to make many alpenstock measurements of depth at any point. By so doing a spot could be selected which would represent the average depth of the snow at the immediate place where the the surveyors were working, and then a density measurement would be made at that spot. If only one depth measurement were taken, immediately followed by a density measurement, then a hole or a hummock might have been inadvertently selected to the detriment of accuracy.

The surveyor also made notes regarding the condition of the snow, whether soft or frozen, drifted or level, the condition of the ground, whether dry or wet, frozen or soft, and any other data as to temperature, elevation, etc., that seemed needful.

The question of headquarters from which to work is of considerable importance in City Creek, which is long and narrow and impossible to work from the lower end.

As there was a summer hotel at the head of Emigration Canyon, it was thought best in March, 1914, to establish headquarters there, thinking that the surveyors could cross the divide, make the measurements, and return at night, since most of the snow lies in the upper half of the canyon. This plan was found to be practicable, but it entailed very hard work, owing to the steepness of the ascent of the divide which separated the two canyons.

In March of 1915 and 1916 surveys were again made in City Creek, but on both these occasions a camp was erected at the head of the canyon, as indicated on the map. It was necessary to drag all the supplies (instrumental equipment, food, and camp material) on improvised toboggans to the camp site. The work under this plan advanced more rapidly than in 1914, but this had also a great disadvantage in that the surveyors would be worn out by the time camp was made. The return journey in 1916, after the survey was finished, was very difficult, as the snow became very soft, and it was necessary to pack all the supplies to the nearest road.

TABLE 1.—Comparative data of snow surveys in City Creek Canyon, Salt Lake City, Utah.

Subarea.	Year.	Snow depth.	Water equivalent.	Per cent of water.
		<i>Inches.</i>	<i>Inches.</i>	
A.....	1914	59	19.8	34
A.....	1915	41	13.2	32
A.....	1916	60	21.4	36
B.....	1914	57	18.6	33
B.....	1915	43	14.6	30
B.....	1916	66	21.3	32
C.....	1914	64	22.6	35
C.....	1915	47	14.4	31
C.....	1916	62	21.4	35
D.....	1915	44	13.9	32
D.....	1916	57	20.5	36
E.....	1915	49	14.5	30
E.....	1916	71	23.2	33
F.....	1914	57	19.2	34
F.....	1915	45	13.9	31
F.....	1916	67	21.3	32
G.....	1914	60	20.5	34
G.....	1915	44	14.0	32
G.....	1916	62	20.9	34
H.....	1914	65	23.6	36
H.....	1915	43	14.0	33
H.....	1916	69	22.7	33
Whole.....	1914	59.9	20.4	34
Do.....	1915	45.9	14.2	31
Do.....	1916	63.2	21.3	34

1914 run-off = 31.88 cubic feet per second.
 1915 run-off = 17.29 cubic feet per second.
 1916 run-off = 29.6 cubic feet per second (estimated).

Table 1 shows the results of the three years of survey. A study was made of the variation of the snow supply in the smaller forks and draws as well as of the canyon as a whole. All the forks and draws where measurements were made in 1914, 1915, and 1916 were lettered, as they do not seem to have been named. The results have been tabulated, and data are given in the table, showing the average snow depth, water equivalent, and per cent of water for each lettered fork for each of the three years. At the end of the table data for the canyon, taken as a whole, are given, showing in addition the actual run-off for the period April 1 to August 31 for the years 1914 and 1915. In almost every case the smaller areas show the same variation in snow depth and water equivalent, as does the whole area. The amount of snow found this year did not vary much from that found in 1914 in regard to the three factors—snow depth, water equivalent, and per cent of water.

The amount of run-off expected from April 1 to August 31, 1916, figured on the run-off of 1914, would be 33.29 cubic feet per second; and on the run-off of 1915, it would be 25.93 cubic feet per second. The average of these two estimates would be 29.6 cubic feet per second.

The rainfall during the summer of 1915 was very small, which accounts for the comparatively small run-off during that year. If the rainfall during this coming summer is near the average, the run-off will be about the same as that of 1914, and it may be more, as the ground is now thoroughly soaked, and the run-off from the watershed area will in consequence be increased.

This is the first spring that the Weather Bureau has given the city a definite estimate of its probable water supply from City Creek. Now that the survey is made and the probable run-off based on that survey is calculated, the question as to how much water the city will get is by no means accurately settled. Early warm weather will cause rapid melting and a larger spring run-off than the city can use, and hence some water always goes to waste in the spring. Heavy summer rains will increase the run-off, while light summer rains will decrease the amount. But disregarding these disturbing factors, the city is immeasurably better prepared to administer its water supply judiciously than if the information supplied by the survey were lacking.

It should be said that at present no storage dams exist in City Creek Canyon.

MEAN LAKE LEVELS DURING APRIL, 1916.

By UNITED STATES LAKE SURVEY.

[Dated: Detroit, Mich., May 5, 1916.]

The following data are reported in the Notice to Mariners of the above date:

Data.	Lakes.			
	Superior.	Michigan and Huron.	Erie.	Ontario.
Mean level during April, 1916:				
Above mean sea level at New York.....	<i>Fect.</i> 602.38	<i>Fect.</i> 579.92	<i>Fect.</i> 572.42	<i>Fect.</i> 246.40
Above or below—				
Mean stage of March, 1916.....	+0.21	+0.44	+0.58	+0.94
Mean stage of April, 1915.....	+1.06	+0.42	+0.97	+1.36
Average stage for April, last 10 years.....	-0.84	-0.34	+0.04	+0.03
Highest recorded April stage.....	-0.31	-3.31	-1.76	-2.03
Lowest recorded April stage.....	+1.84	+0.70	+1.16	+1.56
Average relation of the April level to:				
March level.....	0.0	+0.2	+0.6	+0.5
May level.....	-0.3	-0.3	-0.3	-0.4