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SECTION IV.—RIVERS AND FLOODS.

RIVERS AND FLOODS, MARCH, 1914.

By ALFRED J. HENRY, Professor of Meteorology, in charge River and Flood Division.

In the Mississippi watershed there was no time during March that a flood threatened, and at this writing, April 19, it seems probable that, barring the occurrence of torrential rains in the immediate future, the annual spring rise of 1914 in the Mississippi will not assume the importance of a flood.

A short period of high temperature that culminated on the 16th caused the ice-bound portion of the river, St. Paul to Davenport, to open on very moderate stages on that date. The last of the ice in Lake Pepin did not disappear, however, until about 30 days later. The river below Cairo fell slowly from the 1st to the 13th, and thereafter rose very slowly until the end of the month, when the gage on the Ohio at Cairo read 22.4 feet, 22.6 feet below the flood stage. Below Cairo the river was at moderate stages during the month.

Both the Missouri and the Ohio were also at moderate stages during the month.

Flood stages were reached in the Pedee and Waccamaw of South Carolina, the Pearl of Mississippi, and the Black Warrior of Alabama, due to heavy rains locally over the respective watersheds, but in no case was the flood destructive in character.

A second period of high temperatures about the end of the month, with rain on the 28th and again on the 30th, caused flood conditions to prevail in the rivers of New England and the northern portion of the Middle Atlantic States.

The Connecticut passed the flood stage at Hartford, 16 feet, on the 29th, and crested at 18 feet on the same day. The Hudson at Albany crested at 16 feet on the 29th, flood stage 12 feet. The Susquehanna passed the flood stage, 14 feet, at Binghamton on the 28th, and crested at 18.5 feet on the 29th.

The following crest stages were recorded on the Susquehanna at points below Binghamton: Towanda 20.2 feet on the 28th, flood stage 16 feet; Wilkes-Barre 28.3 feet on the 29th, flood stage 20 feet; Selinsgrove 16 feet on the 30th, flood stage 17 feet; Harrisburg 18.2 feet on the 29th, flood stage 17 feet. The above floods were accurately forecast by Weather Bureau officials in the respective districts.

MOUNTAIN SNOWFALL, MARCH, 1914.

California.—The snowfall during March was very light, but there is a large amount of well-packed snow in the higher mountains which has a water equivalent of from 40 to 50 per cent and insures an ample supply of water for the coming season.—*G. H. Willson, Local Forecaster.*

Oregon.—Owing to unseasonably high temperatures during the greater part of March the precipitation was in the form of rain, and but little snowfall was recorded below the higher altitudes, and, except at a few scattered stations in northeastern and southwestern counties, small amounts of snow were reported throughout the section

Compared with last year there was generally less snow in all districts, the only exceptions being at one station in the Siskiyou Range and at two in the Blue Mountains, where there were somewhat greater depths reported than at the close of March of the previous year.

Compared with the normal there is less snow than usual at this time of year, but that remaining is well packed.—*E. A. Beals, District Forecaster.*

Washington.—The snowfall for the month was much less than the average for March in nearly all localities. It was from 5 to 39 inches at stations on the western slope of the Cascades, from 1 to 47 inches on the eastern slope, and from 1 to 13 inches on the foothills and slopes bordering the Blue Mountains.

The first three weeks of the month averaged 5 or more degrees above the normal temperature for the time of year, and consequently the snow covering disappeared early on all but the higher slopes and summits, in timbered areas, in the gulches, and on cold northern slopes.

Such limited density tests as were made at moderate elevations show the water equivalent to be high.—*G. N. Salisbury, Section Director.*

Montana.—The month of March brought very little change in the snow conditions in the mountains. The snowfall for the month was below normal in most sections, and the mild temperatures that prevailed until about the 20th somewhat reduced the amount remaining from previous months. In the valleys and foothills the ground was generally bare at the end of the month, notwithstanding most of the month's snow fell during the last 10 days.

Owing to the absence of frost in the ground there was comparatively little surface runoff, the percentage of loss from this source being much smaller than in seasons of normal snow accumulation. The late flow of water which is of most importance in irrigation depends in large measure upon the water thus taken up by the soil over the entire surface of the watershed rather than upon the surface supply from melting snows in the high mountains. The effect of the deficiency in the snow accumulation will, therefore, probably be more noticeable in the flood stages of the late spring and early summer than in the later stages.—*R. F. Young, Section Director.*

Wyoming.—Reports from various sources show the average fall of snow for the State to be 7.4 inches, 4 inches below normal. The only watershed over which conditions have improved to a marked degree is that of the Tongue River, where a normal amount of snow covers the ground, promising an average flow of water for the summer. Depths of snow on the Powder River watershed increased appreciably during the month, but less than a normal flow of water may be expected. Accumulated depths on the watersheds of the North Platte, Green, and Snake Rivers promise sufficient water for the approaching season, but conditions on the headwaters of the Sweetwater, a tributary of the North Platte, are much less promising than at the close of February. Reports from the watersheds of the Big Horn, Cheyenne, and Yellowstone vary greatly, although it is thought that the flow of water will be little below normal, espe-

cially as depths of snow have increased substantially dur ing the general snowstorm occurring the first week in April.—*R. Q. Grant, Section Director.*

South Dakota.—The average snowfall in the elevated regions of South Dakota; that is, the greater portion of the Black Hills district of the State, was 7 inches. The largest monthly amount recorded was 23 inches, at Harvey's ranch (P. O. Hanna), Lawrence County; the least 0.2 inch at Hermosa, Custer County. There was none remaining on the ground on either the 15th or 31st of the month, except in the gulches in the timber. Some of the snow melted as it fell, or soon after, and thawing weather with local showers near the close of the month aided in its disappearance.—*S. W. Glenn, Section Director.*

Nevada.—There was scarcely any snow or precipitation in the Truckee, Carson, and Walker Basins during March. The average for 12 stations in the Humboldt Basin was 0.43 of an inch, which was only about one-third of the normal. This is representative of the northern portion of the State.

At the Lake Tahoe level there were about 39 inches of dense snow at the end of the month, and it increased in depth from that point to 137 inches at the 7,400-foot level, just south of Ward Peak. There were from 96 to 120 inches near Grass and Luceil Lakes at an elevation of about 8,000 feet. East of Lake Tahoe there were about 84 inches at 8,000 feet. In the Carson and Walker Basins on nearly all northwest, north, and northeast slopes, above 9,000 feet, there were over 260 inches of snow at the end of March.—*H. S. Cole, Section Director.*

Arizona.—March was a warm, dry month in the eastern and northern mountain districts, and there was a general decrease in the depth of stored snow.

In the White Mountains, where a survey of a representative area was made, March 21 to 27, the snow on the north slopes ranged from a trace at the 8,000-foot level to about 50 inches at the 10,000-foot, while on the south slopes there was but little snow below 9,000 feet, and at 10,000 feet the depth was about 15 inches. The extensive flats of high elevation, situated along the Salt-Little Colorado Divide, held from 20 to 30 inches of snow. The average of a large number of density measurements gave an equivalent of 0.33 inch of water for 1 inch of snow.

Reports indicate that the snow conditions on the Blue, Graham, and San Francisco Ranges are about the same as in the White Mountains, while on the Chiricahuas the depths are somewhat less. There is little or no snow left in the Tonto and East Verde watersheds. Drifts from 2 to 4 feet deep remain on the plateaus north of the Colorado River. A few inches remain on the Huachuca Mountains.—*Robert R. Briggs, Section Director.*

New Mexico.—March averaged much below the normal in precipitation, although the snowfall was parctically normal, owing to heavy snow in certain central and northern mountain districts, notably east of the Rio Grande. For the State as a whole the eastern slopes were most favored.

The average snowfall was 3.8 inches, or about normal, giving a seasonal fall of 26 inches, which is slightly in excess of the normal, owing to the large excess that occurred in December, 1913.—*Charles E. Linney, Section Director.*

Colorado.—The snowfall during March was less than the normal in almost all parts of the mountain region, making the third month in succession with relatively light amounts. Storms were not lacking, but precipitation was general only during the last three days of the month.

On the middle drainage of the South Platte and in the region drained by the southern tributaries of the Arkansas somewhat more than the normal snowfall occurred, but in the rest of the drainage area of these streams a deficiency was general. Marked deficiencies occurred throughout the region drained by the Rio Grande, and and over the greater part of the Grand, Gunnison, and San Juan watersheds.

The average depths of snow on the ground on the different watersheds at the end of the month do not differ materially from the depths on corresponding date a year ago; the water equivalent, however, is greater.—*F. H. Brandenburg, District Forecaster.*

POSSIBILITY OF RECURRENCE OF THE FLOODS OF MARCH, 1913.

By J. WARREN SMITH, Professor of Meteorology.

[Dated Weather Bureau, Columbus, Ohio, March 12, 1914.]

[Abstract of a paper read March 11, 1914, at the Thirty-fifth annual meeting of the Ohio Engineering Society, held at Columbus, Ohio.]

During the past 20 years the number of coöperative stations in Ohio reporting rainfall has varied but little and has been slightly over 100 in number.

The number of times that excessive rains have occurred at these different points has been tabulated and the summary appears in Table 1.

This table shows that while the number of stations reporting 2.5 inches in 24 hours in 1913 was less than twice as many as reported this amount in 1896 and 1897, and only just twice as many as in 1911, the number reporting 5.0 inches or more in 96 hours in 1913 was more than in all of the other 19 years put together.

In March, 1913, the number reporting 5.0 inches or more in 96 hours was 73, while during all of the other months of the 20 years together the number was only 69.

In October, 1910, there was a very heavy and extended rainfall in Ohio that gave 2.5 inches or more in 24 hours at 35 stations, 3.0 inches or more in 48 hours at 49 stations, and 4.0 inches or more in 72 hours at 31 stations; or about half as many as occurred in March, 1913. But in October, 1910, there were only 3 cases of 4.0 inches or more in 24 hours, as compared with 13 in March, 1913, and only 3 stations reporting 5.0 inches or more in 96 hours, as compared with 73 reporting this amount in March, 1913.

It is only when one begins to tabulate the facts in this way that the statement can be understood that when the extent of the territory involved and the sequence of the storms is considered, no previous record exists which, in this section of the country, is in any way comparable with the rainfall of March 23–27, 1913.

The greatest monthly rainfall for the State of Ohio during the past 60 years was 9.67 inches, in September, 1866. The next greatest monthly average was 8.40 inches, in March, 1913. The daily records for such stations as were available in 1866 show, however, that during that month the rainfall was distributed more through the month and that large monthly falls were due to a number of scattered heavy rainfalls.

A careful summary of the rainfall data in Ohio for March, 1913, shows that the average rainfall from the 23d to 27th, inclusive, was as follows:

	Inches.
Over the Little Miami watershed	7.5
Over the Sandusky watershed	8.2
Over the Scioto watershed	8.7
Over the Great Miami watershed above Dayton	8.6
Over the Muskingum watershed above Zanesville	6.9