RIVERS AND FLOODS.

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By far the most destructive floods of the month occurred in Utah and portions of Nevada and southern California. No river work is performed by the Weather Bureau in these sections, but at the request of the River and Flood Service, the officials in charge of the local offices of the Weather Bureau at Salt Lake City and Los Angeles were requested to prepare reports regarding the floods, and their descriptions will be found in another portion of this REVIEW.

Several lives were lost in these floods and the losses amounted to approximately $3,000,000, of which probably three-quarters fell upon the railroads.

The rivers of Arizona were under the influence of the same general conditions that caused the Utah and California floods, but the floods were not serious, although they did damage to the estimated amount of $38,000, divided as follows:

Losses to property	$25,000
Losses to crops	3,000
Losses due to erosion	5,000
Losses due to suspension of business	5,000
Total	38,000
Value of property saved by Weather Bureau warnings	$10,000

Floods occurred generally during the month over the northern districts east of the Mississippi River and in the middle Arkansas and Neosho rivers. The western floods were caused by unusually large percentages of run-off from moderate rainfalls on frozen soil, while the remainder were due to substantial rainfalls accompanied by high temperatures that melted the snows and broke the ice gorges, releasing the large accumulations of water behind them.

The rise in the Arkansas River was most pronounced in the vicinity of Wichita, Kans., where the river rose nearly 6 feet on January 12 and 13, doing damage to bridges to the amount of $4,000. The rise was caused by the rapid run-off of moderate rains over the frozen ground in the Little Arkansas and lower Arkansas watersheds, and the greater portion of the damage was caused by ice. Some lowlands and farm lands above Wichita were overflowed, but the damage to these was nominal.

The flood in the upper Neosho River lasted from January 14 to 18, inclusive. During an extended period of abnormally cold weather from 2 to 6 inches of ice, sleet, and snow had accumulated over southern Kansas. On January 12 a sudden rise in temperature accompanied by moderately heavy rains set in, and owing to the frozen condition of the ground the run-off was exceedingly rapid. At Emporia, Kans., the Cottonwood River reached a stage of 23.5 feet on January 24, and the river was above the flood stage of 19 feet from January 13 to 17, inclusive. Ice gorges in the vicinity of Neosho Rapids, Kans., delayed the flood crest at points below, and it did not reach Iola, Kans., until midnight, January 17, when a stage of 11.5 feet, 1.5 foot above the flood stage, was reached. At Le Roy, Kans., the crest stage was 23 feet, 1 foot below the flood stage, from 6 p. m., January 16, to 8 a. m., January 17. Losses were approximately as follows:

Losses of property, excluding crops	$5,000
Losses of crops left standing	4,000
Losses by erosion and deposit	1,500
Losses through suspension of business	700
Total	11,200
Value of property saved by Weather Bureau warnings	$14,500

Nothing unusual occurred along the Mississippi River, except in the vicinity of St. Louis, although all the rivers in the district were higher than usual during the month. At St. Louis the mean stage of 18.3 feet was the highest average January stage ever recorded, the high waters having been caused by ice gorges that began to form below the city during December, 1909. The ice accumulated until an almost solid dam extended from Jefferson Barracks, Mo., to Chester, Ill. The gorge lasted until January 14. Gorges had also formed in the Missouri River below Hermann, Mo., and in the Mississippi River at Alton, Ill. On January 14 a general break occurred, and the river at St. Louis, which had been rising steadily for two weeks to a stage of 24.4 feet on January 13, rose rapidly to 31.9 feet at 1 a. m., January 14, 1.9 feet above flood stage. The decline was almost as rapid and at 8 a. m., January 14, the stage was 26.5 feet. As the waters receded nearly every boat in the vicinity was beached, and all were somewhat damaged. There was no high water above or below St. Louis. The Illinois River was also above flood stage during the latter half of the month, but no damage was reported.

The conditions in the Ohio watershed above the mouth of Salt River did not become critical at any time, except in the Allegheny River between Freeport and Pittsburg, Pa. There was a 15-foot ice gorge at Freeport, with smaller ones at other places, and the rains and high temperatures on January 17 and 18 caused much alarm, especially in view of the fact that large quantities of snow had accumulated over the entire watershed of the river. Fortunately the rainfall was not excessive, and when the gorge at Freeport broke at 7:30 p. m., January 18, the ice moved out with only a moderate flood wave that reached a crest of 22.3 feet at Pittsburg, 0.3 foot above the flood stage, at noon, January 19. A smaller gorge in Mahoning Creek broke at the same time that the first crest reached Pittsburg, resulting in a second crest of 22.8 feet at 8 p. m., after which time the water began to fall. The greatest damage occurred in the small creeks, the backwater from ice gorges flooding cellars and washing away bridges, and the losses of this character amounted to about $50,000. At Pittsburg the warnings of the coming of the flood prevented any serious damage, and the total losses, including those occasioned by temporary suspension of business, did not exceed $20,000. The value of property saved by the Weather Bureau warnings was about $100,000. No flood stages occurred between Pittsburg and Louisville, except at the mouth of the Great Kanawha River.

Between the mouths of the Salt and Wabash rivers conditions were entirely different. On the evening of December 21, 1909, a gorge formed in the short bend of the river just below the town of Wolf Creek, Ky. It backed up gradually, and eventually reached the mouth of Salt River, about 20 miles below Louisville, so that at the time of its breaking its total length was about 53 miles. A smaller gorge also formed at Mount Vernon, Ind., on December 26, 1909, backing up as far as Evansville, Ind., by December 29. This gorge moved out on January 9, 1910, without doing any damage of consequence. In the meantime conditions above Evansville had been gradually becoming more serious, and the safety of near-by towns, as well as that of property below the gorge was threatened. Mild and rainy weather set in on January 13, and warnings were at once issued from the local office of the Weather Bureau at Evansville to protect or remove all property liable to damage from ice or high water. With the advent of a warm rain on January 18, the gorge finally gave way at 10:10 a. m., on that date, and notice of the fact was scattered broadcast within 30 minutes after. A field of ice that had been left stranded in front of the city of Evansville suddenly moved out at 1 p. m., January 20, but the river continued to rise until noon, January 21, when the crest of 37.8 feet, 2.5 feet above flood stage, was reached. River navigation was partially resumed on this date, and on the

following day the river at Evansville was free from ice. The rise from the upper river set in early on January 23, and during the afternoon of January 27, the river came to a stand at a stage of 38.6 feet. At daybreak, January 31, the water was below the flood stage of 35 feet for the first time in 12 days. At Henderson, Ky., the crest stage of 36.6 feet, 1.6 feet above flood stage, was reached at midnight, January 26–27, while at Mount Vernon, Ind., the crest stage of 38.2 feet, 3.2 feet above flood stage, was reached at 6:30 p. m., January 27. Some empty coal barges, shanty boats, and other craft were torn from their moorings and carried downstream, which was about all the damage done in the district. The warnings issued by the Weather Bureau during those periods were especially accurate and timely, and by their thorough dissemination, saved an immense amount of property. Much assistance was rendered by several public-spirited citizens, and special thanks are due Miss Price, the Postmistress at Brandenburg, Ky., for her valuable services. On January 20, 1910, the Evansville, Ind., Journal-News commented as follows:

> It is true that the big gorge came in like a lion and is going out like a lamb. But one of the causes for its peaceful passing is the fact that it was long in forming, the people along the lower river who would be endangered by it were thoroughly aware of its size and menace, and when it did break the Weather Bureau gave instant warning. Everybody was prepared for the rapid rush of ice, and those boatman and farm dwellers who had been dilatory had sufficient time to get out of danger's way. The care taken by the Evansville bureau to keep the whole lower valley prepared, and the provisions for an instant dissemination of the news from the Wolf Creek gorge when it broke were distinct proofs of the service of the Bureau. River men and bayou people are coming more and more to depend upon the Weather Bureau absolutely.

Nothing of interest occurred below the mouth of the Wabash River. There was a flood in the Wabash River caused by the breaking of ice gorges, and the river at Mount Carmel, Ill., was above the flood stage of 15 feet from January 18 to 31, inclusive, with a crest stage of 21 feet on January 26 and 27. Considerable damage was done by this flood in the vicinity of Mount Carmel and Shawneetown, Ill., and Owensville, Ind., and it is roughly classified as follows:

Property, excluding crops	$103,000
Crops	30,000
Damage by erosion, etc	10,000
Suspension of business	22,500
Total	165,500
Property saved through Weather Bureau warnings	$101,000

The interior rivers of the State of Ohio were in flood at the same time and under the operation of the same causes as those responsible for the floods in the main river. On January 16 there were from 2 to 3 inches of snow on the ground over southern and 6 inches over northern Ohio. This snow had fallen on soil that had become saturated from previous rains and afterward frozen. More snow on January 16 turned to warm rain on the following day, causing rapid rises over all the rivers, which were further augmented on January 20 and 21 by more warm rains.

While flood stages were reached generally, they were not so much due to rain and melted snow as to ice gorges, which raised the waters a few feet above the height that they would ordinarily have reached with a free flow. These conditions prevailed throughout the watersheds of the State, and particularly in that of the Maumee River where ice was very plentiful and easily gorged.

Throughout the State of Ohio there was minor damage by ice and water, and some flooding of lowlands, but the losses were small, and the greater portion were probably those occasioned by delayed steam and electric traffic.

The Susquehanna watershed was ice bound from December 20, 1909, to January 19, 1910, with ice varying in thickness from 6 inches to over 2 feet. At 2 a. m., January 19, the ice broke at Clearfield, Pa., on the West Branch, and moved out on between 8 and 9 feet of water. The breaks were due to high temperatures, melting snows, and rains over the headwaters on January 18. Ice gorged near Jersey Shore, Pa., on the night of January 19, flooding some lowlands, but there was no farther movement until January 21, when general rains and high temperatures with melted snows caused the ice in West Branch to break and a general movement began.

There was no damage of consequence above Harrisburg, but a great deal below, especially at Port Deposit, Md., where the flood caused by the gorge was the greatest in the history of the town, with a stage 3 feet higher than that reached in the great ice flood of March, 1904. Much damage was also done at Perryville and Havre de Grace, Md. The total losses amounted to about $200,000.

The Lehigh and Delaware rivers were also moderately high at the same time with some flood stages in the Lehigh, but no damage of consequence resulted.

At 10:00 a. m., January 22, warnings were issued for flood stages in the Hudson River in the vicinity of Albany, N. Y., as it was feared that the rains and melting snows would cause the ice to move and form gorges below Albany, N. Y. Although there was but little rise at headwaters, the results were in accordance with the warnings, as the gorges backed up the water at Albany and Troy to stages from 1.5 to 2.5 feet above the flood stage. The damage amounted to about $10,000, while the value of property saved by the warnings was about $35,000.

The same general conditions prevailed over western New England, and there were moderate floods in all streams, resulting in considerable damage of a minor character, and much inconvenience. At Hartford, Conn., the Connecticut River reached a stage of 20.2 feet at 9 p. m., January 23, 4.2 feet above the flood stage. The water would probably have gone off without a flood had not an ice gorge formed a short distance below the city, causing a rise of 5 feet in less than 1 hour. However, no damage of consequence was reported.

Navigation in the lower Potomac River was occasionally interrupted by ice during the month, but the inconvenience was only temporary.

The rivers of the South and of the Pacific coast were quiet with stages over the former district, as a rule, somewhat above the January average.

The issue of warnings was attended by the many difficulties incident to the presence of ice gorges, as well as an abnormal amount of accumulated snowfall lying upon a frozen soil, but almost without exception, the warnings of the floods were of the most accurate character, both as to stages and time, while the distribution of the information regarding the movements of ice gorges was so thorough and effective that the resulting losses were reduced to a minimum.

ICE.

There was not much change in the ice situation during the month, except such as have been described in the foregoing reports.

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.