

DISTRICT REPORTS

OHIO RIVER AND TRIBUTARIES AT AND ABOVE
DAM NO. 13

By W. S. BROTZMAN

Over the Pittsburgh River district the month of January 1937 was characterized by mild weather with little snow and freezing temperature, and with frequent and unusually heavy rainfall. The rainfall for the month as a whole was greater than that of any other winter month with the exception of a narrow belt in the extreme eastern portion of the district where rainfall was excessive in March 1936.

The frequent rains kept the ground in a thoroughly saturated condition, and in addition furnished sufficient water to produce a rapid and heavy run-off. The water courses were running bankful from the 15th to near the end of the month, and were in flood in portions of the district almost continuously from the 18th to the 28th.

While the upper reaches of the rivers were in flood or near flood, generally, the flooding and damage was most extensive over the lower portion of the basin, between Pittsburgh and Dam No. 13, McMechen, W. Va. The Allegheny River rose considerably above flood stage between Lock No. 8, near Mosgrove, Pa., and Pittsburgh, Pa., but there was only slight damage, due largely to the fact that damageable property had been removed to safety. The Monongahela River was only slightly above flood stage and no damage was done.

At Pittsburgh, Pa., the river rose to 9.5 feet above the damage stage, but damage was remarkably slight. Warnings of the probable crest stages were issued in ample time to permit all possible precaution, thus limiting the principal losses to the suspension of business and cleaning up after the water receded. The local executive of the Red Cross reported that there were a few houseboats lost, but that they had no calls for rehabilitation as a result of the flood.

OHIO RIVER AND SOUTHERN TRIBUTARIES FROM
BELOW DAM NO. 13 TO AND INCLUDING POINT
PLEASANT, W. VA.

By R. P. POWELL

The January 1937 flood was the second highest flood of record in the central and lower parts of the district. Flood stage was first reached in the lower end of the district on the morning of the 17th. To understand this better, a review of conditions since the 14th is necessary.

On the 14th the Ohio River was about 18 feet under flood stage in the upper part of the district, 14 feet in the central, and only 9 feet in the lower. This was due to the heavy rains that had fallen over the entire watershed on the 10th and 11th and had partially run off thereby leaving the lower part of the district at a comparatively higher stage than the upper. These comparatively high stages were then fed by heavy rain over the Muskingum, the central and lower Ohio Valleys, and moderately heavy rains over the Little and the Great Kanawha, and upper Ohio Valleys on the night and morning of the 15th. This caused the tributaries to rise at all points.

Then, on the night and morning of the 18th heavy rains fell over the entire watershed and caused all the tributaries to start rising again. On the morning of the 19th, the heavy rains over the immediate valley had failed to fill in the differences in the stages of the upper and lower parts of the district, the lower parts still remaining, roughly, 10 to 15 feet higher.

Heavy rains occurred over the Great Kanawha watershed on the night of the 19th and 20th, causing the Great Kanawha River to rise rapidly and moderately heavy to heavy rains over the entire watershed on the 20th and the 21st caused all the tributaries to rise rapidly. Heavy rains again occurred over the lower Ohio and the Little Kanawha Valleys, and moderate rains over the remainder of the watershed on the afternoon of the 22d and the morning of the 23d.

On the morning of the 24th the Ohio River had become stationary to within 30 miles of Parkersburg, W. Va., the Muskingum River was falling as far down as Beverly, Ohio, and the Ohio River was rising very slowly at Parkersburg with a stage of 50.6 feet. Heavy rain beginning at 5 a. m. of the 24th over the central and northern parts of the district caused a secondary rise in the Little Kanawha, Muskingum, and upper Ohio Rivers.

No reports were received on the morning of the 25th because the Western Union wires were inundated, so that the forecasts were based on rainfall reports by radio and by telephone and by the action of the river. A few reports were received from the Pittsburgh, Pa., district on the morning of the 26th.

The Ohio River became stationary at Marietta, Ohio, and Parkersburg, W. Va., the afternoon and evening of the 26th, with a crest of 55.0 feet at Marietta and 55.4 feet at Parkersburg. Communication was still impossible with the lower parts of the district, but it was later determined that the crest at Point Pleasant, W. Va., was 62.7 feet on the morning of the 27th.

Communication was most difficult from the 24th until the 29th, but with the cooperation of the telephone company we were able to use whatever lines they had at any time. For instance, some calls made to Marietta, Ohio, 14 miles distant, were routed through Clarksburg, W. Va., Pittsburgh, Pa., Columbus, Ohio, and thence to Marietta, Ohio. So that about 400 miles of wire was used to complete these calls.

OHIO RIVER AND SOUTHERN TRIBUTARIES FROM AND
INCLUDING THE MOUTH OF THE KANAWHA, TO
AND INCLUDING THE MOUTH OF THE LITTLE
KENTUCKY; THE NORTHERN TRIBUTARIES OF THE
OHIO FROM DAM NO. 31 TO A POINT OPPOSITE THE
MOUTH OF THE LITTLE KENTUCKY

By W. C. DEVEREAUX

The rainfall over the Cincinnati district, and especially along the Ohio River, during the period from January 7-25, 1937, was far in excess of any previous rainfall in this region for a period of 3 weeks or even for a full month. This caused the highest river stages of record at all the stations on the Ohio River from Dam No. 26 to Dam No. 39 and below to the mouth of the river.

The rainfall up to January 13 had been only moderately heavy in this district, and of sufficient amount to fill the river but not to the flood stage. Even the heavy rains on January 14-15 only filled the low places in the river above Cincinnati, and the river at Cincinnati fell 2 feet from the 15th to the 17th.

However, heavy and excessive rains started again on the 17th and continued for 9 days. As all the land surface was saturated with water and all the rivers and streams were bankful, the excessive rainfall ran directly into the river and caused rises as much as 0.4 foot in 1 hour and 6.9 feet in 24 hours at stages above 60 feet. The flood stage was first reached in the lower portion of the river on January 8, and then progressed slowly up the river, reaching Dam No. 38, in the lower part of the Cincinnati district, on January 15, Cincinnati on January 18 and Dam No. 26, in the upper part of the district, on January 19.

As the river was rising so fast and conditions so threatening additional river gages were established by surveys to provide for all possible stage heights. This precaution was taken as a matter of convenience for reading the Broadway gage, but proved most fortunate as both the Broadway gage and the recording gage at the West End Power Plant were flooded at a stage of 72 feet. Special observers read the gages each hour and reported to the Weather Bureau Office within 10 minutes after the hour for a period of 14 days. These readings were made to the hundredth of a foot. The two sets of readings gave most valuable records of stage heights not only for current use but for permanent record of the extreme stages.

The forecasts and warnings were made and fully distributed at frequent intervals. The probable crests were determined for each period when it seemed that the rains might cease, but when heavy rains started again the warning was to keep property 4 feet above the water surface as long as the river continued to rise rapidly, and then gradually decrease this margin as the crest was approached.

Every effort was made to give all reports the widest possible distribution and this phase of the service was very successful. The teletype service from the airport was moved to the Observatory, and gave great assistance in collecting weather reports. The United States Engineers collected river and weather reports, and greatly assisted in the distribution of reports. Electric power, gas, and telephone services were furnished the Weather Bureau when most other industries and residences were cut off, as this was necessary for the protection of lives and property. The weather maps and river bulletins were printed each day in the Weather Bureau Office and also in the Times Star. The hourly bulletins were broadcast by the four regular broadcasting stations and by five special stations set up for that purpose.

The Ohio River in the Cincinnati district was at a higher stage than ever before recorded. The record is fairly complete for 147 years. The excess over previous years increased from 1.6 feet at Dam No. 26 in the upper part of the district to 8.9 feet at Cincinnati and to 9.4 feet at Dam No. 39, the last station in the district.

The tributary streams in the Cincinnati district were in flood only in their lower portions and some of these streams up the valley were not even in flood. The Kentucky River was in superflood for 117 miles up the river, with highest stages of record at Frankfort

and High Bridge, Ky., but flood stages were not reached in the upper part of the river. The Big Miami was in flood below Hamilton, Ohio; the Whitewater and Little Miami were in flood, but flood stages were not reached in the Big Sandy Valley.

OHIO RIVER AND TRIBUTARIES FROM MOUTH OF THE KENTUCKY TO AND INCLUDING HAWESVILLE, KY.

By J. L. KENDALL

The flood developed in three parts or phases. The first was caused by the rains of the 9th to 15th, and crested at Louisville, Ky., on the 17th with a stage of 30 feet, upper gage, and 59 feet, lower gage.

Rain began to fall on this crest on the 17th and continued almost daily until the 23d, producing the second phase of the flood. During this period amounts of precipitation at representative stations were as follows: Louisville, Ky., 9.13 inches; Madison, Ind., 8.35 inches; Frankfort, Ky., 8.88 inches; High Bridge, Ky., 7.53 inches; Dam No. 43, Evans Landing, Ind., 8.91 inches; Dam No. 44, Leavenworth, Ind., 11.40 inches; Dam No. 45, Addison, Ky., 10.15 inches. This section of the flood rainfall ended with a freeze that held back about 0.60 inch of water in the form of snow and sleet. During this phase the flood passed the previous high watermark of February 15, 1884, 46.7 feet, and entered a new region for which there were no comparisons and no experience whatever. The historic record was passed by the rapidly rising stream at 12:30 p. m., January 22. At that time the river was rising at the rate of two-tenths foot per hour.

A crest near 52 feet, upper gage at Louisville, had been forecasted, and the flood showed indications of ending around that stage, when it entered its third phase with the heavy rain of Sunday, January 24. This rain fell on the accumulation of snow and ice, which acted much like a house roof in hastening its progress toward the river. Also, the water held back by the snow and sleet ran into the river with the rain, augmenting its effect. This rain, ranging from 2.00 to 4.00 inches in this district and falling with a high intensity, carried the river to its final crest of 72.7 feet at Madison, Ind., on the 26th, and 57.1 feet, upper gage at Louisville, on the 27th. The lower gage at Louisville was submerged at about 80 feet.

Aside from the entrance of this flood into 10 feet of altitude for which there is no comparison in the records, it had other peculiarities. The precipitation, while not continuous, was so closely grouped that no crest appeared nearer than the extreme upper river after the crest of 30 feet at Louisville on the 17th. This crest did not reach the lower river, where the rise was continuous. Because the heaviest rainfall occurred near the stream, the river filled rapidly from the sides, much like a ditch. Therefore, the flood became, to a marked degree, a rise in which the expected increase had to be computed directly from run-off, with less than the usual reference to gage relations. As with floods of this type, in about 48 hours after the rain ceased the crest was reached.

Another important feature was the tremendous output of the Kentucky River, which exaggerated the height of the water at Madison, Ind., and Louisville, Ky., with relation to stations upstream. The Kentucky River continued at a stage above 40 feet at Frankfort, Ky., for 6 days, and above 30 feet at High Bridge, Ky., for 7 days; although the upper course did not reach flood levels. The crest at Frankfort, Ky., 47.2 feet on the 25th, and 42.2 feet at High Bridge, Ky., on the 23d, are the highest ever known at those stations.

A third interesting feature was the effect of the enormous expansion of the river in the upper 5 feet on the relations with upstream gages. At the crest the river and its backwater at Louisville were 20 to 25 miles wide. This tremendous spread for a few feet of rise used up great quantities of water from up river, and reduced to a marked degree the percentage of stage increase. This was expected and partly provided for in the final estimates, but some allowance was made for a slightly higher stage than this expansion would indicate, so that no one would be caught by a crest set too low. It is estimated that this expansion reduced the probable crest at Louisville by 1.5 feet, if the usual gage relations had held.

In the last phase of the flood the river began to overflow its upper flood plain. Along the Ohio River in this district there are often two well defined flood plains, an upper on which the cities are built and a lower occupied by farm lands. At Louisville, Ky., Jeffersonville, Ind., and New Albany, Ind., these two plains merge more or less gradually into one another. At the crest the lower flood plain was covered, and only the tops of terraces on the upper plain were out of the water. Six more feet of water would have left very little of the upper flood plain protruding in the region of the three Falls Cities.

Strong currents seeking old channels across the flood plain developed in the upper levels of the flood. One of these ran down Broadway, Louisville, with such force that a boat could not be held against it. Another through the heart of Jeffersonville, Ind.,

caused much damage by battering buildings with drift. Erosion that was quite serious in places resulted from these currents. Some high building lots with a gravel base in Howard Park, a suburb of Jeffersonville, Ind., and also the Pennsylvania fill in the rear of the Colgate plant, were eroded away. The river did not run at such levels long enough to cut new channels.

Louisville was flooded to the extent of about 70 percent, and about 175,000 people were evacuated. Jeffersonville, Ind., was 90 percent flooded, and 13,000 people were forced from their homes. Several thousand people took refuge in Fort Fulton, Ind., an eastern suburb, located on a terrace with a few squares out of water. The water was 4 feet deep in the Quartermaster's Depot, which was at first a refuge but later had to be abandoned. New Albany, Ind., was about half covered, West Point, Ky., was nearly all destroyed. Leavenworth, Ind., was partly washed away. Hawesville, Ky.; Cloverport, Ky.; Cannellton, Ind.; and Tell City, Ind., were almost completely inundated.

In the latter part of the second phase of the flood, the regular telegraph and telephone communications with the section of the district below Louisville broke down. While receiving sets in that section continued to work, they obtained advice through WHAS and WAVE, the local radio stations. Crystal sets and battery sets were called into use when the electric power gave out. Amateur stations in Jeffersonville, Ind., were of service after that city had been surrounded by water and mostly overflowed. The local radio stations cooperated faithfully until driven off the air by the failure of the riverside plant of the Louisville Gas & Electric Co. at 11:35 p. m., Sunday, January 24.

At WHAS emergency power was obtained after a short interval, from the line to Dix Dam, and the service went on until the end. At the last this valuable assistant was the only agency through which this office could hope to reach the lower portion of the district. Too much cannot be said in commendation of the personnel of the radio stations, who worked to exhaustion in their efforts to broadcast flood information, calls for assistance, names of refugees, etc.

Upper gage estimates for Louisville, broadcast by radio, served well for all sections below to Tell City, Ind., when the reports from the dams could not be obtained. The people of that section have long been accustomed to the use of the upper gage at Louisville as a guide in estimating their own local flood conditions. The broadcasting of the hourly readings and estimates in terms of the upper gage gave them the information with which they were most familiar.

In the final stage of the flood, when Louisville was two-thirds under water, newspapers could not be published in the city from lack of power. Cards, carrying the forecasts and river stage, were tied to lamp posts by members of the Weather Bureau force, aided by Boy Scouts, on the island that constituted the heart of Louisville. This service continued until the Post Office again began to function. For several days the Federal Building, in which the Post Office is located, was surrounded by water. The Washington Building, in which the Weather Bureau Office is located, happens to be on one of the high spots in downtown Louisville. It is also within a few doors of the Western Union telegraph office. The "life line" of communication through the Western Union held during the flood, enabling the Weather Bureau to keep functioning. The Western Union maintained its service by moving the transformers from the basement to the upper floor and installing tractor engines to produce power. All basements contained water, and were usually one-half to two-thirds full. Fires could not be maintained except by heavy pumping, which had a tendency to carry the sand from under the floors of buildings, allowing them to collapse. For this reason, the pumps had to be stopped in places. One of the dramatic features of the flood was the continual beat of the pumps, going night and day, in the futile attempt to keep the water out of basements. At the Weather Bureau Office heat, light, power, water, and elevator service failed. These were not fully restored until February 18.

The Western Union sent a mobile unit to Jeffersonville, Ind., very quickly after communication with that place was cut off. Through Indianapolis and Cincinnati the operators of this unit were able to obtain the river stages and forecasts throughout the final stages of the flood. This unit was also able to supply New Albany, Ind., with flood information. The work of this unit was extremely valuable in preventing panic in those two cities.

When the water reached the telephone cables in the basement of the Washington Building, cutting off the Weather Bureau Office from the outside, the telephone company ran a special line in a few hours and restored service. Therefore, it was only for a few hours that this office could not be reached by telephone. During that time messenger service was used.

River stages and flood information was obtained early in the morning by teletype. The Weather Bureau men along the river strove in every way possible to get the vital information to each other.