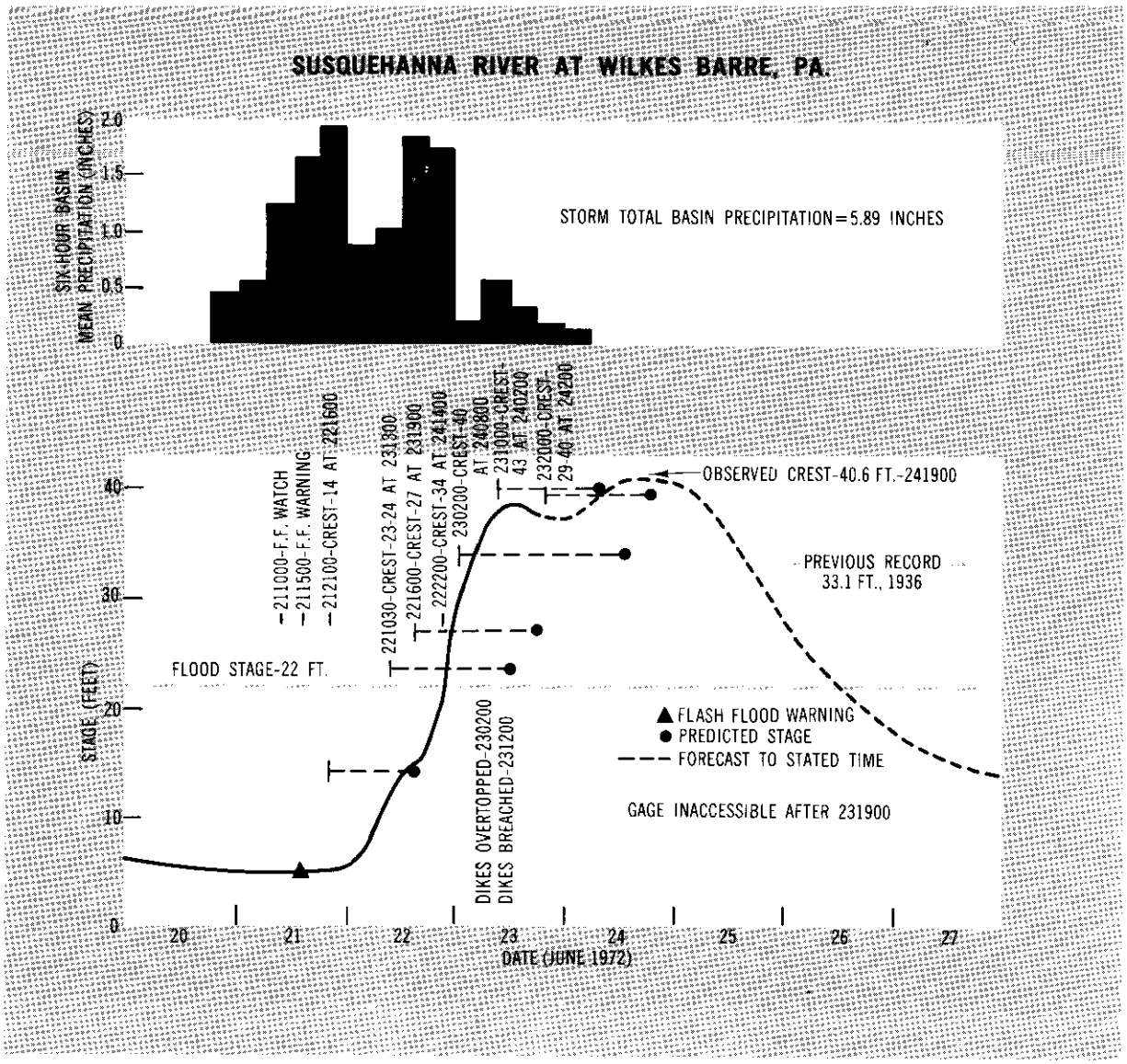


for the flood on the basis of the initial warnings and later forecasts was unusually good and involved the evacuation of 100,000 people. Property damage was heavy, but there is overwhelming evidence that a much greater loss was averted. One death by drowning has been reported in the Wilkes-Barre area.

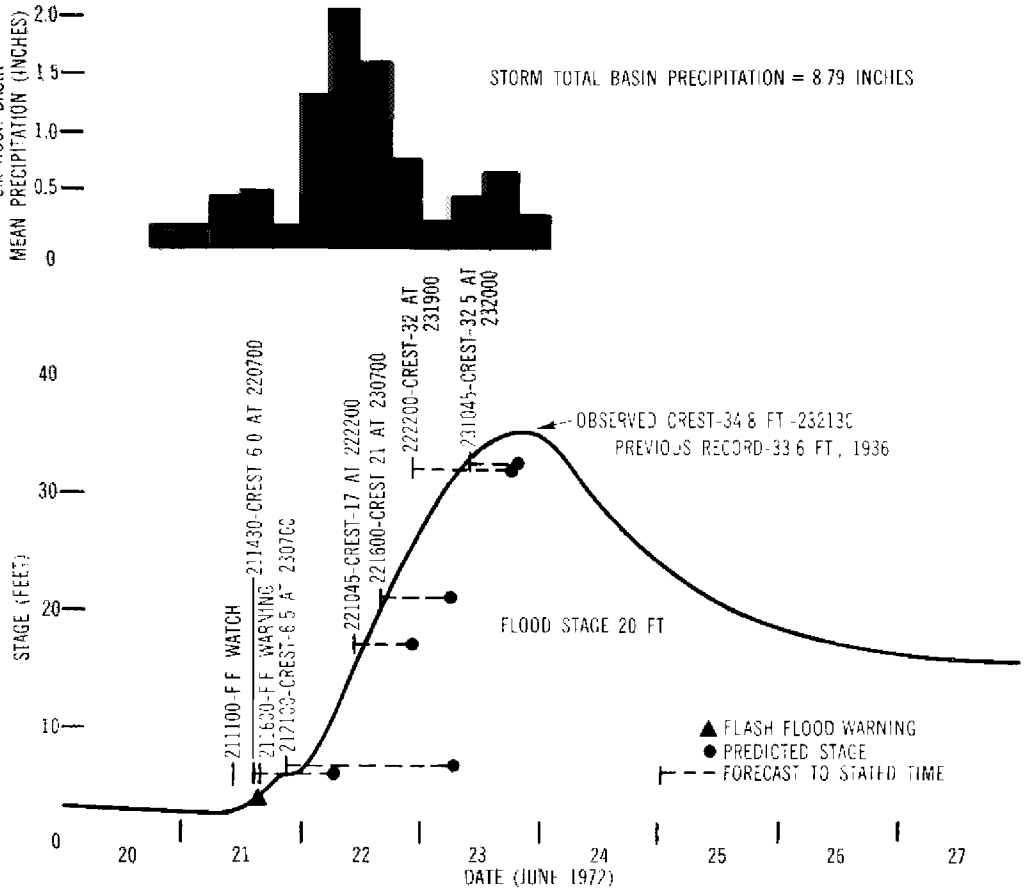
Although the river gage was not destroyed, radio communication with it was lost early in the water's rise. Later, inaccessibility of the gage required the use of a wire-weight gage and telephone communication with the local observer. A forecast of a 40-foot crest was prepared prior to the loss of power to the RFC computer. Although minor revisions were prepared manually later, the decision to evacuate areas in back of the dikes was based on the 40-foot forecast.

Several thousand teenagers, among others, volunteered for sandbag duty and worked around the clock. Despite their efforts, the dikes on both banks were overtopped and eventually breached. The breaching of the dikes probably resulted in a slight decrease in the stage in the main channel and a considerable increase in the size of inundated area.

West Branch Susquehanna River at Williamsport, Pa.

In the river basin above Williamsport, rain began slowly on the afternoon of June 20. On the morning of June 21, the intensity was increasing and the area was placed under a flood watch. The first warning was issued at 4:00 p.m. The rate of rainfall continued to increase through the night and most of the next day. By early morning of June 25, 13.5 inches had been observed at Williamsport. Average precipitation over the entire 5,682-square-mile basin above Williamsport was 8.8 inches. This heavy downstream concentraton caused disastrous flooding along small streams in the local area. The West Branch

W. BR. SUSQUEHANNA RIVER AT WILLIAMSPORT, PA.



crest occurred at 9:30 p.m. on June 23 at a stage of 34.8 feet, 15 feet above flood and one foot above the previous record in 1936.

The 34.8-foot stage is a wire weight gage reading. The maximum stage recorded in the well house was 31.4 feet. Information available at this time indicates that the discrepancy probably was the result of a malfunctioning intake.

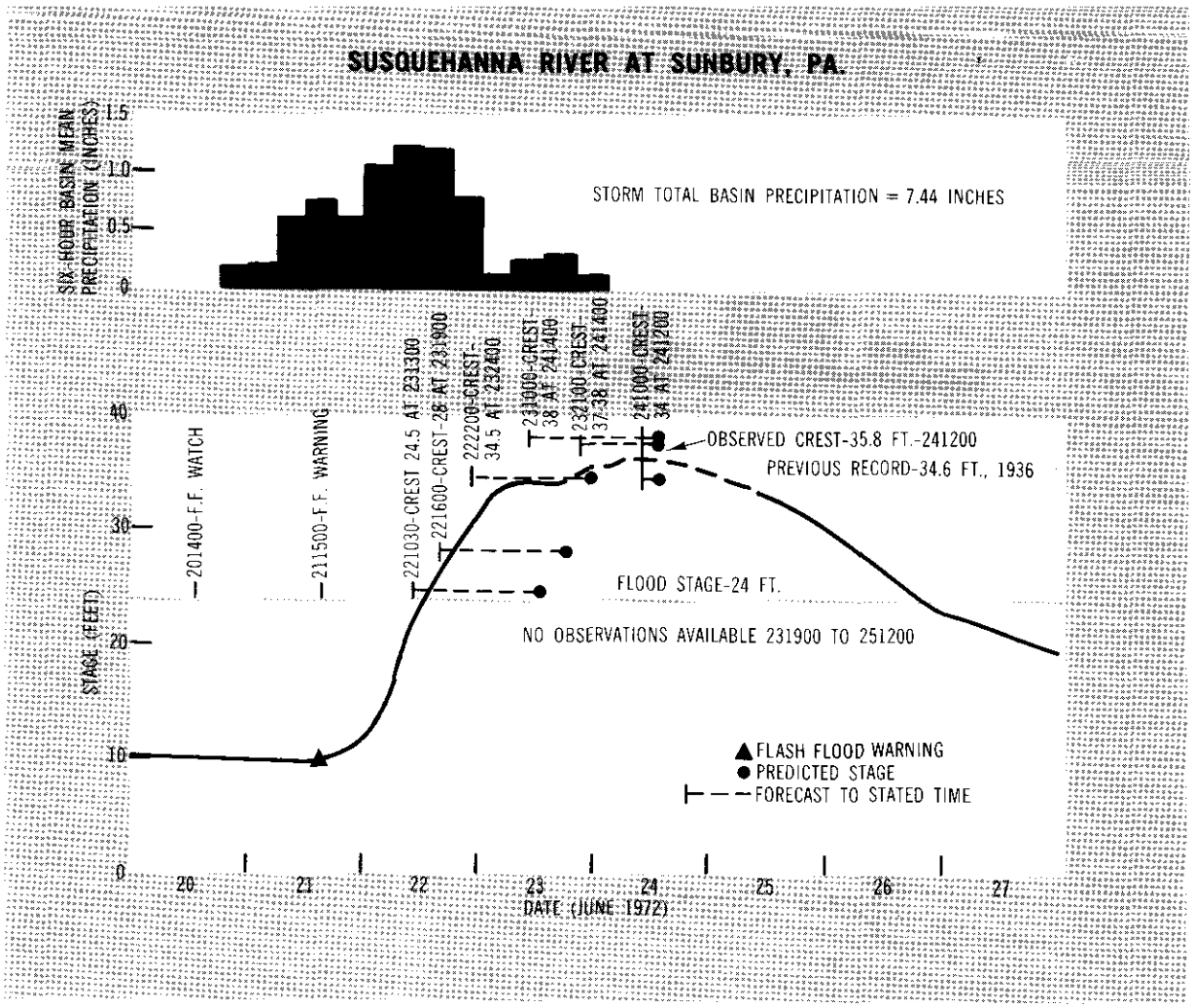
WSO Williamsport issued 90 special statements during the emergency, prompting extensive preventive measures. Most damage in the vicinity of the city was caused by small stream flooding, the main channel being contained by dikes Main stream damage was extensive below Williamsport, however. Five deaths were reported in Lycoming County.

The river gage survived the flood, but radio communication was lost early in the rise Fairly complete reports were received by telephone. The principal crest forecasts were prepared before power to the RFC computer was interrupted.

The crest at Williamsport was only one foot lower than the top of the dikes.

Susquehanna River at Sunbury, Pa.

Sunbury is located on the main river just below the junction of the North Branch with the West Branch. The local area received 10.3 inches of rainfall over the 4-day period, June 21--24, with a 14-inch rainfall center at Milton, Pa. Extensive small stream flooding resulted. The record main-channel flow, which included the tremendous upstream discharges, was contained by dikes with the aid of sandbagging and sand boil repair. A flood watch was issued on the afternoon of June 20, about 12 hours before the beginning of heavy rain. The first flood warning was issued at 4:00 p.m. on June 21. A crest of 35.8 feet occurred at noon on June 24



This was 12 feet above flood stage and 1 foot above the previous maximum in 1936.

A usable crest forecast was issued 36 hours before the crest arrived. The principal protective works were the dikes, although all of the people behind the dikes were evacuated. Property damage in and around Sunbury was caused primarily by small-stream flooding. Major main-stream damage occurred upstream and downstream from the dikes.

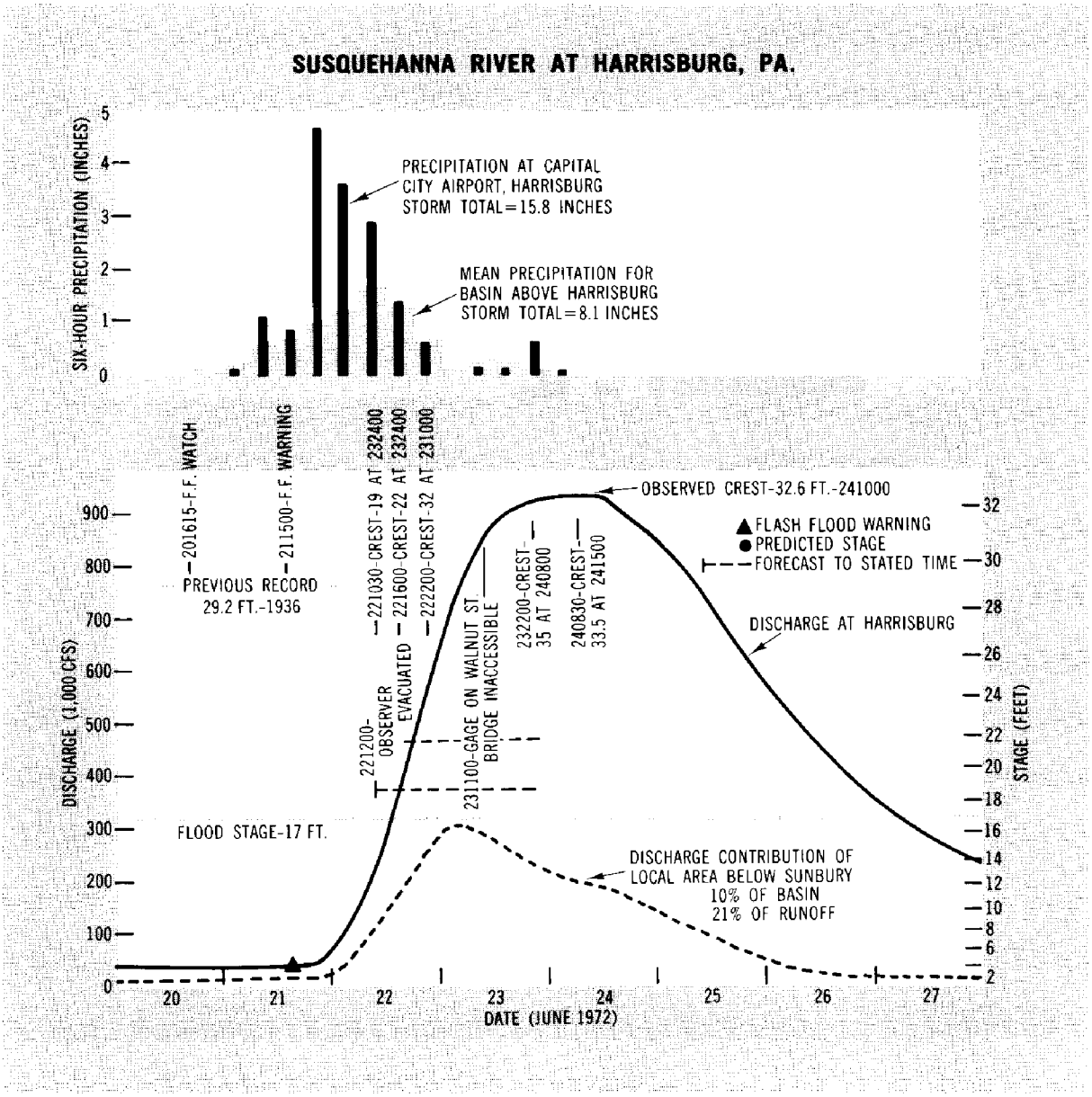
The river gage was not destroyed, but telemetering capability was lost owing to local power failure during the evening before the crest. Readings for an undetermined period prior to the failure were 1.5-feet low because of slippage of the telemark float cable. Loss of power to the RFC computer did not take place until after the principal crest forecast had been issued.

Susquehanna River at Harrisburg, Pa.

In the Harrisburg area, rain began on the morning of June 21 and continued for 3 days, accumulating to 15 inches. The main storm center was near Clingerstown, Pa. (about 30 miles north northeast of Harrisburg), where the rain totaled 19 inches. Harrisburg was placed under a flood watch on the afternoon of June 20. A warning was issued 24 hours later. A sharp rise began at 1 a.m. on June 22. At 2 p.m., the 17-foot flood stage was reached. At 5 a.m. on June 23, the 1936 flood crest record of 29.2 feet was exceeded. The water was rising at the rate of 0.6 foot per hour at this time. The crest of 32.6 feet was reached at 1:30 a.m. on June 24. However, during the 16-hour period from 6 p.m. on June 23 to 10 a.m. on June 24, the level was within one-half foot of the crest stage. A crest forecast of 32 feet was issued at 9:30 p.m. on June 22.

On Monday, June 20, 15 key executive personnel of the statewide civil defense organization began a week-long conference in State College, Pa. Based on the flood watch issued by Harrisburg RFC the next day, this conference was terminated and the personnel returned to their duty stations.

Evacuation in the Harrisburg area was started on

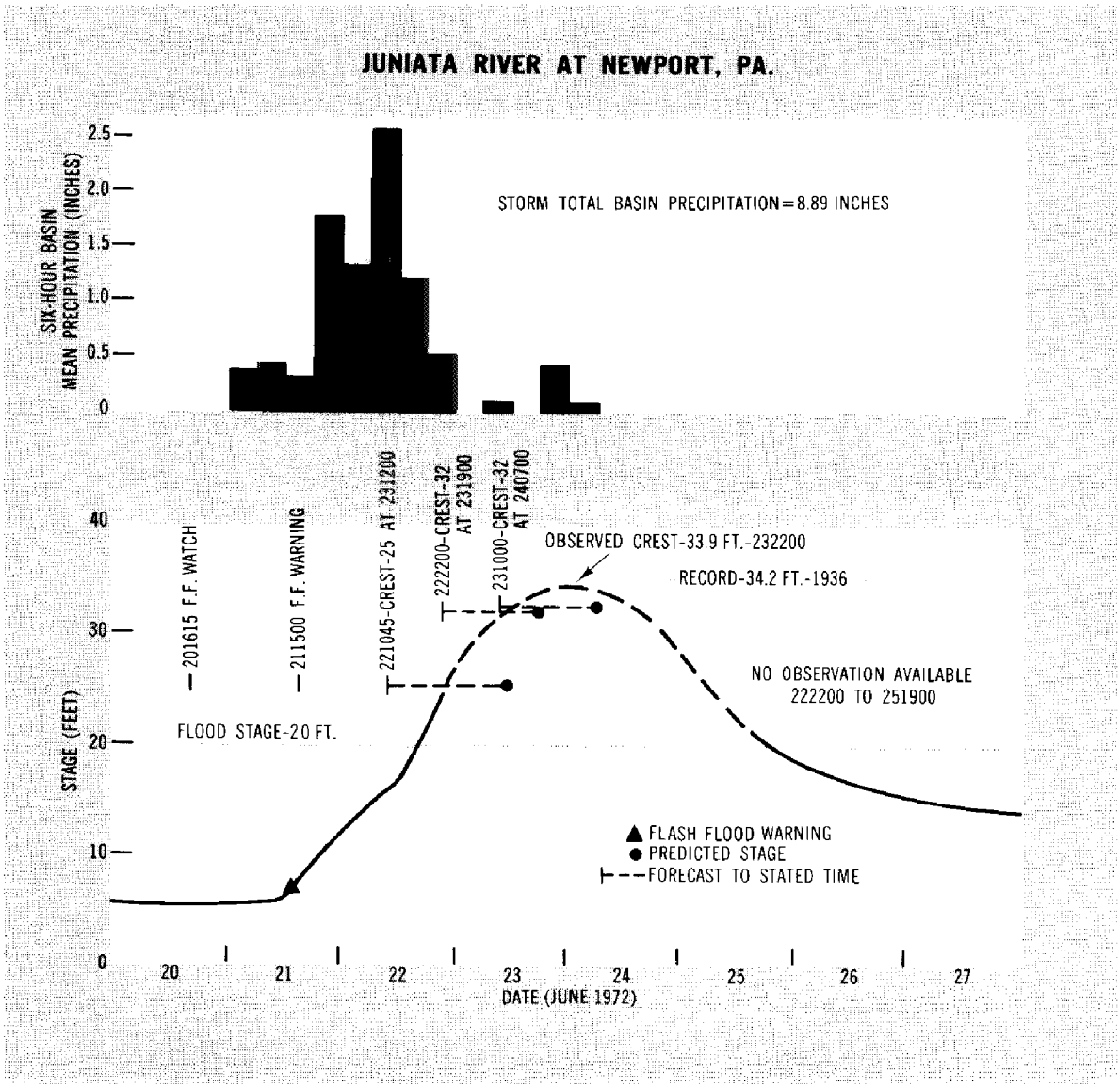


the evening of June 21, because of local flash flooding to 15 inches. The main storm center was near ing. Frequent statements issued by RFC, beginning with the 4 p.m. warning and continuing through the night, called for greatly worsening conditions and disastrous urban flooding from locally heavy rains. These warnings hastened and increased the scope of the evacuation operation. Property damage was severe in the city and surrounding area. One drowning occurred in the Harrisburg area.

The telemetering capability of the Harrisburg river gage was lost early in the rise owing to radio failure. Later, the local observer had to be evacuated because of urban flooding from local rains, at a time when the Susquehanna was still 7 feet below flood stage. Subsequent river readings were made by RFC personnel using the wire-weight gage on the Walnut Street bridge. When the bridge became inaccessible, a gage was improvised.

A 32-foot flood stage was forecast before power to the RFC computer failed, but considerable manual updating computations had to be made later.

Because the principal storm center was near Harrisburg, runoff from the portion of the basin immediately above the city was much heavier than that from the basin as a whole. The result was a very steep rise and an early peak from local inflow. Near-maximum stage at Harrisburg was reached many hours in advance of crests at upstream stations. Although forecasts for points along the river



correctly predicted this somewhat unusual response, some recipients were reluctant to accept these forecasts, being accustomed to the more typical case of a crest moving downstream from point to point.

Paxton Creek flows through the center of Harrisburg. The numerous small-bridge openings, together with intense local runoff, created a series of fixed-orifice reservoirs. This effect aggravated the local flooding condition and produced flash-flood stages (in the city and near the confluence with the Susquehanna) fully as high as those which occurred later from Susquehanna River backwater.

Juniata River at Newport, Pa.

The first flash-flood watch for this area was issued at 4:15 p.m. on Tuesday, June 20, about 12 hours before the beginning of rain. The rain began, at a moderate rate, very early on Wednesday, June 21, becoming heavy by night and remaining so all through the next day. The storm total for the basin was 8.9 inches, of which 6.8 inches fell in a 24-hour period. A flash flood warning was issued at 3 p.m. on Wednesday, June 21, just as the rise started. The river continued to rise for the next 55 hours, passing the 20-foot flood stage the following evening and cresting at 10 p.m. on Friday, June 23. The maximum stage was 33.9 feet, just 0.3-foot less than the 1936 record. Precautionary measures evidently consisted primarily of evacuation of residences. Approximately 700 people were removed, and a small army of volunteers moved large quantities of furniture to high grounds. Property damage was heavy, but deaths were not reported in Newport or in Perry County.

Reporting service from the gage ceased at 10 p.m.

on Thursday, June 22, 24 hours before and 10 feet below the crest. Observations were not available operationally until 2 days after the crest. The reason for the initial loss of communication was the evacuation of the observer from his home, where the remote river gage readout terminal was located. Later, the river gage itself became inaccessible.

Operational precipitation and river-stage data were lacking during the last half of the storm all along the Juniata River, because of the evacuation of observers and the failure of radio communication with RFC Harrisburg.

Upper Ohio (Allegheny–Monongahela) Basin

In southwestern New York State, flash flood watches were issued well in advance of flooding. Local knowledge of the flash flood characteristics of the river in this area resulted in prompt community action and timely evacuation of endangered areas. Because of the cooperation of county civil defense and local safety officials, there were no injuries and no loss of life.

In Pittsburgh, flood warnings were generally available with only a minimum of lead time, because of the suddenness of torrential rains and because these rains occurred at night, when dissemination of warnings is most difficult. There was no loss of life.

River forecasts for the upper Ohio are prepared by RFC Cincinnati. Flash flood watches and warnings are prepared and issued by WSFO Pittsburgh.

Warnings are provided to the general public by the news media which obtain their information from the NOAA Weather Wire Service. The number of NWWS subscribers in Pittsburgh is limited. At the major television station, the NWWS drop is in the office of the staff meteorologist and not accessible to others when he is off duty.

Some commercial interests within Pittsburgh received warnings through a prearranged telephone alerting service operated by the Chamber of Commerce. The Western Area Office of Pennsylvania Civil Defense received and relayed appropriate warnings to country directors. Direct telephone calls were made by the WSFO Pittsburgh staff to an extensive list of community representatives. Warnings also were released to the Army Corps of Engineers, Pittsburgh District, which relayed these to its installations along the Allegheny and Monongahela for local dissemination.

Flash flood watches for areas of western Pennsylvania were issued as early as 3.30 p.m. on June 20. Beginning on June 21, flash flood watches and warnings were issued frequently for numerous areas over the upper Ohio.

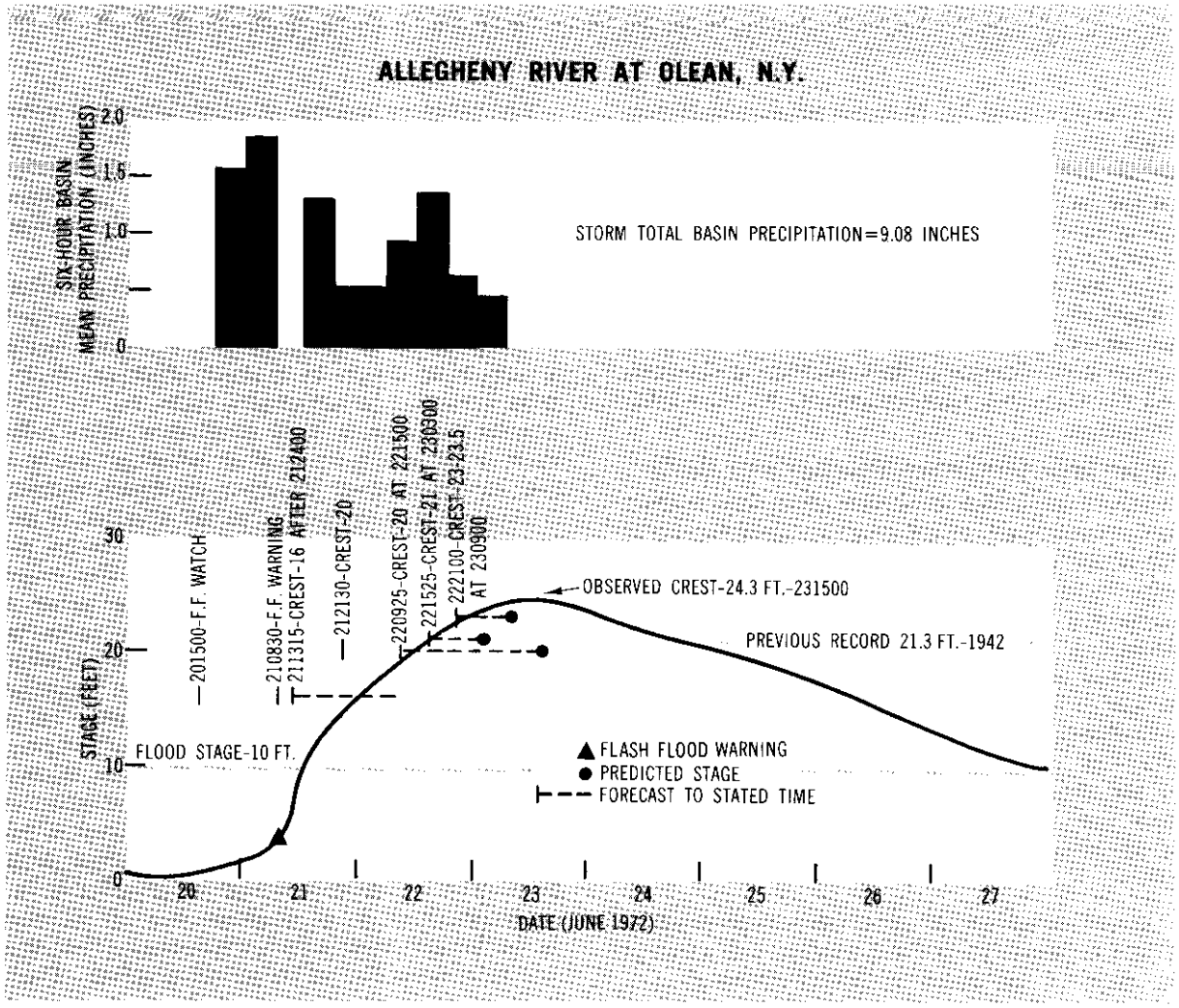
The Allegheny is noted as a fast-rising river when heavy rains occur over the headwaters. The problem was compounded in this flood by general and continuous very heavy rains. As a result, the main stem of the Allegheny rose like a flash flood, contributing to short lead times in the warning issuances.

Although official flood warnings provided limited lead time, and these warnings were generally issued during the night hours, the public was made aware of impending danger by extensive dissemination of flood news through newspapers, radio, and TV. Except for communities in the headwaters of the Allegheny which suffered from flash flooding, there was time for most people to take preparedness actions. A major complaint from a marina operator in the Pittsburgh area led to a Congressional hearing on June 29, 1972. The President of the Waterways Association of Pittsburgh stated that the warnings issued provided adequate time to take necessary preparedness actions. The Mayor and Superintendent of Police of Pittsburgh expressed concern regarding dissemination but otherwise were satisfied. There were problems in the dissemination of information. When the mayor's office was called in the dissemination process, a telephone-answering device responded. The Mayor stated that he expected the Superintendent of Police to be fully informed at all times. The Superintendent said he solved the dissemination problem by detailing one of his men to the forecast office with a walkie-talkie. Once this had been done, he had no further problems. There was no loss of life. The local NWS Environmental Meteorological Support Unit (EMSU) was advised to move from its location on the Monongahela River bank on Friday morning, well ahead of flood stage.

The quantitative precipitation forecasts for the river district, prepared as guidance material by the National Meteorological Center, did not provide an adequate picture of anticipated rainfall. Radar reports on the NOAA Weather Wire did not reflect the heavy rainfall rates during this event. Timely detection of precipitation was not available from the normal substation reporting network.

The local forecast staff did add additional rainfall amounts to the model, based on some knowledge of rainfall in the area. These turned out to be too low in all cases where this technique was used.

One trained hydrologist is on the staff at WSO Pittsburgh, supported by two technicians to carry out river district activities. This is not sufficient professional manpower to meet the hydrologic service needs of this district. During the flood emergency, the only hydrologist remained at his post 6 days and 5 nights. It became necessary to assign a hydrologist from RFC Cincinnati to assist him.



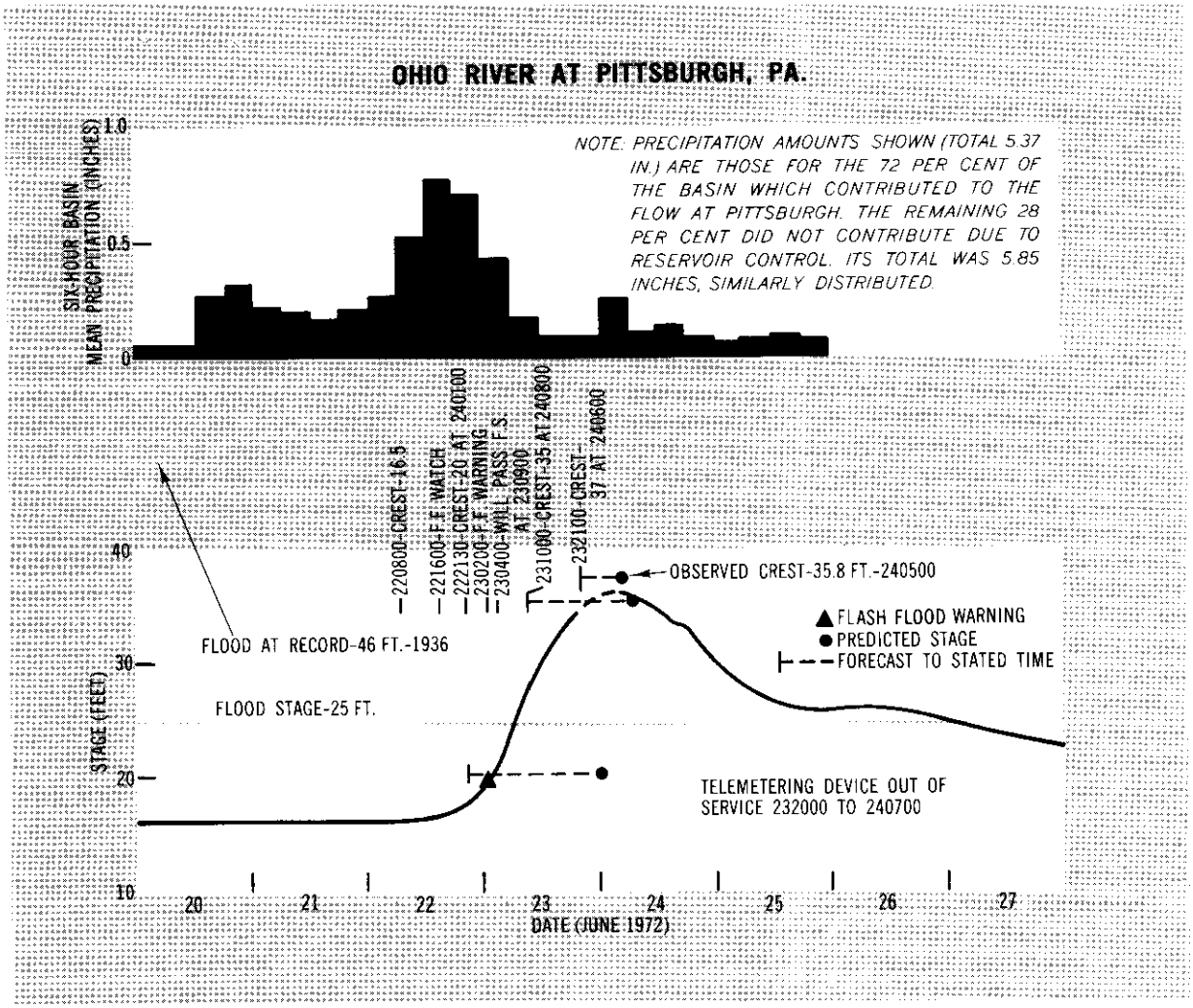
Allegheny River at Olean, N.Y.

The rain began in this basin rather suddenly on the evening of Tuesday, June 20. This rain was the result of a frontal passage and deposited 3.5 inches over the basin in the 12-hour period ending at 7 a.m. Wednesday, June 31. A flash flood watch had been issued at 3:50 p.m. on Tuesday, a few hours before the rain began. This was changed to a warning at 8:30 a.m. Wednesday, as a sharp river rise began. After the frontal passage, the rain stopped. During the afternoon, moisture ahead of tropical storm Agnes moved into the region, and another downpour began just as the river level passed the 10-foot flood stage. It lasted for the next 42 hours, adding 5.6 inches to the 3.5 inches already fallen. The river continued to rise until 3 p.m. on Friday, June 23, when it crested at 24.3 feet, 14 feet above flood and 3 feet above the previous record set in 1942.

As the rain continued, several crest forecasts were issued. Continued updating was necessary, but a satisfactory lead time was established.

Protective measures were timely and effective. The local civil defense office was warned at 8:45 a.m. Wednesday, June 21, and had 28 men on duty within 1 hour. Precautions were not extensive until early Friday morning, when it appeared that the 25-foot flood wall might possibly be overtopped. About 6,000 people—one third of the city's population—were evacuated from 1,500 homes. The National Guard moved both people and furniture. The area evacuated was that which had been covered by the 1942 flood which reached 21.3 feet. Although the crest fell 8 inches short of overtopping the flood wall, there was considerable leakage and sewer backup. Approximately 3,400 homes were affected. About 90 homes located outside the flood wall were heavily damaged or destroyed. The commercial area of the city is not large, and had relatively light damage. No deaths were reported. Throughout the event, radio station WHDL gave excellent cooperation and provided a valuable service.

A network of four rainfall observers reports to the city of Olean, which relays the data to RDO Pitts-



burgh. During the flood, telephone lines into Olean became overloaded, and the observers then reported directly to the RDO. The river gage is located at the Olean sewage plant, which was the city's flood operation headquarters. Readings were made and reported every 15 minutes throughout the rise.

Ohio River at Pittsburgh, Pa.

The entire basin above Pittsburgh received an average of 5.5 inches of precipitation, spread fairly uniformly over a 5-day period. Twenty-eight percent of the basin is controlled by reservoirs which did not release water during the rise. The average rainfall over this portion was 5.85 inches. The remaining 72 percent of the basin received 5.37 inches and produced all of the runoff that appeared at Pittsburgh. The greatest 6-hour amount which fell averaged 0.91 inches over the basin.

Although this was the largest flood ever to occur in June and although the concentration was downstream, the rise was only moderately steep. The 25-foot flood stage was reached at 7 a.m. on Friday, June 23, about 12 hours after the rise started. The 35.8-foot crest was reached 22 hours later at 5 a.m. on Saturday, June 24. It was 11 feet above flood stage, but 10 feet less than the record of 1936.

A flash flood watch was issued at 4 p.m. on Thursday, June 22, and a warning at 2 a.m. on Friday, June 23.

There were no failures of the telephone facilities at the RDO, but the five lines proved totally inadequate during the most critical part of the operation. At times, calls were coming in so fast that it was impossible to place outgoing calls. This resulted in complaints about the inability to contact the weather office. People calling this number for river information were told, via a recording, that the office was closed. NWS received severe public criticism as a result.

The telephone lines to the river gage were submerged and failed at 10 p.m. on Friday, June 23, and were out of service until late the following morning. During the interim, manual readings were relayed to the RDO by telephone.