Notable Local Floods of 1942–43

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1134

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Floods of July 18, 1942 in North-Central Pennsylvania

By W. S. EISENLOHR, JR.

Notable Local Floods of 1942–43

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1134–B

Prepared in cooperation with the States of New York and Pennsylvania

With a section on
Descriptive Details of the Storm and Floods

By J. E. STEWART

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PREFACE

The floods of July 18, 1942, in north-central Pennsylvania were extraordinary. The enormous volume of rain that fell during the storm and produced these floods seems almost unbelievable. For that reason considerable space has been devoted to descriptions of previous historic storms and floods of the same type. The similarity of the eye-witness accounts is striking. It is hoped that this documentation will contribute to a more reliable knowledge of these extraordinarily great floods.

The field work and collection and tabulation of the basic information on stages and discharges for the flood was done in the Harrisburg, Pa., and Albany, N. Y., districts of the Surface Water Branch under the direction of J. W. Mangan and A. W. Harrington, district engineers, respectively. Hollister Johnson, hydraulic engineer, at that time assigned to the Albany district, had immediate supervision of the miscellaneous measurements of peak discharge made in that district, and reviewed most of those made in Pennsylvania. He also obtained the information about previous floods at Salamanca, N. Y. W. S. Eisenlohr, Jr., assisted in some of the measurements of flood flow and prepared the report in the Technical Coordination Branch under the general direction of R. W. Davenport, chief; he also supplied photographs for the report.

Substantial and important contributions to the collection of field information and to the report were made, as noted, by James E. Stewart, hydraulic engineer, now with the West Penn Power Co., who as a young engineer with the Geological Survey was greatly interested in floods. The great number of miscellaneous rainfall measurements are largely the result of his efforts, and his contributions to this report are gratefully acknowledged. Thanks are also due the West Penn Power Co. for making available the results of Mr. Stewart's work.

The Corps of Engineers and the Weather Bureau cooperated in the collection of meteorologic information and made it available for these reports; the Corps of Engineers also furnished the results of four peak-discharge measurements.

The stream-gaging work in the two districts of the Geological Survey was performed in cooperation with the Pennsylvania Department of Forests and Waters and the New York State Department of Public Works.

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FLOODS OF JULY 18, 1942, IN NORTH-CENTRAL PENNSYLVANIA

By William S. Eisenlohr, Jr.

ABSTRACT

The floods of July 1942 in north-central Pennsylvania and adjacent areas in New York were record-breaking on most of the smaller streams. They followed unprecedented rains that amounted to as much as 35 inches at some points during a storm that for the most part lasted less than 12 hours at any point. In the area of heavy rainfall, peak flood discharges were much greater than for the floods of March 1936. The storm was centered over the headwaters of three major drainage basins—Susquehanna, Allegheny, and Genessee—with the result that flood flows in the lower reaches of those streams were not outstanding. The estimated property damage exceeded $10,000,000 and 15 persons lost their lives. Description of previous storms and floods show that quite similar conditions have occurred in other areas in the past. The isohyetal map in the report is based on more than 400 miscellaneous observations of rainfall. Gage heights and discharges during the flood period are given for 14 gaging stations, and peak discharges are given for 47 other points on streams in the flood area. The maximum discharge was 117,000 second-feet in West Branch Susquehanna River at Renovo, and the maximum in relation to drainage area was 2,100 second-feet per square mile from 11.4 square miles in Annin Creek near Turtle Point. The report also contains a table of flood-crest elevations.

INTRODUCTION

On July 18, 1942, north-central Pennsylvania and adjacent areas in New York were visited by destructive floods of unprecedented magnitude. The principal areas affected were in Elk, Cameron, McKean, and Potter Counties in Pennsylvania, and Cattaraugus, Allegany, and Steuben Counties in New York. (See fig. 26.) Rainfalls of more than 30 inches were reported in several localities, and on about 200 square miles the rainfall was as much as 20 inches. The rainfall was greater than 10 inches on more than 2,000 square miles.

The resulting floods produced the highest crest stages ever recorded on First Fork and Driftwood Branch of Sinnemahoning Creek and on upper Allegheny and Clarion Rivers. Flood discharges on small drainage areas—less than 100 square miles—were as great in relation to drainage area (see fig. 43) as any ever recorded on streams in Pennsylvania and adjacent areas in New York. Allegheny River at Red

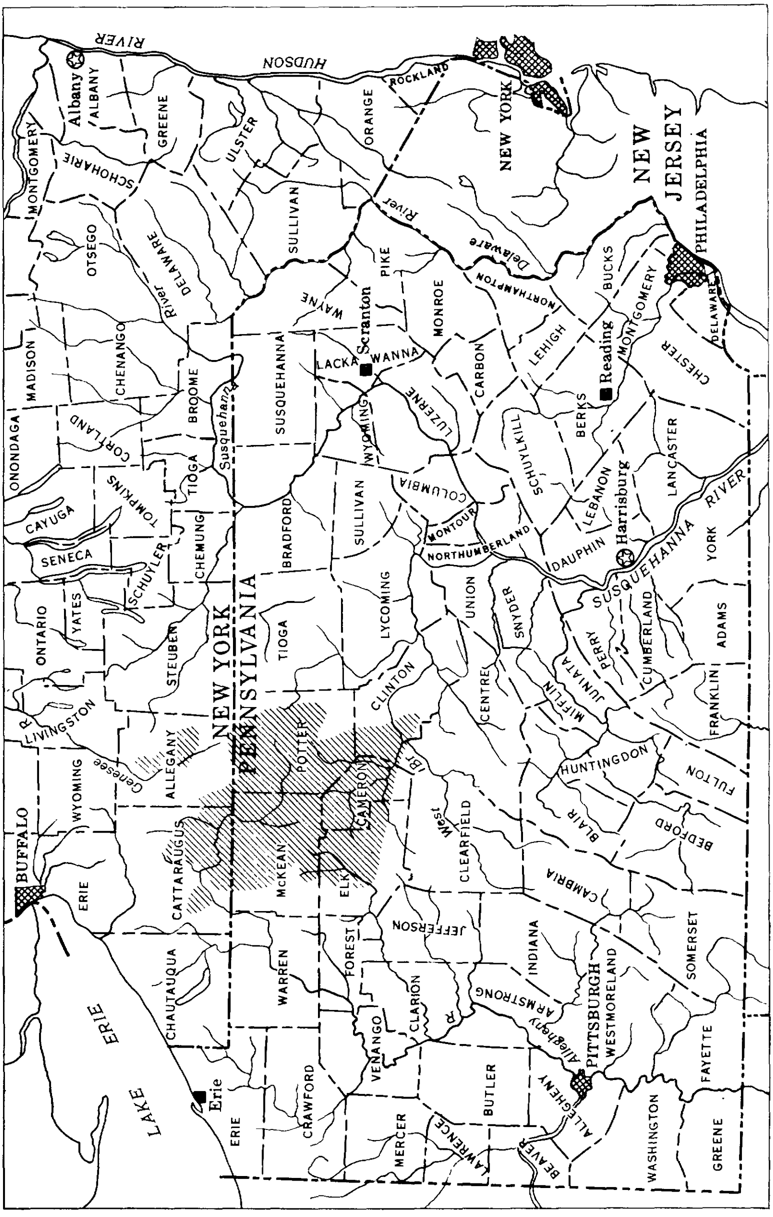

FIGURE 26.—Index map showing location of flood area.

House, N. Y., was nearly a foot higher than the previous maximum in 40 years of record, and at Eldred, Pa., it was more than 9 feet higher than the previous maximum in 27 years of record, with more than four times the discharge. Driftwood Branch Sinnemahoning Creek was nearly 3 feet higher than in March 1936 with more than one and one-half times the maximum discharge.

Practically all the towns along the streams were inundated to a damaging extent. The dikes at Emporium, Pa., were overtopped and about 60 percent of the town was flooded; the water was 5 feet deep in the middle of Broad Street Square. At Austin, Pa., events were reminiscent of the historic flood disaster of September 30, 1911, when the dam broke and 80 people were killed. The dam of the Williamson Pulp & Paper Co.'s reservoir—with a capacity 65,000,000 gallons at spillway crest—was breached (fig. 27), pouring floodwaters upon the

FIGURE 27.—Dam of Williamson Pulp & Paper Co., Austin, Pa., breached by flood.

town of Austin; buildings were knocked off their foundations (fig. 28) and water was 4 to 5 feet deep on the main street. Port Allegany probably suffered the greatest damage per capita of any town in the area. Virtually every business building was flooded 3 to 20 feet. More than 150 people attending a conference in the Free Methodist

FIGURE 28.—Buildings in Austin, Pa., destroyed by flood.

Church were rescued from treetops, roofs, and floating wreckage. The church was washed against a nearby silk mill; it caught fire, and both buildings—as well as others adjacent—were destroyed.

Many other towns were inundated to a considerable extent: Coudersport, Smethport, Eldred, Bradford, and Ridgway, Pa., and Portville, Olean, and Salamanca, N. Y. Above Johnsonburg, Pa., a dam broke, and a wall of water 8 feet high was reported as having swept through the town; 18 families had to be rescued with makeshift rafts, and many houses were moved off their foundations and pushed together (fig. 29). All these communities supported industries that suffered heavily, at a time when capacity production was needed for the war effort.

Public utilities and transportation systems were badly damaged. Water, gas, and electric services were disrupted in many communities. Railroads, highways, and bridges were washed out. A passenger train was marooned by the collapse of a bridge near Ridgway. It was estimated that 75 miles of Pennsylvania Railroad track was damaged. The Coudersport and Port Allegany Railroad between Roulette and Port Allegany, and the Baltimore & Ohio Railroad between Sinnemahoning and Austin were so badly damaged that they were abandoned. (See figs. 30 and 31.). Over all the 27 miles of this stretch of the Baltimore & Ohio Railroad it is doubtful if a section as

FIGURE 29.—Houses in Johnsonburg, Pa., swept off their foundations and pushed together.

FIGURE 30.—Bridge of Coudersport & Port Allegany R. R. damaged by flood.

FIGURE 31.—Baltimore & Ohio R. R. tracks along First Fork Sinnemahoning Creek torn up by flood.

long as a tenth of a mile anywhere was left undamaged; at one place the track was left in the middle of the stream.

Fifteen persons lost their lives in this storm, and many others were made homeless. The damages sustained were extremely large for the size and population of the area. That they were not larger, however, is probably because three separate drainage basins were involved: the Susquehanna, flowing into Chesapeake Bay; the Allegheny, head of the Ohio River system; and the Genesee, tributary to St. Lawrence River. This distribution may explain why the floods were not severe in the lower courses of the major streams. Had the storm that produced these floods been centered over only one major drainage basin, it seems likely that the floods would have been much more severe on the larger streams. The estimated total damage, according to figures compiled by the Weather Bureau, was $10,121,550; this was divided approximately as follows:

Railroads	$3, 106, 200	Communications and power lines	$123, 000
Commercial property	2, 050, 000	Agriculture	750, 000
Residential property	1, 650, 000	Relief	100, 000
Industrial property	1, 470, 000		
Highways	872, 350	Total	10, 121, 550

Two pictorial booklets describing the flood were published by W. H. Greenhow Co., Hornell, N. Y., and Nelsen Enterprises, Emporium, Pa.

The storm that produced these floods was of less than 24 hours' duration and at many places lasted little, if any, more than 12 hours. Rainfall measured at regular precipitation stations did not exceed 8 inches, except at Coudersport and Emporium where 8.22 and 8.10 inches, respectively, were recorded. From the magnitude of the floods, James E. Stewart, hydraulic engineer of the West Penn Power Co., concluded that rainfalls greatly in excess of these amounts must have fallen within the flood area. Being concerned over the capacity of the spillways designed for power dams of his company, Stewart visited the flood area and obtained evidence that verified his conclusions. A container was found that caught 30.8 inches of rain, and small streams everywhere had moved enormous quantities of rock. This information was brought to the attention of the Corps of Engineers, the Weather Bureau, and the Geological Survey.

At a joint conference held in Pittsburgh, it was agreed that the Corps of Engineers and the West Penn Power Co. would cooperate in a program to obtain all available precipitation data for the storms. This information would be turned over to the Weather Bureau for study in connection with the records for regular weather stations. The Geological Survey would collect additional information on flood runoff to complement the rainfall data. This program was carried out. A detailed meteorological analysis of the storm was made by the Weather Bureau, and a report was prepared as a hydrologic bulletin supplement (U. S. Weather Bureau, 1944).

As soon as field work was completed, the Geological Survey cooperated with the Pennsylvania Department of Forests and Waters in preparing and publishing a report (Pennsylvania Department of Forests and Waters, 1943) on the floods. The purpose of that report was to place in the hands of the public at the earliest practicable time the flood data then available. The present report by the Geological Survey, delayed in preparation owing partly to situations arising from the war emergency, contains additional runoff data as well as records revised since the Pennsylvania report was published. The rainfall records and an isohyetal map also are included so that all base data for rainfall-runoff studies will be contained in a single report. All clock times given are referred to eastern war time; to convert to standard time, subtract 1 hour.

DESCRIPTIVE DETAILS OF THE STORM AND FLOODS

By James E. Stewart [1]

DESCRIPTION OF THE STORM

A rainstorm, unusual in the amount of precipitation, and remarkable in its other characteristics, occurred in north-central Pennsylvania and adjacent areas of New York on July 17–18, 1942. The forerunners of the storm may have arrived as early as 6 a. m., Friday, July 17, when there were short, intense showers at such recording rainfall stations as Wellsboro and Jackson Summit, Pa. Nevertheless, the first definite warning of exceptional meteorologic conditions was a 10- or 15-minute hailstorm that occurred about 3 p. m., Friday, in the region of Keating Summit, Pa., to the east of that point, and perhaps at other locations.

At 8:35 p. m., Friday, the rainstorm burst furiously near Cohocton, N. Y. From that time until 8 p. m., Saturday, it raged almost continuously but shifted from place to place and back and forth in the storm area. Generally, however, the areas of heavy precipitation gradually shifted southwestward until, in the main storm area, the last of the storm's explosive energy was expended in the vicinity of Ridgway, Pa. After 8 p. m., Saturday, in this main storm area, there was no overhead evidence of the previous tumult except for some very light, intermittent showery conditions that continued through Sunday, July 19.

The heavy storm rainfall covered a period of slightly less than 24 hours, but at no one location was there more than about 16 hours between the beginning and ending of the heavy rain; in fact, at many places this period was confined to about 14 hours. But even a 14- or 16-hour period gives a false idea of the storm's intensity, because in most locations the rainfall was concentrated in a very few periods of heavy precipitation. It is probably conservative to say that at any given spot more than 50 percent of the rain fell during high-intensity periods, in which the total elapsed time was 6 hours or less. (See fig. 36.) In fact, at many locations more than 80 percent of the rain is known to have fallen in periods of 5 hours or less.

In the area near Cohocton, N. Y., and in the main storm area west of Hornell, N. Y., the heavy rain had stopped by 7 a. m., Saturday. In the main storm area northeast of Coudersport, Pa., most of the rain fell before 7 a. m., Saturday. In much of the remaining, indeed the major part, of the storm area the deluge occurred between 7 a. m. and 1 p. m., Saturday. In a few small sections of this area, however, the rainfall before 7 a. m. was as great or nearly as great as after 7 a. m. From Emporium, Pa., westward and northwestward there was heavy

[1] Hydraulic engineer, West Penn Power Co.

rain after 1 p. m., Saturday, and from the head of Clarion River southwestward to Ridgway, Pa., most of the rain occurred after that hour.

Where the total storm rainfall is known to have exceeded 12 inches, and many times for lesser amounts, people complained of the following:

1. Cellars being filled or partly filled with water—far away from and above streams—where flood water inflow either had never occurred before or had never exceeded the cellars' drainage capacities.
2. Roofs leaking badly that had never leaked before.
3. Water coming out the stovepipe holes in the chimneys.

Generally there was wind at the start of the storm and sometimes at the end, but usually very little or no wind during the storm. Wind directions were erratic; for example, at two different locations they were in exactly opposite directions within a distance of 1 mile. Quite often the wind seemed to be up or down a hollow, irrespective of the direction of cloud travel. There were many reports of thunderstorms coming first from one direction, then returning from another; of storms that traveled perpendicular to the path of previous storms; storms that seemed to mill or circle; and of storms that seemed to come together. As far as lightning was concerned, there was uniform testimony that a much higher percentage of lightning strokes occurred between clouds rather than between cloud and ground as compared with ordinary storms.

In the Austin, Pa., region, many people said that the rain did not come down in drops, and they had the visual impression, at least, that the rain came down in streams which they likened to strings and ropes. This phenomenon appears to be a characteristic of intense cloudburst storms as described in the accounts of previous storms given later. Although it could have been an optical illusion, it seems more likely to have been an actual occurrence. Also, in that region, there were people who had not been able to reach shelter and were afraid they would drown during the downpour through lack of oxygen. One man expressed the effect by saying it was just like breaking water after a long dive, lungs bursting, with water pouring down over his head.

The observer who recorded more than 30.8 inches of rain in 4¾ hours stated that it seemed to fall at a tremendous rate, but quite uniformly, for the greater part of the time. Also, the drops seemed to be exceptionally large and very close together. From her statement and the record of total rainfall at that point, it may be assumed that the rainfall at no time exceeded a rate of about 10 inches per hour and that there was no "streaming" for that rate and for that size of drop.

On the other hand, there were regions, particularly around Austin, where the rainfall rate for very short periods ranged from 15 to nearly 40 inches per hour. For such high rates of rainfall it would appear that the drops would be so close together they would tend to coalesce into streams and sheets as a result of mutual mass attraction. If streaming actually occurs at extremely high rainfall rates, then the question arises as to its effect on rainfall catch and the deductions therefrom. It would seem that such streams of water, although moving about, might result in the catch at any given point being materially different from one only a few feet away.

PREVIOUS EXTRAORDINARY STORMS

STORM OF JULY 26, 1819

Storms of the intensity of the one that occurred in July 1942 in Pennsylvania are extremely rare. That this storm was not unique, however, is shown by the following quotations from reports of apparently similar storms that have occurred in the past. The earliest record is the account by Dwight (1822) of the storm of July 26, 1819, at Catskill, N. Y., from which the following quotations are taken:

About half past five [p. m.] another dense and black cloud accompanied by a fresh wind arose from the southwest. * * * About the same time, or immediately after, a very thick and dark cloud rose up rapidly from the northeast. They met immediately over the town. At this instant a powerful rain commenced. The air soon became so obscure, that trees and buildings, and other large objects, could not be discerned at the distance of a few yards. The obscurity did not appear to arise from a fog, of the usual kind; but from the abundance of the rain and the low descent of the clouds, which appeared to rest upon the ground or to hang a little above it. After the clouds met, the wind became very variable, and blew for short periods from almost every point of the compass. At times it came with so much force as to drive the rain in a very unusual manner, through the crevices in doors and windows, and the roofs of dwelling houses. Many houses which had never before been known to leak at this time admitted great quantities of water. In several instances the wind suddenly abated, and a calm of a few minutes ensued. The lightning and thunder were unusually severe. The thunder frequently resembled a violent crash, and was as sudden and of as short continuance as the sound occasioned by the firing of a cannon, or by the snapping of a whip. The rain descended at times in very large drops; and at times in streams, and sheets.

During the storm four or five intermissions each of about 8 or 10 minutes occurred, also in the rain. In each instance it excited a hope that the storm was approaching its termination, but this hope was soon dissipated by the appearance of fresh torrents. The extreme violence of the rain terminated before half past six o'clock, though it continued to descend with considerable briskness until about nine; and moderately until about ten, and it did not entirely cease until about eleven. The quantity which fell from the commencement to the termination of the storm is difficult to ascertain with exactness. It seems probably from the facts hereinafter mentioned, that it exceeded 15 inches on a level. Some remarkable phenomena occurred in various places.

At the Point, just before the clouds met, two sloops were observed sailing before the wind, under a full press of sail, one sailing rapidly up stream, and the other more rapidly down. They met near the north end of the island, when the northeast wind prevailed.

Further on, Dwight gives the account of

a gentleman who * * * observed the phenomena of the storm with more exactness than any other person with whom I have conversed. His account is as follows: * * * "The descent of rain was most copius between a quarter before 6 o'clock, and a quarter after 6. In this half hour he estimates the descent of water to have exceeded 12 inches upon a level."

Dwight continues:

The whole quantity of water which fell at the Point, is estimated to have exceeded 15 inches upon a level. * * * Should we then estimate the whole tract, on which the rain descended with peculiar violence, and in quantities never before known, in this section of the country, since its first settlement at 80 square miles, we probably should not be very wide from the truth; and on this tract, I am persuaded that the water fell full 15 inches upon a level. On a considerable part of the tract there is reason to believe that the quantity exceeded 18 inches."

STORM OF AUGUST 5, 1843

Another storm of similar magnitude occurred August 5, 1843, in Delaware County, Pa. That storm was the subject of a report by a special committee of the Delaware County Institute of Science (1910 pp. 7–18), from which the following descriptions are taken:

No general description of the *heavy rain* which * * * caused the inundation, will exactly apply to any two neighborhoods—much less to the whole extent of the county. In the time of its commencement and termination—in the quantity of rain which fell—in the violence and direction of the wind, there was a remarkable want of correspondence between different parts of the county. It may be observed, however, that comparatively little rain fell along its southern and southeastern borders. * * *

In those sections of the county where its greatest violence was expended, the character of the storm more nearly accorded with that of a tropical hurricane, than with anything which appertained to this region of country. The clouds wore an unusually dark and lowering appearance, of which the whole atmosphere appeared in some degree to partake, which circumstance, no doubt, gave that peculiarly vivid appearance to the incessant flashes of lightning which was observed by every one. The peals of thunder were loud and almost continuous. The clouds appeared to approach from different directions, and to concentrate at a point not very distant from the zenith of the beholder. In many places there was but very little wind, the rain appearing to fall in nearly perpendicular streams; at other places it blew a stiff breeze, first from the east or northeast; and suddenly shifting to the southwest; while at a few points it blew in sudden gusts with great violence, accompanied with whirlwinds, which twisted off and prostrated large trees, and swept every thing before it. * * *

As observed by Joel Evans, at his residence in Springfield * * * the heaviest rain fell between five and six o'clock. The direction of the wind during the day, until the heavy fall of rain commenced, being generally from the S. E., though at some periods throughout the day it was variable, shifting from E. S. E., to S. S. E. The atmosphere at a considerable height above the earth's surface, appeared to be in a very unsettled and agitated state, from 12 o'clock, M. to 5 o'clock P. M., which was indicated by contrary and opposite currents of wind prevailing, carrying with them light clouds, which he observed several times in the afternoon; he being induced to go out to make observations on the state of the weather, from its very unusual and threatening appearance. During the fall of the very heavy rain, and as nearly as he can recollect, about half past five o'clock, the wind suddenly commenced blowing with great force from the east, which soon increased to a violent gale, prostrating fences, and some trees in its course. Its velocity was such that with the immense quantity of water falling (which it carried with it in one continuous sheet, as it were), rendered it impossible to see a distance of more than fifty yards. After blowing in this way for fifteen or twenty minutes, the wind almost as suddenly veered to S. W. (nearly the opposite point of the compass), and for a short time (perhaps not more than from five to ten minutes) blew with equal violence, leveling in that direction on his farm, a number of panels of fence, and one or two apple trees. The wind subsided about six o'clock or very soon after, and was succeeded by a calm. * * *

As observed by Professor John F. Frazer * * * in the upper end of Chester township, the heavy rain commenced late in the afternoon, about half past five or six o'clock, and continued perhaps half an hour or more. During the rain there was no wind, the streams (for it fell more in streams than in drops) were, apparently quite vertical. Professor F. was unprepared to measure the quantity of rain which fell, but it exceeded anything which he had ever witnessed. * * *

Mr. Joseph Edwards, who resides in Middletown township, within half a mile of the center of the county, observed a phenomenon during the last heavy shower of rain, which does not appear to have been noticed in any other part of the county. He remarks that during the last shower which continued, say twenty minutes, and in which there fell a greater quantity of water than during any equal space of time during the afternoon—unlike any other shower he had witnessed—the distant woods and other objects were not obscured in any sensible degree by the falling rain. This extraordinary appearance was a subject of remark by all present, and created considerable surprise. At the time there was an impending mass of dense clouds, without any apparent motion in the air. This particular shower approached from the south, unaccompanied by wind.

STORM OF JULY 5, 1939

More recently a similar storm occurred July 5, 1939, in eastern Kentucky, which has been described in a special report (Schrader, 1945):

The characteristics of the storm are well defined because its unusual aspects attracted the attention of many people. Although generally considered as a single storm, it actually consisted of a series of thunderstorms accompanied by almost continuous lightning and thunder, which were noticeable for a considerable time before the storm. The lightning was described as continuous lightning and sheet lightning and by several observers as the most persistent they had ever witnessed. The thunder preceding the storm was a low rumble and at the height of the storm is reported to have shaken the earth. The lightning was so continuous that, despite the fact that the storm occurred at night in most localities, the cloud formations could be viewed without difficulty in what is described as a purplish hue. Although in a turbulent state, these cloud formations had a distinct outline and could be seen approaching from the north at a rapid rate.

On the edge of the storm area winds reached gale proportions such that buildings were damaged and in several places were entirely destroyed. Reports indicate that there was relatively little wind outside of the storm area, and observers at the storm centers reported that little or no wind accompanied the rainfall. According to information obtained from weather stations, the prevailing direction of the wind was to the southwest on the northeast side of the storm area, to the northeast on the southwest side, and variable on the northwest and southeast sides. * * *

The rates of precipitation produced by this storm were extremely high and exceeded any known to have occurred previously in the region affected. The rainfall is described by observers as having been so intense that it was impossible to see objects only a few feet away. People caught out in the storm were compelled to stop before reaching shelter because of the lack of visibility. Numerous accounts were given of runoff that covered the sloping ground in sheets. Although the rain did not fall at a continuous high rate throughout the storm, high rates apparently were maintained in some localities for periods as long as an hour. These periods of sustained intensity occurred near the end of the storm. During such periods the rainfall was alternately in the form of large drops and of continuous sheets of water similar to those coming from the eaves of a roof.

The remarkable similarity in the descriptions of each of these storms is most striking. It indicates that they were all of the same general type.

COLLECTION OF RAINFALL RECORDS

Radio and newspaper reports of the storm of July 17–18, 1942, were exceedingly interesting. Accordingly, as rapidly as they became available, the official records of rainfall were studied. Although those records indicated rainfalls of as much as 8 inches, it did not appear reasonable that even that considerable amount of rain would have sufficed to cause the flood and resulting damage, particularly as it followed a drought. Therefore, the writer asked for and received permission from the West Penn Power Co. to make a preliminary investigation of the rainfalls that had occurred. A field trip was made August 5 to 9, inclusive, and rainfall records were obtained from about 50 amateurs. Among these was one reliable overflow record showing more than 30.8 inches of rainfall. That record, along with many other overflows and three total-storm records of 17.5, 18.5, and 19.0 inches, respectively, indicated that the storm had been one of major intensity and that its rainfall warranted a thorough investigation. On another trip to the storm district August 15 and 16 the writer obtained 23 more records.

Meanwhile in Pittsburgh the original findings were called to the attention of the Weather Bureau, Geological Survey, and Corps of Engineers. It was suggested that interested agencies should meet and plan a thorough field and office rainfall-investigation program that would avoid duplication of work. Also, that other hydrologic phases of the storm and storm damage, already under investigation by one or more of these Federal bureaus, be discussed at the meeting and coordinated with the rainfall program. This suggestion met with approval.

A meeting was held on August 17 in Pittsburgh with representatives of the interested agencies present. Those attending the meeting came to unanimous conclusions as follows:

1. All the subsequent runoff determinations should be made by the Geological Survey, but a close liaison should be established between the Survey and the collectors of precipitation data so that good and sufficient field data on rainfall and runoff would become available for correlation studies.

2. All available miscellaneous precipitation records should be collected by the Corps of Engineers and the West Penn Power Co. through a cooperative and systematic coverage of the storm area.

3. All rainfall data should be pooled and finally turned over to the Weather Bureau.

The Corps of Engineers and the West Penn Power Co. thoroughly searched the main storm area for rainfall records, except for a small region west of Hornell, N. Y., which was only partly covered owing to bad winter weather. The rainfall records obtained through this further investigation, with regular and miscellaneous records previously obtained, resulted in nearly 500 records of precipitation being made available for the storm study.

It is worth while to point out to those who may sometime be interested in collecting miscellaneous rainfall records that the country, rather than the city, is the place to obtain records. This is because the farmer often has empty containers set out in the open, whereas the city inhabitant rarely does. In northern Pennsylvania a record was probably obtained for every 12 or 15 contacts in the country, whereas there might not have been obtained 1 in 200 or 300 contacts in the towns and cities.

It was found necessary to visit every farmer in the storm area, inasmuch as apparently one farmer rarely knew of a record that his neighbor had. In fact, often within a family only one person might know of the record. This was due not to reticence, but to lack of importance of the record to the observer.

At first, no data were obtained except as to the actual rainfall, but later a form was gradually evolved which brought in much pertinent information, such as location of container, direction of wind and clouds, presence or absence of hail and sheet runoff, beginning and ending times for rain periods, time any adjacent stream was highest, etc. A copy of the questionnaire in its final form is shown on figure 32. They were filled out through personal interviews.

The more than 400 records of rainfall thus obtained were used to draw the isohyetal map contained in this report. If the precipitation had not been so great—causing overflows—and the distribution had been somewhat better, it would have been an excellent isohyetal map.

STORM OF JULY 17-18, 1942, IN NORTHERN PENNSYLVANIA

1. Hour and date this questionnaire was made out?

2. Auto mileage and on what stream, or distance and direction to a map location?

3. Did you have out any empty bucket, tub, washboiler, milk can, jar, oil drum, or watering tank during the storm? If so, what was it?

4. Size of container?

5. Location of container and distance from nearest obstacle?

6. Depth of water in container?

7. Was this depth of water for all of storm or only part? If only part, what part?

8. Did container overflow?

9. If it overflowed, how much additional rain is estimated to have fallen?

10. Approximate time that heavy rain began Friday or Friday night and ended Saturday. Also times for any periods that rain was stopped or nearly so?

11. Direction of both storm movement (clouds) and ground wind, if any, at beginning, during, and at end of storm.

12. Was there any hail before or during the storm, and if so when?

13. Time and length of period minor streams were highest on Saturday?

14. Did side-hill streams carry stones, and if so when?

15. Describe electrical features of storm.

16. Describe effects of heavy rainfall on roofs, cellars, chimneys, etc.

17. What was the appearance of the water flowing down the hillsides?

18. Name and Post Office address of person furnishing data?

19. Remarks, estimated accuracy of observations, reliability of observer, etc. Use back of sheet if necessary.

20. Depth of rainfall.

FIGURE 32.—Questionnaire used for recording miscellaneous rainfall information.

As it is, the map should represent fairly well the rainfall centers and isohyetals. There undoubtedly are areas of low rainfall not found, however, because they are in a large and practically uninhabited forest reserve in one section of the storm area. A preliminary isohyetal map made in the offices of the West Penn Power Co. involved months of work in drawing and redrawing isohyetals and in reviewing partial records and other data. The preliminary map was used in the drawing of the map prepared by the United States Weather Bureau.

FLOOD WAVES

Where the total precipitation was greatest over considerable areas, the intense rains started about 8 a. m. Saturday. They fell on ground completely saturated by 4 inches or more of rain that had fallen the previous night. Not only was the ground saturated, but the streams were very high and in some cases far out of their banks. With such high stages, the streams were overwhelmed by the sudden inrush of water from the tremendous Saturday forenoon rain. As a consequence, flood waves from 1 to 3 feet in height formed on top of the previous flood waters of many streams. These waves swept the full length of streams having drainage areas of less than 100 square miles.

Near Port Allegany and north therefrom to the New York State line, a single rolling wave about 1 to 3 feet high probably occurred in the fairly large streams: Sartwell, Lillibridge, Twomile, Annin, and Newell Creeks, Barden Brook, and Rock, McCrea, Kings, and Bells Runs. Furthermore, for most of these streams the maximum stage set by the wave was at least maintained, and in many cases increased somewhat, during the period of heavy rain.

Where the total rainfall was the greatest in the Port Allegany region, the larger streams seemed to remain near the maximum stage for hours. In some cases, even the outpouring of the small hillside gulches seemed to be at a tremendous but fairly steady rate. On the other hand, near the edges of the heaviest rainfall areas, where there were definite intervals between heavy downpours, there were also definite recessions between flood peaks for small streams such as Taylor Brook—a tributary of Bells Run—and Champion Hollow—a tributary of Kings Run.

Many streams in other sections also had flood waves: Freeman Run, Dexter Run, East Branch Clarion River, Straight Creek, South Fork Straight Creek, and upper Portage Creek. There probably were other streams on which the flood waves were unrecorded. Particularly is this true of smaller streams in the State Forest which flow into First Fork Sinnemahoning Creek and the headwaters of Sinnemahoning Portage. On East Branch Clarion River at Glenn Hazel, where the drainage area is about 80 square miles, there were three rolling waves, each apparently about 1½ feet high and about 100 yards apart. The waves on this particular stream were a result of intense rains Saturday afternoon.

DEBRIS MOVEMENTS, BLOW-OUTS AND SLIDES

The tremendous rainfalls concentrated into a short period resulted in certain physical and geologic phenomena. For example, all steep-sloped streams did a great deal of eroding and carried along large quantities of detritus. The streams ranged from those in small gulches, with drainage areas less than 0.01 square mile, to mountain rivers, such as First Fork Sinnemahoning Creek, draining several hundred square miles—Allegheny River and some of its tributaries in their middle and lower reaches, such as Oswayo, Potato, and Portage Creeks, are not considered steep-sloped streams. Tremendous quantities of rock and gravel poured out from small gulches and streams with a few square miles of drainage area. From the small gulches these outpourings lodged on the alluvial cone at the mouth of each gulch, whereas along the small streams most of the material was carried to a point near their mouths where backwater from the main stream caused the material to deposit. The largest deposits noted were at the mouths of streams tributary to First Fork Sinnemahoning Creek near Wharton.

In the regions of exceptionally heavy rainfall around Port Allegany, particularly heavy erosion occurred in small side gulches where there was less than a square mile of drainage area. As a consequence, there were tremendous outflows of rock in proportion to the drainage area, but in total volume, outflows could not compare with those from the small streams in First Fork Sinnemahoning Creek district where the slopes and drainage areas were greater.

The erosion and rock movement caused by the flood of July 18, 1942, substantiates the belief that, instead of long time attrition, infrequent but tremendous floods are the principal eroding agents where steep topography, bedrock, and rock detritus are involved. During this flood, peak flows of 100 to 500 second-feet plunged down small gulches where there were irregular slopes of 10 percent or more. Vivid evidence that great forces had been at work was found in small gulches near Port Allegany. There, apparently great quantities of actual bedrock had been ripped out and carried down to the alluvial cones and deposited (fig. 33).

The same process probably occurred on a smaller scale in the larger streams. For example, on First Fork Sinnemahoning Creek there was considerable evidence that during the flood all the channel material down to bedrock had been in motion and in many places the channel itself had shifted. This is the usual process whereby streams erode their channel through rock. Many streams of relatively flat gradient often are not considered as lowering their channels because floods of sufficient magnitude to do the cutting are so extremely rare. That tremendous but infrequent floods are the princi-

FIGURE 33.—Upstream end of debris cone on Taylor farm, formed during flood. Note that stream channel is dry. Photographed August 26, 1942.

pal land-leveling agent is supported by the appearance of the old alluvial cones at the mouth of small gulches.

Inspection of the trenches cut in those old cones by the flood of July 18, 1942, clearly showed that they consisted mainly of great masses of broken-up bedrock, embeded in soil, that could have been brought down only by tremendous floods of the past. However, from the first settlement of that territory until July 18, 1942, the rock detritus cones were covered with grass and soil and a little rivulet coursed across each one in rainy weather; hence they gave no hint to the settler as to their underlying significance. In fact, they blended in with the general topography to such a degree that their true nature would have been apparent only to the trained eye of a geologist. Of course, when trails or roads were built along the valleys of the main streams, those early highways went up and over the alluvial cones. Naturally, the settlers built their homes on the cones in preference to the hillsides between the gulches, and no doubt they congratualted themselves that they had also obtained excellent protection from floods by their increased elevation above the main creek into which the gulches debouched. This sense of security was rudely shaken by the tremendous water and rock outflows from the gulches during the 1942 flood. Fortunately, so far as known, no loss of life resulted from this rather dangerous location for homes, although narrow escapes were common.

An especially interesting effect of the torrential rainfalls was an exceedingly great number of what, for want of a better expression, have been termed "blow-outs." Where the rainfall exceeded 10 inches, these blow-outs, or large holes, were found on most of the hillsides. The soil from the blow-out holes, mostly in a semiliquid form, had run and slid down to the bottom of the hills but had scarcely disturbed the ground surface or anything thereon. When the first holes were seen, it was thought that perhaps in each case the excessive surface runoff had started a small hole and rapidly enlarged it to the size noted. However, this thought was quickly discarded owing to the fact that there was little or no erosion either at the upper or lower side of the holes (fig. 34), and to the fact that normally they occurred in a series and all in one plane. Examination of individual holes indicated

FIGURE 34.—Blow-out hole near Port Allegany. Note absence of erosion around rim.

that they had been caused by flows of water from within the hillsides, a method of formation confirmed by interrogation of persons who had seen the blow-outs burst forth.

The holes occurred where zones of shattered rock would have formed outcrops on hillsides but for the shallow soil mantle. It is thought that great pressures were built up at this point by the large quantities of water that reached the zone of shattered rock by infiltration from the extremely heavy rainfall on higher ground. The dense ground surface, usually sod-covered, acted as a dam which blew out at the weakest spots when enough pressure developed. Each of these blow-outs acted as a safety valve to protect a considerable length of ground surface in front of the shattered rock layer on either side of that hole. Thus, a series of perhaps only a dozen large holes would occur along a mile or two of hillside. Manifestly, each line of holes clearly defined the location of a shattered rock stratum.

In addition to the blow-outs, there were many true slips and slides. although even those may very well have been due to water from shattered rock strata wetting and lubricating the slipped material. Some of these slides plunged down through forested areas, carrying everything before them. One swept from near the top of a hill to its bottom in Kettle Creek, a distance of probably more than a mile. Although small at the top, the slide appeared from a distance to be nearly a quarter of a mile wide at the bottom. Some of the slides, with the trees upright, moved for hundreds of feet. Some of the trees continued to grow in the new location as though nothing had happened.

METEOROLOGY OF THE STORM

DESCRIPTION

The following description is taken from the analysis contained in the Hydrologic Bulletin Supplement (U. S. Weather Bureau, 1944), omitting all references to the detailed charts and diagram used in that analysis as they are beyond the scope of this report.

The phenomenally heavy rains that fell over Elk, Cameron, McKean, and Potter Counties, Pa., and adjoining sections of New York on July 17–18, 1942, resulted from the recurrent thunderstorm activity associated with an atmospheric flow pattern that has been named Type V in Hydrometeorological Report No. 2: "Maximum possible precipitation over the Ohio River basin above Pittsburgh, Pa." Notable among heavy storms of this type are the Newcomerstown, Ohio, storm of August 6–7, 1935 (Showalter, 1941), and the eastern Kentucky storm of July 4–5, 1939 (Schrader, 1945). The July 1942 storm is classed as a 24-hour storm although durations were generally less than 24 hours at any one place. Nevertheless, the point-rainfall measurements of July 17–18, 1942, exceeded by several hundred percent the known 24-hour amounts of May 30–31, 1889 (the Johnstown flood). They also exceeded the all-time Pennsylvania 24-hour record of 16.0 inches at Concord Township, Delaware County, on August 5, 1843 (see p. 148), the United States 12-hour record of 24.0 inches at Ewan, N. J., on September 1, 1940 (see p. 151), and approached the United States 24-hour record of 38.2 inches at Thrall, Tex., on September 9–10, 1921.[2]

It cannot be said, however, that amounts of rainfall like those of July 17–18, 1942, have never occurred before in the United States, even within a narrowly but reasonably defined period of record. The only certainty is that those amounts are among the highest for such durations that have been measured. It is notable, also, that this storm was one in an unusually extended series of excessive rainfalls that occurred in Pennsylvania between early in March and the latter part of August 1942.

Meteorological conditions near the earth's surface on July 17–18 were characterized by a warm anticyclone centered over the Southeastern States and the adjoining ocean. The flood area throughout was south of a quasi-stationary front extending eastward from Minnesota through the Great Lakes and then southward through eastern New York and New Jersey. The frontal system advanced slowly northeastward during the 18th.

The warm anticyclonic circulation extended above 15,000 feet. Around the western and northern periphery of the warm anticyclone there was the usual flow of maritime tropical air. The moist air stream was continuous from the Gulf of Mexico to Buffalo, N. Y. Over Buffalo on July 18 the air was unusually warm and moist even for July 1942, which was not a dry month. Except in the surface layer, where passage over the Great Lakes had induced an inversion, the air showed conditional and convective instability up to 15,000 feet and neutral equilibrium above that level. The precipitable water content up to about 16,000 feet was computed to be 1.95 inches. This is close to the maximum values of long record in the vicinity—for example, 2.13 inches at Cleveland. A concurrent sounding of the upper air at Sault Sainte Marie showed unusual warmth, moisture, and instability extending even that far north.

Soundings of the upper air in the Mississippi Valley region indicated decreasing pressure gradient with altitude and smooth anticyclonic flow without much change in curvature. Over the New York-Pennsylvania region, however, there was an increasing pressure gradient with altitude and a rapid change of curvature in the flow from anticyclonic to cyclonic. This was true at the 5,000-, 10,000-, and 15,000-foot levels, indicating a deep zone of convergence. An

[2] These United States 12-hour and 24-hour records supersede those previously published.

area of saturation coincident with the heavy rainfall zone also was apparent on one of the upper air charts prepared for this analysis.

The persistence of the zone of convergence over the region can be considered the major cause of the heavy rain. Other factors, which of themselves were not entirely effective impulses but which must be given consideration as adding to the effect, were the orographic lift of the unstable air mass from about the 600-foot elevation of Lake Erie to the more than 2,000-foot elevations of the mountain ridges of Pennsylvania and New York and the regenerating influence of the locally formed dense, cold air mass in the zone of heavy rain. The latter effect is an unusual illustration of how a thunderstorm zone maintains its own existence.

In general, the areas of lowest temperature coincided with the heavy-rain zone. Active cooling within the rain zone can be attributed to a combination of causes other than reflection of solar radiation from cloud tops. There was cooling of the air by conduction from cold rain and by melting of hail. Airplane pilots' reports during the period indicated cloud elevations well above the freezing level. In addition, however, the air was cooled by evaporation of rain. This is thought to be the dominant cause of cooling. As a result of such evaporation, the surface air would cool to its wet-bulb temperature, but the temperatures observed in the rain zone were as low as 63° F., a temperature lower than the wet-bulb temperature of any surface air that could have moved into the region horizontally. The indications are that in a process of such convective intensity as the rainfall amounts imply there was a large-scale exchange of air between the surface and aloft. Examination of the radiosondes from Detroit, Mich., and Huntington, W. Va., both representative of some of the air undergoing convergence over the area, shows wet-bulb temperatures aloft such as to produce, by descent of air through heavy rainfall, surface temperatures as low as 63° F.

The cooling thus accomplished produced a mass of cold, dense air at the surface. A slight ridge of high pressure was associated with the cold mass probably as a result of both the denser air and downward accelerations which also contribute to a pressure rise. The demarcation between cold and warm air became, in effect, a frontal zone, the cold air spreading laterally to lift the warm air and also acting as a barrier which the warm air overran, renewing and spreading thunderstorm activity by both methods.

The frontal zone became pronounced at about sunset of July 17, when heavy thunderstorms began over Cohocton, N. Y., and then spread fanwise, reaching Ridgway, Pa., between 2 and 3 a. m., July 18. A careful study of the data available shows that, while the individual thunderstorms moved to the southeast in harmony with the northwest winds aloft, the thunderstorm area was propagated towards the southwest also. Such a propagation—to the right across the mean upper-air current—has been noted in previous thunderstorm studies and has been attributed to the hydrodynamical principle that cyclonic vortices move (or propagate) to the right across the current in which they are imbedded.

Between 3 and 6 a. m. July 18 the major extension of the cold-air mass seemed to be to the northeast. The heavy-rain zone spread with it, diminishing in the southwest. After 6 a. m. the edge of the cold air, acting as a front, moved to the southwest again, bringing a second period of heavy rain to the regions within its path.

Over the area of heavy rainfall the total precipitation resulted from a succession of three downpours coinciding with the oscillations of the cold air mass, the first and last outbursts being the most intense. The greatest amounts were centered between Emporium, Coudersport, Shinglehouse, and Smethport—unfortunately a region containing no official rain gages. The isohyetal map (pl. 2) based largely on miscellaneous records, shows the effect of the persistent, mainly northwesterly, winds in elongating the isohyetal pattern in a southeastward direction. Added to this effect was the southwestward-propagating effect plus the spreading of the cold, dense air-mass formed at the surface. It should be noted that equally plausible interpretations of the miscellaneous rainfall reports could lead to different isohyetal values near the storm center. Material differences in resulting duration-depth data would become negligible for the larger areas but any duration-depth computations for areas under 100 square miles should be classed as doubtful.

RAINFALL RECORDS

All available rainfall records for this storm, other than those few that were rejected because their accuracy was too uncertain, are given in tables 1 and 2. Table 1 contains the records for regular precipitation stations and is based on the Weather Bureau report (1944). The data have also been plotted in figure 35 to show the storm periods at the different locations and their timing. The data have been revised where necessary to correct known errors. The geographical positions are as accurate as could be determined, but they may still be subject to slight error for a few stations.

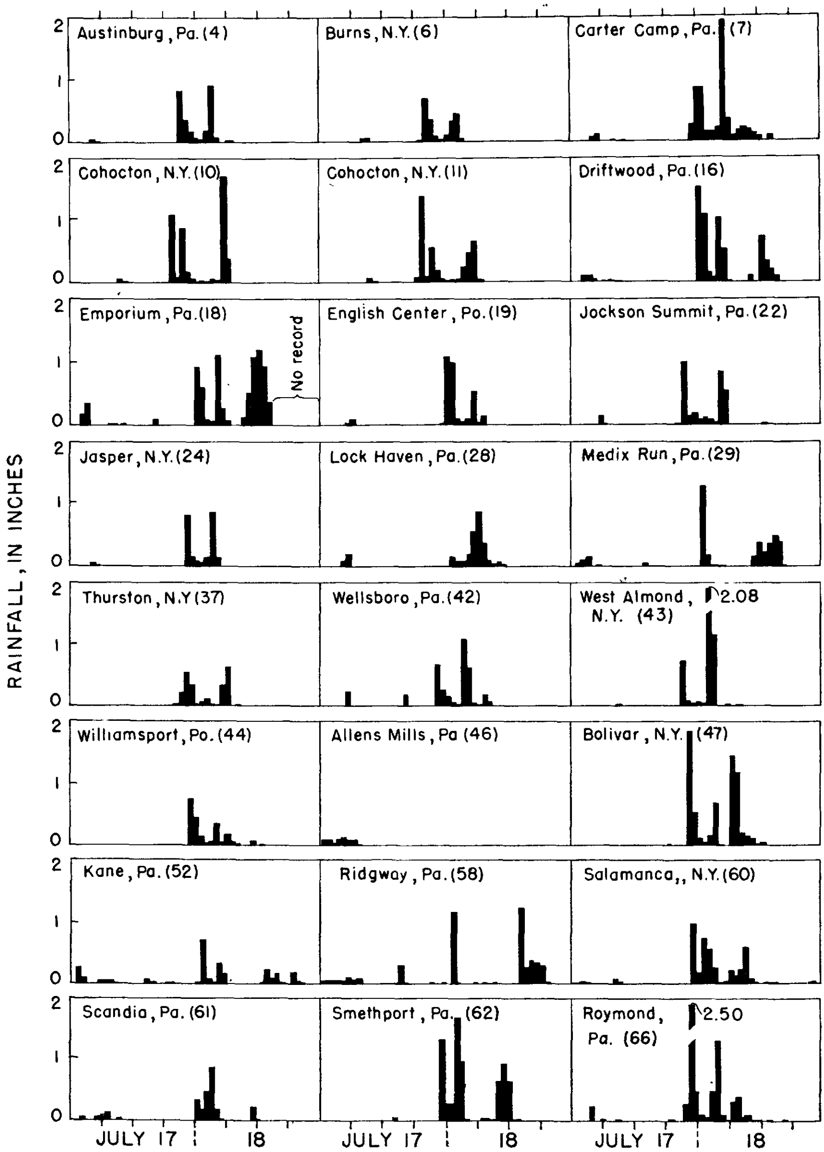

FIGURE 35.—Distribution of rainfall at recording-gage stations.

TABLE 1.—*Rainfall at precipitation stations, July 17–19, 1942*

[R, recording gage; amount shown is for 24-hour period ending at midnight. Other gages read in the morning except as noted. T, Trace. Records furnished as follows: C of E. Corps of Engineers; SCS, Soil Conservation Service; F-S FFS, Federal-State flood forecasting service of Pennsylvania; all others, Weather Bureau]

No. on pl. 2	Station	County	Latitude (deg., min.)	Longitude (deg., min.)	Elevation	July 17	July 18	July 19	Storm total [1]
	Susquehanna River drainage basin								
1	Addison, N. Y	Steuben	42 06	77 14	990	0.10	2.50	1.05	3.55
2	Alfred, N. Y	Allegany	42 16	77 47	1,760	T	3.35	0.	3.35
3	Ansonia, Pa	Tioga	41 45	77 26	1,136	.20	2.44	.42	2.86
4	Austinburg, Pa. (C of E, T-3) R	do	42 00	77 32	1,790	1.35	1.26	.01	2.61
5	Bradford, N. Y. (C of E, H-26)	Steuben	42 22	77 08	1,430	0	1.67	0	1.67
6	Burns, N. Y. (C of E, N-19) R	Allegany	42 25	77 44	1,620	1.19	.80	.80	1.99
7	Carter Camp, Pa. (F-S FFS) R	Potter	41 38	77 43		.39	4.85	0	5.24
8	Cedar Run, Pa	Lycoming	41 31	77 27	800	.38	3.20	.12	3.32
9	Clearfield, Pa	Clearfield	41 01	78 27	1,260	.28	.63	.55	1.18
10	Cohocton, N. Y. (SCS, R-1) R	Steuben	42 30	77 29	1,570	2.29	2.23	.07	4.52
11	Cohocton, N. Y. (SCS-10) R	do	42 32	77 27	1,900	2.35	1.47	.13	3.82
12	Cohocton, N. Y. (SCS, S-43)	do	42 30	77 31	1,520	0	2.69	0	2.69
13	Cohocton, N. Y. (SCS, S-60)	do	42 28	77 30	1,460	0	2.83	.05	2.88
14	Corning, N. Y	do	42 08	77 03	925	T	1.58	.07	1.65
15	Covington, Pa	Tioga	41 50	77 05	1,193	.80	1.45	0	2.25
16	Driftwood, Pa. (F-S FFS) R	Cameron	41 20	78 08	820	.29	5.59	.17	5.88
17	Du Bois, Pa. (near) [2]	Clearfield	41 06	78 38	1,670	.68	.27	.26	.27
18	{Emporium, Pa	Cameron	41 30	78 14	1,033	.59	3.44	4.23+	7.67+
	{Emporium, Pa. (Z) (F-S FFS) R	do	41 30	78 14	1,033	.67	7.43	(3)	[3] 8.10
19	English Center, Pa. (F-S FFS) R	Lycoming	41 26	77 17	881	.15	3.08	0	3.23
20	Galeton, Pa.[2]	Potter	41 44	77 39	1,330	.46	3.78	0	3.78
21	Haskinville, N. Y	Steuben	42 25	77 34	1,620	0	1.88	.05	1.93
22	Jackson Summit, Pa. (C of E, G-4) R	Tioga	41 57	77 01	1,700	1.54	1.74	0	3.28
23	Jasper, N. Y. (C of E, N-9) [2]	Steuben	42 09	77 33	1,610	0	1.82	0	1.82
24	Jasper, N. Y. (C of E, N-8) R	do	42 09	77 35	2,160	.97	1.20	0	2.17
25	Karthaus, Pa	Clearfield	41 07	78 07	860	.40	.95	.83	1.78
26	Lawrenceville, Pa.[2]	Tioga	42 00	77 08	996	.12	3.39	0	3.39
27	Lock Haven, Pa	Clinton	41 08	77 26	557	.30	1.82	.29	2.11
28	Lock Haven, Pa. (No. 2) (F-S FFS) R	do	41 07	77 27	600	.28	2.40	0	2.68
29	Medix Run, Pa. (F-S FFS) R	Elk	41 17	78 23		.42	3.37	.08	3.79

See footnotes at end of table.

971774—52——3

TABLE 1.—*Rainfall at precipitation stations, July 17–19, 1942*—Continued

No. on pl. 2	Station	County	Latitude (deg., min.)	Longitude (deg., min.)	Elevation	July 17	July 18	July 19	Storm total [1]
	Susquehanna River drainage basin—Continued								
30	Middlebury, Pa. (C of E, T-4)	Tioga	41 54	77 20	1,780	0	2.00	0.06	2.06
31	Prattsburg, N. Y. (C of E, H-25)	Steuben	42 33	77 17	1,580	0	2.12	0	2.12
32	Pump Station Tower, Pa	Lycoming	41 28	77 34	2,150	0	2.70	.30	3.00
33	Renovo, Pa	Clinton	41 19	77 46	645	.31	1.90	2.69	4.59
34	Richmond, Pa. (C of E, T-2)	Tioga	41 50	77 04	1,580	0	1.95	0	1.95
35	Smith-Elliot Tower, Pa	Jefferson	41 06	78 32	2,230	0	.62	1.08	1.70
36	Tamarack Tower, Pa	Clinton	41 24	77 51	2,220	.34	2.70	3.35	6.05
37	Thurston, N. Y. (C of E, H-2) R	Steuben	42 12	77 20	1,640	1.14	1.25	0	2.39
38	Troupsburg, N. Y. (C of E, N-16) [2]	do	42 04	77 30	1,945	0	2.26	0	2.26
39	Wallace, N. Y. (SCS, S-49)	do	42 26	77 28	1,600	0	1.89	0	1.89
40	Wayland, N. Y. (SCS, S-52) [2]	Livingston	42 35	77 30	1,600	0	2.92	0	2.92
41	Wellsboro, Pa	Tioga	41 45	77 17	1,319	.26	3.03	.25	3.28
42	Wellsboro, Pa. (C of E, T-1) R	do	41 45	77 15	1,600	1.32	2.13	0	3.45
43	{Williamsport, Pa	Lycoming	41 15	77 00	550	.20	1.83	.32	2.15
	{Williamsport, Pa. (Z) (F-S FFS) R	do	41 15	77 00	542	.74	1.42	0	2.16
	Allegheny River drainage basin								
44	Allegany State Park, N. Y. [2]	Cattaraugus	42 06	78 45	1,500	0.18	3.92	0.32	3.92
45	Allens Mills, Pa. (F-S FFS) R	Jefferson	41 12	78 54	1,590	.70	0	.16	.70
46	Bolivar, N. Y. (near) (F-S FFS) R	Allegany	42 03	78 11	1,560	2.32	4.02	.52	6.34
47	Bradford, Pa. (Reservoir No. 1) [2]	McKean	41 57	78 44	1,680	.17	4.70	.02	4.70
48	Coudersport, Pa. (No. 1) [4]	Potter	41 46	78 01	1,653	.26	8.22	0	8.22
49	Franklinville, N. Y. [4]	Cattaraugus	42 21	78 27	1,600	0	3.21	.28	3.21
50	Kane, Pa. (near, No. 3)	McKean	41 41	78 48	1,800	0	1.51	1.68	3.19
51	Kane, Pa. (near), (F-S FFS) R	Elk	41 36	78 44	1,680	.62	2.95	.15	3.57
52	Knapp Creek, N. Y. [5]	Cattaraugus	42 01	78 31	2,370	.54	6.32	.75	6.77
53	Little Valley, N. Y. [6]	do	42 15	78 48	1,575	.23	3.61	.07	3.61
54	Mount Alton Airport, Pa. [2]	McKean	41 48	78 38	2,155	0	4.64	0	4.64
55	Olean, N. Y	Cattaraugus	42 04	78 26	1,440	.17	6.00	1.70	7.70
56	Raymond, Pa. (F-S FFS) R	Potter	41 52	77 52	2,220	3.00	3.17	.04	6.17
57	Red House, N. Y	Cattaraugus	42 07	78 48	1,382	0	4.48	.98	5.46
58	{Ridgway, Pa	Elk	41 26	78 44	1,393	.38	1.68	2.62	4.68
	{Ridgway, Pa. (Z) (F-S FFS) R	do	41 26	78 44	1,371	.80	3.59	.31	4.39

59	Saint Mary's, Pa. (near)	do	41	24	78	33	1,664	0	1.70	3.63	5.33
60	Salamanca, N. Y. (F-S FFS) R	Cattaraugus	42	11	78	43	1,750	1.15	2.95	.35	4.10
61	Scandia, Pa. (near) [7] R	Warren	41	55	79	01	2,040	.28	2.21	.39	2.49
62	{Smethport, Pa	McKean	41	48	78	27	1,510	T	4.35	2.41	6.76
	{Smethport, Pa. (Z) (F-S FFS) R	do	41	48	78	27	1,510	1.34	5.35	.30	6.69
	Genesee River drainage basin										
63	Andover, N. Y.[2]	Allegany	42	10	77	47	1,670	0	4.10	0	4.10
64	Angelica, N. Y.[4]	do	42	18	78	01	1,420	.05	4.00	.11	4.00
65	Dansville, N. Y.[2]	Livingston	42	34	77	42	700	.13	2.44	0	2.44
66	Scio, N. Y.[2]	Allegany	42	10	77	59	1,440	.16	4.56	0	4.56
67	West Almond, N. Y. (C of E) R	do	42	18	77	53	1,960	.84	3.31	.11	4.15
68	Wiscoy, N. Y.[2]	do	42	30	78	05	1,200	.06	3.37	.10	3.37

[1] Does not include rainfall measured by recording gages July 19.
[2] Measured in the afternoon, 4 to 6 p. m.
[3] No record 3 p. m. July 18 to 6 a. m. July 20.
[4] Measured in the evening, 7 to 8 p. m.
[5] Observations at 1:30 and 7:30 by Airway observer; amount given is for 24 hours ending at 1:30 a. m.
[6] Measured at 2 p. m.
[7] Observations by L. D. Anderson.

Table 2 contains the rainfall records that J. E. Stewart, with the Corps of Engineers cooperating, was instrumental in collecting, as described on pages 71 to 74. They are arranged in order from north to south by major drainage basins. The geographical positions were checked thoroughly and should be as accurate as the maps available. Unfortunately, much of the area is sparsely settled, and topographic maps, based on surveys using modern methods and with the culture reasonably up to date, were available for only very small parts of the area. The quadrangle designation is given only for purposes of cross reference to the Weather Bureau report. For that reason the quadrangle designation for each record is the same in both reports, except for obvious typographical errors such as for No. 398, even though some designations were found to be incorrect. The rainfall measured represents the volume of the catch divided by the area of the opening through which it was caught. At many locations, the reporter or resident furnished information concerning more than one container. The rainfall caught in each one is listed separately in table 2. When several measurements were made using the same container, the rainfall measured each time is given in italics in table 2. The total amount measured in each of these containers is then given immediately below in roman type; the time period for the total is not given as it is merely the sum of the elapsed time for the separate measurements. Under Remarks is given information on the intensity of precipitation and factors that affected the accuracy of the catch.

Many of the records in table 2 were for parts of the storm period only. They are useful to some extent in that they show an amount by which the total precipitation is known to have been exceeded. They would be more useful if they could be used as a basis for estimating the total rainfall at that point. Several methods were investigated by Stewart, who finally adopted the relation shown in figure 36. The maximum rainfall for various intervals of time was picked off the charts for several representative recording gages. These amounts were expressed in percent of total storm rainfall and plotted in figure 36. The heavy line in that figure represents a weighted average that was used to estimate the storm rainfall from the partial records. The procedure was to assume that the amount of rainfall measured was the maximum that occurred during the storm for that length of time. The measured rainfall was divided by the percentage of the total rainfall occurring during the same length of time, obtained from the average curve in figure 36. More than 50 estimates of total rainfall given in table 2 were obtained by this method.

Records of rainfall of less than 1 hour duration were not used to estimate total rainfall. The estimates were interpreted as the minimum amount that could be expected for the total rainfall; the assumption that the measured rainfall was the maximum was considered

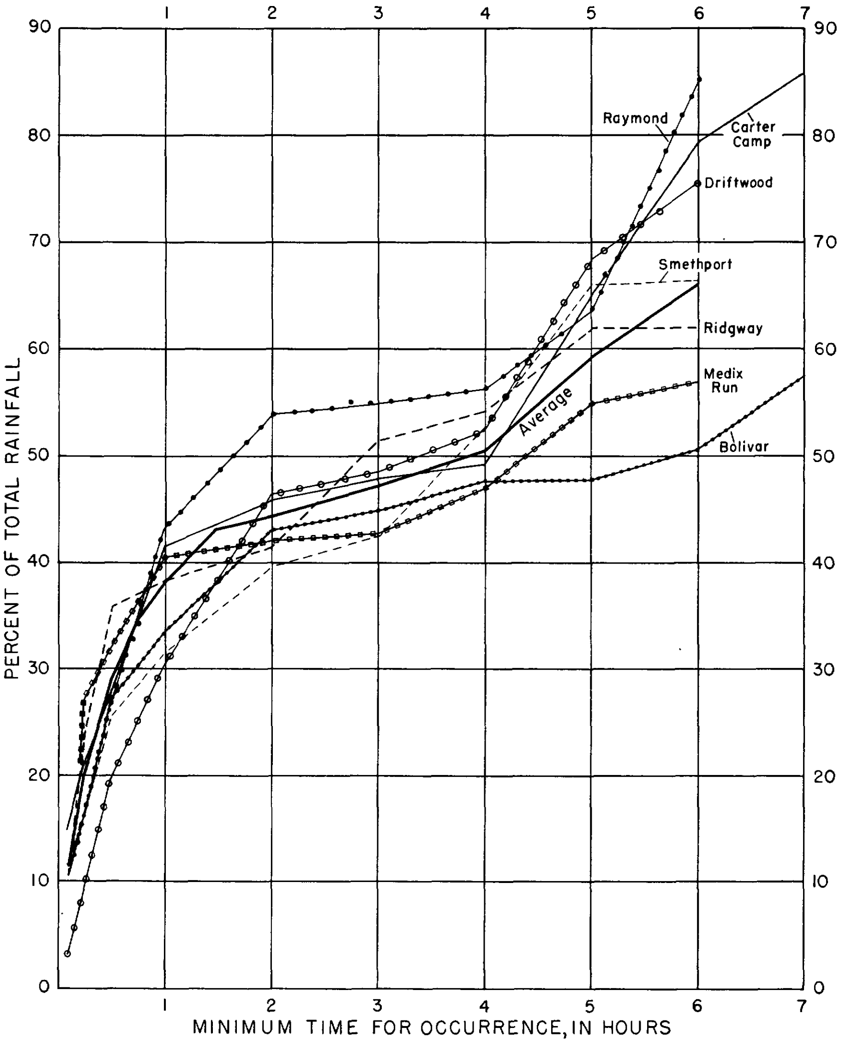

FIGURE 36.—Relation between percent of total rainfall and minimum time required for its occurrence.

unlikely in many instances. The method was tested by comparing the estimated total rainfall, computed from a partial catch and figure 36, with the observed total catch in the same container. The results were reasonably satisfactory. Admittedly the process is somewhat crude, but with the tests made and the relatively small variations shown by the observed data in figure 36, it was concluded that the estimates obtained were of sufficient accuracy to be given weight in drawing the isohyetal map (pl. 2).

Table 2 in manuscript form was checked by Mr. Stewart against the original field notes so as to eliminate all errors in compiling the table, insofar as possible. Several errors in previous work were eliminated in that way.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*

[DN, During night; *, container overflowed at unknown time or leaked badly; E. estimated on basis of rainfall measured; + or − with time of rain indicates a variation from time shown up to 15 minutes. Italic figures indicate more than one measurement in the same container; total for the container is given immediately below in roman type]

No. on pl. 2	Latitude (deg., min., sec.)	Longitude (deg., min., sec.)	Quadrangle designation [1]	Reporter or resident	Rainfall between times shown: July 17 p. m.	Rainfall between times shown: July 18 A. m.	Rainfall between times shown: July 18 P. m.	Amount measured (inches)	Storm period between times shown: July 17 p. m.	Storm period: July 18 A. m.	Storm period: July 18 P. m.	Total rainfall measured (inches)	Remarks
					West Branch Susquehanna River drainage basin								
			Pennsylvania										
1	41 51 36	77 49 18	Genesee 6a	W. Cutler	11:30	12 m.		8.6	11:30	12 m.		8.6	Very heavy rain 11:30 p. m. 17 to 9 a. m. 18.
2	41 50 22	77 50 33	5c	L. Hawkes	12	12 m.		9.5	12	12 m.		9.5	Very heavy rain 12 p. m. 17 to 7 a. m. 18.
3	41 49 51	77 48 20	9a	J. Griffins	11	10:30		6.8	11	10:30		6.8	Heavy rain 11 p. m. 17 to 6:30 a. m. 18.
4	41 47 35	77 45 52	9b	P. Bowen	12	9		6.5	12	9		6.5	Hard rain 12 p. m. 17 to 8 a. m. 18.
5	41 47 05	77 53 11	8h	Blough	11			*7.4	11				Heavy rain 11 p. m. 17 to 10:30 a. m. 18.
6	41 45 56	77 52 43	8j	Dr. Nixon	11:30		1:30	17.5	11:30		1:30	17.5	Hard rain 11:30 p. m. 17 to 7 a. m. 18 and 8 a. m. to 1:30 p. m. 18.
7	41 44 49	78 00 06	Emporium 3a	F. Kellnor	9	6		4.1	9				
8	41 44 14	78 02 00	3b	Grumm	11		12:30	11.4	11		12:30	11.4	11.4 inches catch probably small as container leaned to south with wind from northwest. Reporter estimated as much rain fell after 9 a. m. 18 as before.
					11	9		7.8					
9	41 44 04	77 48 56	Short Run 3a	J. O'Neill				*17.2					Container 2 feet from house with eaves extending 8 inches and probably reducing catch.
10	41 44 03	77 59 17	1b	Weiss	10	4		*13.9	10		2	E21.2	A little hail about 10 p. m. 17. No rain 8 to 9 a. m. 18.
11	41 43 49	77 58 54	1c	L. Littlefield	11	4		*10.0	11		2	E>15.1	
12	41 43 36	77 59 15	1e	Evjen	10	11:30		*10.0	10	11:30			Very hard rain 10 p. m. 17 to 8 a. m. 18. No rain 8 to 9 a. m. 18.
					10	6		**5.4*					
						6 to 11:30		**5.4*					
								*10.8					

13	41	43	33	77	57	45	1f	Pritt				12.8+				12.8+	Container leaked slightly.
14	41	43	20	77	58	06	1g	U. Buttnen		6–12		4.2	8:30	12 m.			Hail 2 to 2:10 p. m. 17.
15	41	43	17	78	00	49	Emporium 3d	S. Kelly	12		3	16.0	12		3	16.0	Short thunderstorm about 4 p. m. 17. Heaviest rain 7:15 a. m. to 1:30 p. m. 18.
16	41	42	27	78	05	00	3e	A. Hackett	DN	11		21.2	DN		5?		Heaviest rain 8:30 a. m. to 3:30 p. m. 18.
17	41	42	21	78	05	35	2b	J. Smith				19.0				19.0	Container empty 17; emptied a few days after storm.
18	41	42	19	77	57	46	Short Run 1h	E. Vergason	11:45		12:30	*9.1	11:45		12:30		
19	41	42	15	78	05	14	Emporium 2c	R. Hackett	11:30	7 7:15 to 9:15		*8.1 *8.1*	11:30		1:30	E18.3	About 4 hours heavy rain after container filled the second time.
20	41	42	10	77	58	28	Short Run 1i	G. Girardin	11 11	12 m. 11 11–12		*16.2 *12.7 **7.9* *3.7* *11.6	11	12 m.			Amount of rain may include that for hailstorm 3 to 3:15 p. m. 17.
21	41	42	04	78	05	40	Emporium 2d	Mitcheltree				*10.2	12		12:30		Heaviest rain 12 p. m. 17 to 6:30 a. m. 18. Reporter estimated rain enough to fill container 2 more times.
22	41	41	53	77	56	15	Short Run 1j	O. Watson	7:30	6		*1.7	7:30		2		Shower with hail 3 to 3:10 p. m. 17.
23	41	41	31	78	05	20	Emporium 2f	L. Tyler	12		3	*9.6	12		3		Downpour started 9 a. m. 18.
24	41	41	30	78	07	11	2e	R. Kio	11:30	6 6–10		*5.6* **3.3* *8.9	11:30		3:30		Hailed 4 to 4:30 p. m. and about 11:30 p. m. 17. Heavy rain 8:30 a. m. to 12 m. and 12:30 to 3:30 p. m. 18. Reporter estimated container would have filled again after 10 a. m.
25	41	40	55	78	07	33	2g	J. MacMartin	11:30		3:30	4.1	11:30		3:30	4.1	Some hail 3:45 to 4:05 p. m., 11:30 to 11:45 p. m. 17, and 2 to 2:15 p. m. 18. Continuous heavy rain 11:30 p. m. 17 to 3:30 p. m. 18. Container sheltered by dense foliage of maple tree.
26	41	40	43	77	56	23	Short Run 1k	M. Kio	8		9	5.7	8		9	5.7	Hailed about 1 minute at beginning of storm; heaviest rain 3 a. m. to 5:30 p. m. 18.
27	41	40	39	78	11	19	Emporium 1g	E. Sebring	9		4	*10.0	9		4		No rain to 8 a. m.; very heavy rain 8 a. m. to 2 p. m. 18.
28	41	40	30	78	02	15	3f	Stephens		2–8 8–12		**6.0* *6.0* *12.0		2	4	E15.0	Reporter estimated at least 3″ rain after 12 m. 18. Very little rain 9 to 9:30 a. m.

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

No. on pl. 2	Latitude (deg., min., sec.)	Longitude (deg., min., sec.)	Quadrangle designation [1]	Reporter or resident	Rainfall between times shown				Storm period between times shown				Remarks
					July 17 p. m.	July 18		Amount measured (inches)	July 17 p. m.	July 18		Total rainfall measured (inches)	
						A. m.	P. m.			A. m.	P. m.		
West Branch Susquehanna River drainage basin—Continued													
			Pennsylvania—Con.										
29	41 40 02	78 12 06	Emporium 1h	C. Perrigo		8–12		11.0	DN		P. m.	E21.7	Reporter estimated that container would have filled again 5.5″ more had it been emptied at noon 18.
30	41 39 32	78 08 28	5b	L. Goodwin	11	12 m.		*8.8	11		P. m.		Heaviest rain 8 a. m. to 1 p. m. 18.
31	41 39 31	78 09 10	5a	E. Ludwig	10		3:30	*12.5	10		3:30		Some hail p. m. 17; heavy rain 10 p. m. 17 to 6 a. m. 18; no rain 6:30 to 7:45 a. m.; and very heavy rain 10:30 a. m. to 12 m. 18.
32	41 39 11	78 09 21	5c	H. Andrews	DN	10		*9.6	DN		P. m.		Heavy hail storm about 3 p. m. 17; heaviest rain about 12 m. 18.
33	41 39 06	78 09 19	5d	G. Earl	DN	8		*7.1	DN		1		A little hail on 18. Reporter estimated more rain after 8 a. m. 18 than before.
34	41 38 57	77 58 03	Short Run 4a	E. Reed		8–12		*6.0		1	1:30	E11.8	Heavy rain 1 to 7 a. m. and 8 a. m. to 12 m. 18. No rain 7 to 8 a. m. 18.
35	41 38 18	77 59 10	4b	Pierce	9:30	8 8	 P. m.	*10.1* **3.1* *13.2	9:30		P. m.		
36	41 37 27	77 42 43	Galeton 4a	C. Heuser	10:30	9:30		3.6	10:30	12 m.			Hard rain period 10:30 p. m. 17 to 10:30 a. m. 18.
37	41 37 17	78 02 53	Emporium 6a	D. Rees		1–12		*9.4		1	P. m.		Hailed about 1 a. m. 18.
38	41 36 50	78 04 02	6b	C. Cooney		1–11		18.0		1	P. m.		Reporter estimated 25% more rain after 11 a. m. Container carried away by flood about 12 m. 18.
39	41 36 35	77 53 28	Short Run 5a	A. Walker	DN			*12.4	DN		5		Heaviest rain 8:30 a. m. to 12 m. 18. Catch measured Sept. 8 probably small.

40	41 36 04	78 12 50	Emporium 4b	V. Cannon	11:15	A. m.		*7.2	11:15		4:30		Container nearly full early a. m. 18. Reporter estimated enough rain to fill container twice.
41	41 35 34	77 53 57	Short Run 5b	C. Lloyd		1	1:30	8.5		1	1:30	8.5	Some hail about 1 a. m. 18, heaviest rain 8:30 a. m. to 1:30 p. m. 18. Container at end of house with 10-inch eaves.
42	41 35 14	77 54 08	5c	Williams		1	P. m.	6.5		1	P. m.	6.5	Heavy rain 1 to 6:15 and 6:30 to 11:30 a. m. 18. Container may have been emptied about 10 a. m. as usual but probably not.
43	41 34 45	77 54 20		Casbear	12		2	6.0	12		2	6.0	Container under tree.
44	41 34 43	78 13 22	Emporium 7a	C. Dodge				6.5					Heaviest rain started between 10:30 and 11 a. m. 18. Reporter states container filled in about 5 minutes and then overflowed, but time may have been longer.
45	41 34 22	78 12 05	7b	C. Howard		11:30	4	5.4	DN		4		Heaviest rain on 18 started about 11 a. m.
46	41 33 54	77 55 56	Short Run 7a	G. McFall	DN		5	4.0	DN		5	4.0	Light shower at 5 p. m. 17.
47	41 33 51	77 56 18	7b	Berglund			12:30 to 1:30	6.2	DN		4	E 16.3	Heavy rain 8:15 a. m. to 2 p. m. 18; heaviest 12 m. to 2 p. m.
48	41 33 35	78 02 03	Emporium 9a	Card		9:30 to 9:55		9.5		12:30	1		Heaviest rain with steady intensity 9 a. m. to 12 m. 18.
49	41 33 31	78 01 45	9b	D. Williams		1–8 8	 2	2.9 *6.4 *9.3		1	2		Intermittent heavy downpours 8:30 a. m. to 2 p. m. 18.
50	41 33 24	77 57 26	Short Run 7c	F. Decker		9 to 9:20		4.4	12		4		Very heavy rain 8 a. m. to 1 p. m. 18.
51	41 33 03	78 01 21	Emporium 9c	Greely	DN	8		*7.1					
52	41 32 47	77 47 14	Short Run 8a	Knickerbocker	11	7		*1.7	11		2		Heavy rain 7 a. m. to 2 p. m. 18.
53	41 32 26	77 58 51	7d	J. Foster	12	6		5.4	12	12 m.			
54	41 32 00	78 00 52	Emporium 9d	T. Mancuso	12		2:30	20.4	12		2:30	20.4	Hard rain 12 to 5 a. m. 18, and 12 m. to 2:30 p. m. 18. Downpour 10 a. m. to 12 m. 18.
55	41 31 57	78 17 59	Colegrove 9a	F. Lockwood	11:30		P. m.	*6.7	11:30		P. m.		Hard rain 11:30 p. m. 17 to 3 a. m. 18. Downpour 11 a. m. to 12 m. 18.
56	41 31 53	78 18 00	9b	W. Timblin				*8.7					Container set out DN 17 and found full on 19.

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

No. on pl. 2	Latitude (deg., min., sec.)	Longitude (deg., min., sec.)	Quadrangle designation [1]	Reporter or resident	Rainfall between times shown				Storm period between times shown				Remarks
					July 17 p. m.	July 18		Amount measured (inches)	July 17 p. m.	July 18		Total rainfall measured (inches)	
						A. m.	P. m.			A. m.	P. m.		
					West Branch Susquehanna River drainage basin—Continued								
			Pennsylvania—Con.										
57	41 31 34	78 03 55	Emporium 9e	B. Abel		9:50 to 10		6.5	12		5		Container, set out 8 feet from house about 10 a. m. 18, overflowed in 10 min. Cloudburst from about 10 a. m. to 12 m. 18. No rain 6 to 8 a. m. 18.
58	41 30 02	78 02 07	9f	J. Lewis				*11.9					
59	41 29 57	78 02 15	Driftwood 3a	W. Deibler		7	1	7.8	DN		2.30	E 12.8	
60	41 29 29	78 02 53	3b	C. Logue	11	A. m.		*7.4	11		2:30		Hailed about 5 min. about 10 a. m. 18; heaviest rain 8:30 a. m. to 2:30 p. m. 18.
61	41 29 14	78 26 08	Caledonia 1a	G. Mahoulich, Jr.	DN		4:30	*9.3	DN		4:30		Very hard rain 12 m. to 4:30 p. m. 18.
62	41 29 08	78 17 14	3b	M. Judd	12	9		*2.4*	12		6	E>12.5	Downpour 10 a. m. to 3 p. m. 18; container only 3¾ feet from eaves of house. No rain 7 to 8 a. m. 18.
						9	6	**7.1*					
								*9.5					
63	41 29 07	78 13 42	Driftwood 1a	J. Sage	8		6	*6.5	8		6		Heaviest rain 8 a. m. to 12 m. 18.
64	41 29 05	78 17 35	Caledonia 3a	S. Crawford		8	3	10.5					Accuracy of record in doubt. Hail 1:45 to 2 p. m. 18.
65	41 29 00	78 27 42	1b	P. Herzing	11		4:30	5.3	11		4:30	5.3	Container 15 feet from lee side of barn. Downpour 2:30 to 4:30 p. m. 18.
66	41 28 57	78 13 47	Driftwood 1b	J. Ostrum	12	6		3.4	12		8		Very heavy rain 12 m. to about 6 p. m. 18.
						12 m.	6	3.3					
67	41 28 53	77 49 22	Bitumen 3a	S. Jones	10	8		4.9	10		2:30		
68	41 28 51	78 25 12	Caledonia 1c	I. Carter	DN		3	*7.8	DN		3		Container 14 feet from porch, under dense evergreen. Heavy rain between 10 a. m. and 3 p. m. 18.
69	41 28 40	78 15 39	3c	C. Lyon	12		3:30	7.2	12		3:30	7.2	No rain 7 to 8 a. m.; heavy rain 8 a. m. to 3:30 p. m. 18; downpour 12 m. to 3:30 p. m. It is possible that container overflowed.

70	41	28	34	78	11	03	Driftwood 1c	H. Hicks	10:30 10:30		4:30 3	7.6 *6.9	10:30		4:30	7.6	
71	41	28	04	78	16	35	Caledonia 3d	E. Mumford				4.7				4.7	Container under maple tree with thin foliage.
72	41	28	03	78	29	26	1d	J. Brentel		12 m.	6	4.4	12		6		Heavy rain 1 to 5 p. m.; very heavy rain 5 to 6 p. m. 18.
73	41	28	00	78	61	51	3e	P. Lyon		1–7 8	 5:30	3.9 3.9 7.8		1	6	8.1±	Very hard rain 12 m. to 4 p. m. 18. Moderate rain 7 to 8 a. m. and light rain 5:30 to 6 p. m. estimated as 0.3 in.
74	41	27	48	77	50	42	Bitumen 2a	F. Caldwell	DN		P. m.	*9.8	DN		P. m.		Heavy rain 6 to 8 a. m. 18.
75	41	27	42	78	03	28	Driftwood 3c	R. Keller	11	11		*12.1	11		3		May include rain from previous storms. Heavy rain to 6 a. m. and 6:40 a. m. to 2 p. m. 18.
76	41	27	33	78	17	30	Caledonia 3f	J. Reed	12		7	16.5	12		7	16.5	Downpour 3:30 to 4:30 p. m. 18.
77	41	26	08	77	53	17	Bitumen 2b	Peters	10	7		*7.3	10		3	E14.3	Heavy rain 5 a. m. to 12 m. 18.
78	41	25	52	78	22	34	Caledonia 2a	G. Sprankle		7:30 11	6 6	*8.2 2.9	10		6		Heaviest rain between 10 a. m. and 12 m. 18.
79	41	25	45	77	54	50	Bitumen 2c	D. Crane		9 to 10		3.6	10		2:30		Heaviest rain DN 17. Container filled in 20 min.
80	41	25	42	77	54	48	2d	H. Cramer		11	1	*7.5	12		2	E16.9	Very heavy rain 11 a. m. to 1 p. m. 18.
81	41	25	32	77	54	04	2e	Summerson		8	3	8.0		1	3	E11.4	Container 6" from end eaves. Poor location due to sheltering.
82	41	25	19	77	54	05	2f	C. Calhoun	10		3	8.6	10		3	8.6	
83	41	24	46	78	02	12	Driftwood 6a	C. Peno		12:30	2	*8.9		12:30	2		Very heavy rain 8:30 a. m. to 2 p. m. 18.
84	41	24	35	78	11	56	4a	S. Barr	DN		4	*7.3	DN		4		Heavy rain 12 m. to 4 p. m. 18. Container overflowed 3 times. Emptied 6 a. m. and 12 m. 18.
85	41	24	17	77	55	14	Bitumen 4a	McCoy			12:30 to 3:15	3.3	11		3:15	E6.5	Very heavy rain 12:30 to 3:15 p. m. 18.
86	41	24	04	78	14	44	Caledonia 6a	J. Mix	9	5:30		3.9	9		P. m.		Heaviest rain about 11 p. m. 17.
									9		P. m.	*8.2					Container overflowed near end of storm.
87	41	23	46	78	01	10	Driftwood 6b	P. Johnson		12:30	2	9.7		12:30	4		Downpour 11 a. m. to 3 p. m. 18.
88	41	22	53	78	01	29	6c	S. Kuppelweiser	9	7 8 to 10:30		6.9 8.6	9		5	E19.0	No rain 7 to 8 and 10:30 to 11 a. m. 18. Very heavy rain 9 to 10:30 a. m. and 11 a. m. to 3:30 p. m. 18.
	41	22	43	77	55	28	Bitumen 4b	D. Schoonover			4–5	15.5 3.5				E9.2	

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

No. on pl. 2	Latitude (deg., min., sec.)	Longitude (deg., min., sec.)	Quadrangle designation [1]	Reporter or resident	Rainfall between times shown: July 17 p. m.	Rainfall between times shown: July 18 A. m.	Rainfall between times shown: July 18 P. m.	Rainfall between times shown: Amount measured (inches)	Storm period between times shown: July 17 p. m.	Storm period between times shown: July 18 A. m.	Storm period between times shown: July 18 P. m.	Storm period between times shown: Total rainfall measured (inches)	Remarks
West Branch Susquehanna River drainage basin—Continued													
			Pennsylvania—Con.										
90	41 22 22	78 09 10	Driftwood 5a	H. Jordan	DN	8	----	*7.9	DN	----	3	----	Container in poor location. Very hard rain 1 to 3 p. m. 18.
					DN	----	3	*5.4					
91	41 21 39	78 08 17	5b	J. Johnson	----	1–7	----	*5.2*	----	1	P. m.	9.5	Very heavy rain 7:30 a. m. to 2 p. m. 18.
						7	P. m.	*.3*					
								9.5					
92	41 21 23	78 03 12	6d	Miller	----	1–7	----	3.1	----	1	P. m.	----	Very hard rain 10:30 a. m. to 2 p. m. 18.
93	41 20 25	77 50 33	Bitumen 5b	Desmond Mine	----	----	----	*11.8	----	----	----	----	
								*9.2					
94	41 20 20	77 52 22	5a	Janet Mine	----	----	----	*7.4	----	----	----	----	
								*10.0					
95	41 18 05	78 03 06	Driftwood 9a	C. Pitts	10	5:30	----	*3.1	10	----	3	----	Heavy rain 2:30 to 3 p. m. 18.
96	41 17 52	77 50 46	Bitumen 8a	F. Morton	11	10:30	----	8.3	11	----	3	----	Heaviest rain between 5 and 6 a. m. 18; drizzled after 3 p. m. to 8 p. m. 18.
97	41 16 49	77 53 14	8b	H. Anderson	----	1:45 to 6:30	----	*1.5*	----	1:45	2	3.0	Hard rain 6 to 7 a. m. and 11 a. m. to 2 p. m. 18. No rain 7 to 9 a. m.; light rain 2 to 9 p. m. 18.
						6:30	9	*1.5*					
								3.0					
98	41 15 31	77 54 32	8c	A. Stimson	----	2	2	4.2	----	2	2	4.2	Very hard rain noon to 2 p. m. 18.
					----	2	2	4.0	----	2	2	4.0	Container under big limbs of a tree.
Allegheny River drainage basin													
			New York										
99	42 11 48	78 33 28	Salamanca 3a	J. Wiley	9	11	----	8.0	9	11	----	8.0	Heavy downpours 7 to 11 a. m. 18.
100	42 11 36	78 28 16	Olean 1a	G. Wilber	DN	11	----	6.8	DN	11	----	6.8	1 cloudburst after another 6:30 to 11 a. m. 18. Very little rain after 11 a. m. 18.

101	42	11	25	78	33	25	Salamanca 3b	B. Potter	DN	12 m. 12 m.	 4	4.7 2.8 7.5	DN		4	7.5	Downpour 5 to 9 a. m. 18.
102	42	11	22	78	29	38	Olean 1b	J. Whitcher	11	A. m.		*8.7	11	A. m.			Heavy rain 11 p. m. 17 to about 7:30 a. m. 18.
103	42	10	45	78	26	26	1c	R. Rogers	DN	8		*7.6	DN	10			Downpour 6:30 to 8 and hard rain 8 to 10 a. m. 18.
104	42	10	45	78	24	29	2a	F. Gile		6:30 to 10		*5.3	11:30	10		E>12.6	Very heavy rain 11:30 p. m. 17 to 1:30 a. m. 18, downpour 6:30 to 9 a. m. 18.
										6:30 to 10		*5.8					
105	42	10	30	78	28	57	1d	M. Hitchcock	7		1	*9.4	7		1		Heavy rain 5 to 11 a. m. and downpour 11 a. m. to 1 p. m. 18.
106	42	10	27	78	22	24	2b	D. Wing	10:30			*8.1	10:30				Downpour 7:30 to 9 a. m.; not much rain after 9 a. m. 18.
107	42	10	19	78	21	58		C. Wagner	11:30	9		4.7	11:30	9		4.7	A little hail DN 17. Hard rain 11:30 p. m. 17 to 12:30 a. m. 18. Downpour 8 to 9 a. m. 18. Container sheltered by tree.
108	42	09	54	78	23	12	Olean 5a	G. Bell	DN		1	14.1	DN		1	14.1	Downpour 8:30 to 9:30 a. m. 18.
109	42	09	32	78	23	45	5b	E. Saylor	12	12 m.		6.0	12	12 m.		6.0	Hard rain 12 to 7:30 a. m. and downpour 7:30 to 9:30 a. m. 18.
110	42	09	27	78	26	36	4a	C. Adams	10	12 m.		*2.5	10	12 m.			A little hail and downpour for ½ hour shortly after 8 a. m. 18.
111	42	09	24	78	30	12	Salamanca 6a	G. Wood		7 to 11		6.0+	Before 12	11		E9.6	No rain 5 to 7 a. m. 18. ¾ hr. downpour between 7 and 8 a. m. 18. Hard bursts of rain 8 to 11 a. m. 18. Slight leak in container.
112	42	09	23	78	25	20	Olean 4b	A. Swart	10	11		*6.6	10	11			No rain 5 to 7:30 a. m. 18. Downpour started 7:30 a. m.; thereafter heavy bursts of rain until 11 a. m. 18.
113	42	09	10	78	17	38	6a	C. Kratts	10	9		*4.8	10	10			Excessive rain 7:30 to 8:30 a. m. 18.
114	42	09	03	78	17	45	6b	A. Subject	10:45		2:30	5.4	10:45		2:30	5.4	Excessive rain 7 to 8:30 a. m. 18.
115	42	08	40	78	21	16	5c	J. Bump	9	10		5.9	9	10		5.9	No rain 5 to 7 a. m.; downpour 8 to 10 a. m. 18.
116	42	08	24	78	24	30	5d	E. Hurlburt	11	11		*9.2	11	11			Downpour 8:45 to 11 a. m. 18.

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

No. on pl. 2	Latitude (deg., min., sec.)	Longitude (deg., min., sec.)	Quadrangle designation [1]	Reporter or resident	Rainfall between times shown: July 17 p. m.	Rainfall between times shown: July 18 A. m.	Rainfall between times shown: July 18 P. m.	Rainfall between times shown: Amount measured (inches)	Storm period between times shown: July 17 p. m.	Storm period between times shown: July 18 A. m.	Storm period between times shown: July 18 P. m.	Storm period between times shown: Total rainfall measured (inches)	Remarks
				Allegheny River drainage basin—Continued									
			New York—Con.										
117	42 08 20	78 21 05	Olean 5e	F. Miller		6:30 to 10		*1.7	11	12			Downpour 7 to 11 a. m. 18.
118	42 08 06	78 20 21	5g	A. Dehnkam		10		*6.6					Downpour 8 to 8:30 a. m. 18. Container noticed overflowing 9:30 or 10 a. m. 18.
119	42 08 04	78 20 50	5f	C. Shaffer	9	11		*7.9	9	11			Very hard rain 6 or 7 to 9:30 a. m. 18.
120	42 07 57	78 28 52	4c	F. Miller	DN		2	*7.0	DN		2		Downpour 7:30 to 8:30 a. m. 18, followed by another slightly later.
121	42 07 56	78 18 11	6c	M. Manley	11	9		3.5	11	9		3.5	Excessive rain 7:30 to 9 a. m. 18.
122	42 07 46	78 28 35		A. Hansel		8:30 to 12		2.6	DN	12 m.		E6.0	Steady hard rain 5:30 to 10 a. m.; heaviest rain 6 to 9:30 a. m. 18. Good record of amount of rainfall after 8:30 a. m.
123	42 07 46	78 22 44	Olean 5h	W. Alexander	DN	10		*7.4	DN	10			Heavy rain 12 to 8 a. m. and downpour 8 to 8:30 a. m. 18.
124	42 07 40	78 24 48	5i	F. Phelps	DN	12 m.		9.5	DN	12 m.		9.5	Downpour 6:30 to 8:30 a. m. and hard rain 8:30 until nearly noon 18.
125	42 07 38	78 14 33	Belmont 4a	C. Congdon	DN	10 10 to 12 m.		*4.5* *3.5* 8.0	DN	12 m.		8.0	Hard bursts of rain 8 to 12 noon 18.
126	42 07 20	78 20 50	Olean 5j	E. Miller	8:30	9		*9.9	8:30	11			Heavy rain for an hour about 9 p. m. 17; excessive rain 8:30 to 11 a. m. 18.
127	42 07 08	78 18 56		A. Forsythe	11:30 11:30	11:30 11:30		*7.3 *7.2	11:30	11:30			Heavy rain 11:30 p. m. 17 to 12:30 a. m. 18. Downpour 7:45 to 10 and hard rain 10 to 11:30 a. m. 18.

128	42 07 07	78 23 01	Olean 5l	J. Zink	DN	12 m.		11.2	DN	12 m.		11.2	Hard rain 4 to 8 and excessive rain 8:30 to 9 a. m. 18. Container may have leaked at beginning of storm.
129	42 07 05	78 18 58	6d	D. Wagner	11:30	11:30		*7.4	11:30	11:30			Excessive rain 7:45 to 10 a. m. 18.
130	42 07 00	78 24 08	5k	F. Smith	10:30			13.4	10:30			13.4	Excessive rain 8 to 8:30 and hard rain 8:30 to 10:30 a. m. 18.
131	42 06 53	78 15 01	6e	H. Higby	10:45	7		3.8	10:45		P. m.		Succession of heavy thunderstorms 7:30–12 a. m. 18.
132	42 06 49	78 14 57	Belmont 4b	F. Walbur		7	1:30	5.7	10:45		1:30	E12.5	Downpour 7:30 a. m. to 10 a. m. 18.
133	42 06 44	78 23 15	Olean 5m	Bush				*6.0					
134	42 06 40	78 19 53	6f	O. Crawforth	11	8 8–11		*6.5* *2.6* *9.1	11	11			Hard showers 11 p. m. 17 to 6:30 a. m. 18. Downpour 6:30 to 7:30 and hard rain 7:30 to 11 a. m. 18.
135	42 06 40	78 12 58	Belmont 4e	C. Fisk	11	12 m.		3.4	11	12 m.		3.4	Downpour 7:30 to 10:30 a. m. 18.
136	42 06 39	78 22 36	Olean 5n	C. Brown	9:45	7 7 to 11:30		**3.6* **10.9*	9:45	11:30		E>22.1	Intermittent heavy rain DN 17. No rain 7 to 7:30, excessive rain 7:30 to 9:30, and hard rain 9:45 to 11:30 a. m. 18.
137	42 06 38	78 14 26	Belmont 4c	J. Aud	DN	6 6–11		*14.5 *7.0* *7.0* 14.0	DN	11		14.0	Hardest rain about 8 a. m. 18.
138	42 06 36	78 13 30	4d	C. Foster	11	12 m.		8.9	11	12 m.		8.9	Downpour 8 to 9 a. m. 18.
139	42 06 12	78 14 00	4f	C. Beckwith	10:15	10		11.2	10:15	10		11.2	Succession of heavy rains DN 17 to 5:45 a. m. 18. Cloudburst 8 to 10 a. m. 18.
140	42 05 54	78 15 14	Olean 6h	H. Robinson	DN	5:30		2.8	DN	11			Downpour 7 to 8 a. m. 18.
141	42 05 53	78 14 20	Belmont 4g	F. Barber				6.0					Amount measured is night rain only.
142	42 05 49	78 19 07	Olean 6g	C. Willover	4	12 m.		*9.1	4	12 m.			Excessive rain 7:30–12 a. m. 18. A little hail within this period.
143	42 05 29	78 14 53	Belmont 4h	F. Foster				*6.9					Most of rain came in cloudburst between 8 and 9 a. m. 18
144	42 05 27	78 21 35	Olean 5o	C. Fredrick	DN	10:30		*7.9	DN	10:30			Excessive rain 8 to 10 or 10:30 a. m. 18.
145	42 05 14	78 21 34	5p	D. Kayes		7 to 8		*8.2	DN	8		E>21.6	Time container was in use is somewhat indefinite; reporter estimated enough rain fell to fill container two more times.
146	42 05 14	78 14 31	Belmont 4i	L. Childs				*1.0					

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

No. on pl. 2	Latitude (deg., min., sec.)	Longitude (deg., min., sec.)	Quadrangle designation [1]	Reporter or resident	Rainfall between times shown: July 17 p. m.	Rainfall: July 18 A. m.	Rainfall: July 18 P. m.	Rainfall: Amount measured (inches)	Storm period between times shown: July 17 p. m.	Storm period: July 18 A. m.	Storm period: July 18 P. m.	Storm period: Total rainfall measured (inches)	Remarks
			Allegheny River drainage basin—Continued										
			New York—Con.										
147	42 05 06	78 17 44	Olean 6i	J. Hewitt	DN	9:30		6.4	DN	9:30		6.4	Downpour 7 to 9:30 a. m. 18
148	42 04 55	78 15 41	9b	H. Burgett	7	12 m.		8.3	7	12 m.		8.3	Heavy rain 7 to 9 and down pour 9 to 11 a. m. 18.
149	42 04 50	78 19 50	9a	R. Blakeslee	10:30	12 m.		*8.9	10:30	12 m.			Downpour 7:30 to 12 m. 18; some hail in this period.
150	42 04 47	78 25 56		Times Herald	DN	11:30		6.5					
151	42 04 46	78 11 59	Belmont 7a	P. Hoffman	10:30			8.0	10:30			8.0	Hardest rain about 11 a. m. 18 when it was almost as dark as night.
152	42 04 42	78 15 04	Olean 9c	M. Neu	11	9		8.0	11	9		8.0	Cloudburst 6:30 to 8 a. m. 18.
153	42 04 37	78 12 26	Belmont 7b	B. Frost	DN	6		5.1					
						6–8		*2.7					
								*7.8					
154	42 04 30	78 16 17	Olean 9f	L. Lewis	11	12 m.		6.1	11	12 m.		6.1	Downpour 7 to 9 a. m. 18.
155	42 04 24	78 16 37	9e	F. Payne	11	6		2.9	11	12 m.		9.3	Downpour 7:30 to 11 a. m. 18.
						6–12		6.4					
								9.3					
156	42 04 23	78 17 48	9d	O. Merrick		7:45 to 9		6.1	DN	10		E15.0	Downpour 7:45 to 9 a. m. 18.
157	42 04 19	78 14 56	Belmont 7c	W. Keller	7	11		7.5	7	11		7.5	Hard rain 7 p. m. 17 to 9 a. m. 18.
158	42 04 13	78 16 58	Olean 9g	O. Ecker	9:30	10		6.0+	9:30	10		6.0+	Catch small, owing to some leakage and end of catch trough being sheltered. Hard rain all night; downpour 6:30 to 8:30 a. m. 18.
159	42 04 10	78 13 43	Belmont 7d	A. Chaffee				6.7				6.7	
160	42 03 44	78 22 04	Olean 8a	F. Witherell	9	11		*1.5	9	11			Very heavy rain 7:20 to 8 and downpour 8 to 10 a. m. 18.
161	42 03 37	78 18 25	9h	E. Bradford	10:30	12 m.		8.7	10:30	12 m.		8.7	Downpour started about 8 a. m. 18.
162	42 03 33	78 14 45	Belmont 7e	H. Woodard	11:15	12 m.		9.5	11:15	12 m.		9.5	Heavy rain 11:15 p. m. 17 to 11 a. m. 18; heaviest 7:30 to 9 a. m. 18.

163	42	03	25	78	15	02	Olean 9i	J. Coffey	DN	11		*9.5	DN	11			Downpour 8:30 to 9:30 and hard rain 9:30 to 11 a. m. 18.
164	42	03	14	78	21	48	8c	W. Boxer	8	12 m.		*13.1	8	12 m.			5 cloudbursts forenoon of 18.
165	42	03	09	78	21	52	8b	B. Martin	DN	12 m.		*5.0	DN	12 m.			Downpour 8–9 and hard rain 9–12 a. m. 18.
166	42	03	03	78	12	37	Belmont 7f	G. Hulbert	10	12 m.		4.8	10	12 m.		4.8	Hard rain 10 p. m. 17 to 8 a. m. 18; heaviest between 7 and 8 a. m.
167	42	02	35	78	10	22	7h	C. Rigby	11	11		1.3	11	11		1.3	
168	42	02	27	78	11	22	7g	J. Cartwright	7	5		6.3	7	10			Cloudburst 8 to 10 a. m. 18.
169	42	02	18	78	22	39	Olean 8d	F. Vanyo	DN	12 m.		*6.6	DN	12 m.			Cloudburst before 9 a. m. 18.
170	42	02	01	78	10	25	Belmont 7i	M. Burrows	9	11		3.0	9	11		3.0	Hard rain 9 p. m. 17 to 11 a. m. 18.
171	42	01	41	78	09	10		F. Bates				*8.2	DN	12 m.			Hardest rain 6:30 to 8 a. m. 18. Container in poor location.
172	42	01	24	78	13	20	Belmont 7j	M. Lamphere	DN	8		6.4	DN	9			Downpour 7 to 8 a. m. 18.
173	42	01	12	78	21	48	Olean 8e	M. Coleman	10:45	12 m.		5.6	10:45	12 m.		5.6	Heavy rain all night 17. Excessive rain 8–12 a. m. 18.
174	42	00	52	78	12	54	Belmont 7k	C. Giddings				6.8				6.8	Hard rain all night 17.
175	42	00	50	78	09	23	8a	D. Grimes	11	11		3.6	11	11		3.6	Hard rain 11 p. m. 17 to 4:30 a. m. 18 and 8:30 to 11 a. m. 18. Downpour 5:30 to 8:30 a. m. 18.
176	42	00	34	78	15	52	Olean 9j	R. Loucks	 DN	8–12 12 m.		5.0 *5.0	DN	12 m.		E9.4	Hardest part of rain between 8 and 9 a. m. 18. Reporter estimated that 0.5″ fell between 7:30 and 8 a. m. 18, making a total of 5.5″ from 7:30 to noon 18.
							Pennsylvania										
177	41	59	59	78	16	45	Smethport 3a	F. Pitzrick	DN	11:30		*9.3	DN	11:30			No rain 6 to 8 a. m.; heavy rain 8 to 11:30 a. m. 18. Reporter estimated total rain as about 15 inches.
178	41	59	57	78	16	16	3b	L. Shaw	11:30	A. m.		4.3					
179	41	59	57	78	10	55	Coudersport 1a	P. Gillmer	12	10		*7.4	12	8+			Downpour 6 to 8 a. m. 18.
180	41	59	50	78	20	55	Smethport 2a	L. Evens	11:30	12 m.		6.7	11:30	12 m.		6.7	Succession of downpours 5–12 a. m. 18.
181	41	59	50	78	11	18	Coudersport 1b	D. Green	11	10+		*8.3 *8.7	11	10+			Downpour 5:30 to 10 a. m. 18.
182	41	59	27	78	15	09	Smethport 3c	E. Turner	10:30	10+		*7.8	10:30	10+			Downpour 7 to 10 a. m. 18.
183	41	59	22	78	20	58	2b	C. Baldwin	12	12 m.		*10.6	12	12 m.			
184	41	59	18	78	11	08	Coudersport 1c	R. James	11:45	12 m.		23.0	11:45	12 m.		23.0	Downpour 7:45 to 10 a. m. 18. Container may have held rain from previous storms, but probably not more than 2 inches. Reporter stated no water in container prior to 17.

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

No. on pl. 2	Latitude (deg., min., sec.)	Longitude (deg., min., sec.)	Quadrangle designation [1]	Reporter or resident	Rainfall between times shown: July 17 p. m.	Rainfall: July 18 A. m.	Rainfall: July 18 P. m.	Rainfall: Amount measured (inches)	Storm period between times shown: July 17 p. m.	Storm period: July 18 A. m.	Storm period: July 18 P. m.	Storm period: Total rainfall measured (inches)	Remarks
					Allegheny River drainage basin—Continued								
			Pennsylvania—Con.										
185	41 59 17	78 17 52	Smethport 3d	E. Mills	10		2	*5.6	10		2		Downpour by "bursts" 7 a. m. to 2 p. m. 18.
186	41 59 09	78 21 03	2c	D. Buffun	12	8 8–12		*5.8 9.0 *14.8	12	12 m.		E17.7	Downpour 8–12 a. m. 18.
187	41 58 47	78 13 02	Coudersport 1d	H. Blanchard	DN	11+		10.5	DN	11+		10.5	Heavy rain 7:30 to 11 a. m. 18.
188	41 58 44	78 19 28	Smethport 3 e	Shoemaker	DN		1	8.5	DN		1	8.5	Downpour about 11:30 a. m. 18.
189	41 58 43	78 22 22	2d	Mason	DN		1	10.5	DN		1	10.5	Heavy rain 8:15 a. m. to 1 p. m. 18.
190	41 58 41	78 17 05	3h	A. Scutt	11	10+		*7.2	11	10+			Container nearly full before heavy storm of 18.
191	41 58 36	78 20 13	2e	J. Soules	11	 7:30 or 8	2 2	9.5+ *7.2	11 11		2 2	9.5+ E>14.1	Container for 9.5-inch catch 1 foot from end of house, probably leaked at beginning of catch. Hard rain 11 p. m. 17 to 3 a. m. 18; downpour 7:30 to 11 or 11:30 a. m. 18.
192	41 58 36	78 08 39	Coudersport 2a	L. Drake	11	5		*2.3					Container overflowed before 5 a. m. 18.
193	41 58 34	78 19 20	Smethport 3f	S. Peasley	11:30	12 m.		*7.1	11:30	12 m.			Heavy rain 7 to 8 a. m. 18.
194	41 58 34	77 59 24	Genesee 1a	F. Walker	10	7		5.0	10	9			Hard rain 10 p. m. 17 to 6 a. m. 18 and 7 to 8 a. m. 18.
195	41 58 33	78 14 32	Coudersport 1e	L. Holly		1–9		*4.5		1	1:30		Heavy rain 9 a. m. to 1:30 p. m. 18.
196	41 58 33	78 12 15	1f	P. Baker	9		2	*9.9	9		2		Downpour 8 a. m. to 2 p. m. 18.
197	41 58 32	78 19 14	Smethport 3g	A. Cole				6.5				6.5	
198	41 58 31	78 23 01	2f	McNaughton		9	1	6.3	11		4	E>10.7	Container (wood-stave barrel) probably leaked materially at beginning of catch. Heavy rain 8 a. m. to 1 p. m. 18.
199	41 58 22	78 23 08	2g	F. Johnson	DN	12 m.		*6.1	DN	12 m.			Rained 1" 11 to 11:40 a. m. 18.

200	41 58 03	78 14 25	Coudersport 1g	M. Maxson	----	2 to 11	----	*7.3	----	2 to 12 m.	----	----	Downpour period 8 to 10:30 a. m. 18.
201	41 57 58	78 16 34	Smethport 3i	G. Taylor	11:30	9:30	----	9.7	11:30	12 m.	----	----	Downpour 7:45 to 11 a. m. 18. The reporter estimated that the rainfall for that period alone was enough to fill the container, which overflowed.
202	41 57 50	78 12 35	Coudersport 1h	J. Kemp	10	----	1	12.5	10	----	1	12.5	Downpour 7:30 to 10 a. m. 18.
203	41 57 45	78 20 48	Smethport 2i	R. Leet	----	6:30 to 9:30	----	8.0	----	----	----	E21.1	Heavy rain 8:30 to 11 a. m. 18. Container overflowed 9:30 a. m. 18 or before. Presumably no rain between 6:30 and 8:30 a. m. 18.
204	41 57 44	78 08 31	Coudersport 2b	A. Cronk	Before 12	6;30	----	*3.0*	Before 12	12 m.+	----	E8.2	Downpour 7–12 a. m. 18. Container lacked 0.5″ of being full at noon. Reporter stated that there may have been enough rain after noon to finish filling the container.
						6:30 to 12	----	*4.9*					
								7.9					
205	41 57 43	78 20 06	Smethport 2j	Ewing	----	8:30 to 9	----	3.1	----	----	----	----	Heavy rain 8:30–12 a. m. 18.
206	41 57 42	78 22 00	2h	G. Eastman	----	8:15 to 9:30	----	9.2	10	11:15	----	E22.7	No rain 5:30 to 8:15 and heavy rain 8:15 to 11:15 a. m. 18.
207	41 57 30	78 16 10	3j	----	----	----	----	*7.9	----	----	----	----	Container set out during a. m. storm of 18.
208	41 57 24	78 10 37	Coudersport 1i	J. Rupert	----	7:30 to 11	----	*7.7	DN	11	----	E>15.8	Cloudburst 7:30 to 8:30 a. m. 18. No rain 6 to 7:30 a. m. 18.
209	41 56 56	78 14 12	Coudersport 1j	D. Stannard	----	8:30 to 9+	----	*7.7	6	----	2	E20.3	Downpour started 7:30 a. m.; heaviest rain 9 to 10 a. m. 18. Reporter estimated that there was enough rain to fill container almost 4 times. A very little hail night of 17.
210	41 56 50	78 10 43	1k	E. Salisbury	11	7	----	3.4	11	11	----	----	Hard rain 8 to 11 a. m. 18 of which the heaviest was 8 to 9 a. m.
211	41 56 47	78 09 35	2c	W. Bliss	----	12:30	About 12 m.	12.8	----	----	----	----	Downpour 8 to 12 a. m. 18.
						12:30	12 m.+	13.8	----	12:30	12 m.+	13.8	
212	41 56 44	78 35 50	Bradford 2a	E. O'mara	5	----	9	*14.0	5	----	9	----	Heavy rain 2 to 5:30 and 9 to 11 a. m. 18.
213	41 56 43	78 23 35	Smethport 2k	O. Ward	DN	----	12:30	12.2	DN	----	12:30	12.2	Very heavy rain 8:30 to 9:30 a. m. 18.
214	41 56 35	78 10 43	Coudersport 1l	T. Elliot	11	9	----	*9.6	11	11:30	----	----	Downpour period 8 to 11:30 a. m. 18 (5 cloudbursts).
215	41 56 34	77 56 24	Genesee 1b	F. Kenyon	----	----	----	18.0	----	----	----	18.0	

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

No. on pl. 2	Latitude (deg., min., sec.)	Longitude (deg., min., sec.)	Quadrangle designation [1]	Reporter or resident	Rainfall between times shown				Storm period between times shown				Remarks
					July 17 p. m.	July 18		Amount measured (inches)	July 17 p. m.	July 18		Total rainfall measured (inches)	
						A. m.	P. m.			A. m.	P. m.		
Allegheny River drainage basin—Continued													
			Pennsylvania—Con.										
216	41 56 27	78 08 45	Coudersport 2d	E. McGuirl	11	12 m.		*12.5	11	12 m.			Downpour 7:30 to 11:30 a. m. 18.
					11	12 m.		*10.5					
217	41 56 26	78 10 35	1m	B. Kellog	DN	12 m.		9.8	DN	12 m.		9.8	Heavy rain 8 to 12 a. m. 18.
218	41 56 17	78 13 59	1n	L. Chase	11:45	9		9.2	11:45	10			Downpour 6:30 to 10 a. m. 18. Observer estimated that about 2″ of rain fell after container was full at 9 a. m. 18.
219	41 56 15	78 05 35	2c	F. Dunshie	12		4	2.8	12		4	2.8	Very hard rain 9 a. m. to 1:30 p. m. 18.
220	41 56 07	78 14 46	1o	L. Bridge	10		P. m.	*8.1	10		P. m.		Downpour 7:30 a. m. to 1 p. m. 18.
221	41 56 04	78 13 30	1p	A. Blanchard	11		1	*9.4	11		1+		Downpour period 8:30 a. m. to 12 m. 18. A little hail a. m. 18.
222	41 56 00	78 15 22	Smethport 3k	F. Matthews	11:30	7:30		*6.7	11:30	About 12 m.			Extremely heavy rain from shortly after 8 to 9:30 a. m. 18.
						7:30	P. m.	*6.7					
								*13.4					
					11:30	12 m.		*13.2					
223	41 55 51	78 15 51	3l	Woodward	10	8		*9.4	10		P. m.		Reporter estimated enough rain fell to have filled container again.
224	41 55 36	78 20 56	2n	R. Kelley		5:30 to 11		*3.9	DN	11		E>6.3	A little hail about 9 a. m. 18.
225	41 55 33	78 21 24	2m	W. Barnes	11:45	12 m.		8.5	11:45	12 m.		8.5	
226	41 55 28	78 22 30	2l	Smith	DN	9:15		6.1	DN		12:30		Heavy rain 9 a. m. to 12:30 p. m. 18. Container (capacity 6.1 inches) filled in a 15- or 20-minute period beginning 9 a. m. 18 except for estimated 1 in. remaining from previous night's storms.
227	41 55 02	78 06 48		Keir		8 to 8:30		3.0					

228	41	54	55	78	17	58	Smethport 6a	L. Jordan		8:30	1	*9.6	12		3		No rain 7 to 8:30 a. m. 18.
229	41	54	46	78	18	03	6b	C. Hubble	11	8:30 8:30	 12:30	3.8 *15.0 *18.8	11		12:30		Heavy rain started 8:30 a. m. 18.
230	41	54	45	78	06	16	Coudersport 5a	P. Fisk	DN	7 7-10		5.2 *3.9 *9.1	DN		2 or 3		
231	41	54	38	78	13	36	4a	N. Austin	DN		2:30	*7.3	DN		2:30		Very heavy rain 8 a. m. to 2:30 p. m. 18. Light hail just before heavy rain.
232	41	54	27	78	23	45	Smethport 5a	A. Rice		11:30	12:30	*2.9	11:30		2	E>7.6	Heaviest rain 10 a. m. to 12:30 p. m. 18.
233	41	54	18	78	03	45	Coudersport 6c	R. Haskins	DN	10		*8.4					Reporter believed there was enough rain to have filled container again.
234	41	54	14	78	03	45	6a	A. Swift	10		P. m.	10.0	10		P. m.	10.0	
235	41	54	12	78	07	18	5b	W. Stephenson	DN		1	*7.0	DN		1		No rain 6 to 8 a. m. 18.
236	41	54	08	78	01	06	6d	F. Amidon	12	5:30 7 to 9:30		6.8 6.4	12	9:30		E14.0	Very heavy rain 12 to 5:30 and 6:30 to 8:30 a. m. 18.
237	41	54	07	78	04	18	6b	F. Rachick	9:30		2	8.4	9:30		2	8.4	Container may have leaked a little at beginning of storm.
238	41	53	48	78	19	42	Smethport 6c	Lewis	10		P. m.	*9.7	10		P. m.		Heavy rain 8:30 a. m. to 12:30 p. m. 18.
239	41	53	45	78	20	40	5b	J. Cooney				*8.8					Hard rain 7:30-12 a. m. 18. A little hail about 10:45 a. m. 18.
240	41	53	35	78	15	29	6d	H. Evans		7:45 to 10:15		7.7					Heavy rain beginning between 7:30 and 8:15 a. m. 18 and ending about 12:30 p. m. 18. Reporter stated more rain fell, during heavy rain, after container was full than before (7.7 inches).
241	41	53	31	78	20	57	5c	Glover		8:45 to 9:30		5 8	11		2		Heavy rain started 8:30 a. m. 18.
242	41	53	24	78	06	28	Coudersport 5c	L. Shattuck	DN	10		*8.3					Heavy rain 8 to 11:30 a. m. 18.
243	41	53	23	78	19	02	Smethport 6e	Cantwell	DN		4	*8.1	DN		4		Heavy rain started 8:30 a. m. 18.
244	41	53	12	78	16	30	6f	A. McNeil		8 to 8:20		1.8	DN	12 m.			Heavy rain about 8-12 a. m. 18. Container sheltered.
245	41	53	09	77	59	31	Genesee 4c	J. Hemple	DN	8 8	 1	*6.6 1.9 *8.5	DN		1		
246	41	53	07	78	06	44	Coudersport 5d	E. Fosmer	DN	8 8 to 9:30		6.3 3.4 9.7	DN		P. m.		Heaviest rain from 8:30-12 a. m. 18. Reporter estimated nearly as much rain after 9:30 a. m. 18 as before.

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

No. on pl. 2	Latitude (deg., min., sec.)	Longitude (deg., min., sec.)	Quadrangle designation [1]	Reporter or resident	Rainfall between times shown				Storm period between times shown				Remarks
					July 17 p. m.	July 18		Amount measured (inches)	July 17 p. m.	July 18		Total rainfall measured (inches)	
						A. m.	P. m.			A. m.	P. m.		
					Allegheny River drainage basin—Continued								
			Pennsylvania—Con.										
247	41 52 51	77 55 14	Genesee 4d	R. Conable	DN	6		*7.0					Reporter estimated total rainfall to be 10.5″.
248	41 52 35	78 06 17	Coudersport 5e	M. Sperl	10:30	6:30 6:30	 P. m.	*7.2 3.9 *11.1	10:30		P. m.		Very heavy rain 10:30 p. m. 17 to 7 a. m. 18.
249	41 52 33	78 14 10	4b	F. Van Nater		8–11		7.5	12	12		E>15.9	Very hard rain 12 to 2 a. m. and downpour 7–12 a. m. 18. Reporter estimated there was enough rain to fill container again.
250	41 52 27	77 56 24	Genesee 4e	W. Leet	11:30		1+	8.8	11:30		1+	8.8	Very hard rain 11:30 p. m. 17 to 6:30 a. m. 18 and 8 a. m. to 1 p. m. 18.
251	41 52 20	78 20 15	Smethport 5c	E. Hultz		12:15	3	34.5		12:15	3	34.5	Downpour 8 to 11:30 a. m. 18.
252	41 52 17	78 23 44	5d	W. Finley		A. m.	P. m.	*5.5					The wood-stave bucket leaked badly until soaked up; therefore there must have been more than 5.5″ rain for the period of catch.
253	41 52 13	78 25 55	4a	W. Brown	11		5	12.5	11		5	12.5	Heavy rain 11 p. m. 17 to 6:30 a. m. 18 and 8:30–12 a. m. 18. A little hail about 11 p. m. 17.
254	41 52 12	78 24 02	5f	Bickford		12:30	P. m.	9.1		12:30	P. m.	9.1	Heavy rain 9:45–12 a. m. 18.
255	41 52 12	78 17 10	6g	Sigward		8:30	1:30	7.3	DN		1:30		Heavy rain 12 to 2 and 4 to 6:30 a. m. 18; downpour 9:30 to 11:30 a. m. 18.
256	41 52 03	78 24 22	5g	A. Stratton				2.8					Amount for night of 17 only. Heavy rain 7–12 a. m. 18.
257	41 52 03	78 13 09	Coudersport 4c	T. Robbins		10	2	*7.5	11:30		2	E>14.7	A little hail about 11:30 p. m. 17. Reporter estimated there was enough rain to fill container 2 more times.
258	41 51 59	78 24 30	Smethport 5h	Stratton				*5.6					

259	41 51 59	78 11 45	Coudersport 4d	C. Baum	12	6 6	 12:30	*3.3* *5.3* 8.6	12		12:30	8.6	Downpour 8 a. m. to 12:30 p. m. 18.
260	41 51 46	78 19 36	Smethport 6h	R. Simar				14.2				14.2	Downpour 7 to after 10 a. m. 18.
261	41 51 45	78 00 11	Coudersport 6e	A. Sturdevant	12	6:30 6:30 to 9 9–11		*3.1* *1.9* *1.9* 6.9	12		2		Very hard rain 12 to 2, 4:30 to 7, and 9 to 11 a. m. 18. Nearly all of storm rainfall measured.
262	41 51 38	78 15 14	Smethport 6i	G. Scott		11 to 11:20		1.8	12		12:30		Heavy rain 12 to 5 a. m. 18. A few large hail stones about 9:30 a. m. 18. Downpour period 9:30 to 11:30 a. m. 18.
263	41 51 11	78 24 50	5i	Harris				*11.5					Amount is for part of downpour period on 18.
264	41 51 04	78 13 20	Coudersport 4e	M. Thornshelley				6.7					Container may have overflowed and children dipped out part of catch. Downpour started at 9 a. m. 18.
265	41 51 02	77 56 28	Genesee 4f	Aheara	2:30		P. m.	10.0	2:30		P. m.	10.0	Hard showers 2:30 to 3 p. m. 17, also hail. Very heavy rain 11 p. m. 17 to 9 a. m. 18 and hard rain 10–12 a. m. 18.
266	41 51 01	78 21 47	Smethport 5j	R. Teeter				17.2				17.2	Amount small owing to small leak in container.
267	41 50 55	78 01 03	Coudersport 6g	F. Kenyon				*12.5					
268	41 50 54	78 13 47	4g	A. Burr	DN	12 m.		*13.8	DN		P. m.		Very hard rain from before 8 a. m. to 12 m. 18. Reporter estimated there was nearly enough rainfall to have half-filled container again.
269	41 50 44	78 03 52	6f	R. Brock	11:20	6		5.7	11:20		12:30		Heaviest part of rain on 18 was over by 10:30 a. m.
270	41 50 42	78 18 23	Smethport 6j	S. Carlson	12	7		*7.3	12		1		Hard rain 12 to 4 a. m. 18. Downpour period 6 a. m. to 1 p. m. 18. Reporter estimated there was enough rain to have filled container again.
271	41 50 42	78 06 05	Coudersport 5f	J. Birosh	10		3:45	6.4	10		3:45	6.4	Excessive rain 7:30 a. m. to some time in p. m. 18.
272	41 50 32	78 14 40	4h	K. Cooke	12		3:30	*12.7	12		3:30		Downpour 7:30 a. m. to 2:30 p. m. 18. A little hail about noon 18.
273	41 50 28	78 04 03	6h	F. Snyder		9:30 to 10:30		2.5	DN	12 m.			

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

No. on pl. 2	Latitude (deg., min., sec.)	Longitude (deg., min., sec.)	Quadrangle designation [1]	Reporter or resident	Rainfall between times shown: July 17 p. m.	Rainfall: July 18 A. m.	Rainfall: July 18 P. m.	Amount measured (inches)	Storm period between times shown: July 17 p. m.	Storm period: July 18 A. m.	Storm period: July 18 P. m.	Total rainfall measured (inches)	Remarks
			Allegheny River drainage basin—Continued										
			Pennsylvania—Con.										
274	41 50 27	78 24 13	Smethport 5k	A. Austin		8	P. m.	3.3		12:30	P. m.	E7.1	No rain 4 to 9 a. m. 18. Heavy rain 12:30–4 a. m. and 9-12 a. m. 18.
275	41 50 24	78 17 09	6k	G. Appolt		7:45	About 1	*30.8	11		About 1		Heavy rain 7:45 a. m. to 12:30 p. m. 18. The heaviest rain was around noon.
276	41 50 22	78 24 11	5l	F. Wilcox		7:30	P. m.	*9.8	DN			E>22.4	Hard rain 9 to 10:45 a. m. 18.
277	41 50 17	78 03 22	Coudersport 6j	M. Peet	11		2:30	*6.7	11		2:30		Very heavy rain 7 to 11:30 a. m. 18.
278	41 50 15	78 03 42	6i	A. Thompson	11		1	*6.8	11		1		Amount greater than 6.1 inches by 8 a. m. 18. Reporter believed as much or more rain fell after 8 a. m. 18 as before.
279	41 50 06	78 23 30	Smethport 5m	K. Austin	12		1:30	*13.1	12		1:30		Heavy rain 9 a. m. to 1:30 p. m. 18.
280	41 49 59	78 17 39	9a	R. Hardes	DN	6		4.5					
281	41 49 57	78 21 33	8a	C. Strang	11		4:30	*12.1	11		4:30		Heaviest rain 12:30 to 4:30 p. m. 18.
282	41 49 54	78 15 06	9c	H. Brown		12:30	12:30	*10.8		12:30	12:30		Hard rain 12:30 to 5:30 a. m.; downpour 8 a. m. to 12:30 p. m. 18. A little hail a. m. 18.
283	41 49 53	78 19 17	9b	E. Strang		7	P. m.	6.5				E11.9	
284	41 49 52	77 51 05	Genesee 8a	G. Harvey	12	5:30		*12.5	12	12 m.			Very heavy rain 12 to 6:30 a. m. 18.
					12	12 m.		18.5	12	12 m.		18.5	
285	41 49 48	78 24 56	Smethport 8b	P. Olson	9:30	A. m.		4.4	9:30		3		Amount for night of 17 only. Hard rain 9:30 to 10:30 a. m. 18.
286	41 49 35	78 19 56	9d	G. Stoker	DN	11:30		*9.3	DN		3		Heavy rain 8:15 to 10:15 a. m. 18.
287	41 49 34	78 08 17	Coudersport 8a	E. Harned	DN		1:30	8.5	DN		1:30	8.5	Rained some about 6:30 p. m. 17.

288	41	49	19	78	00	40	9a	W. Perry	11 11		2 2	*13.5 *9.9	11		2		Very hard rain 11 p. m. 17 to 3:30 a. m. and 6 to 9 a. m. 18. The 13.5 inches record was obtained at a poor location and therefore is somewhat questionable.
289	41	49	13	78	03	23	9b	W. Scott	DN		3	*6.5	DN		3		Very hard rain 9 to 12 a. m. 18.
290	41	49	08	78	11	20	7a	H. Baker	12	11		11.5	12		P. m.		Downpour 8 a. m. to 12 m. 18. Container full by or before 11 a. m.
291	41	49	08	78	08	36	8e	R. Green				*8.3					
292	41	49	07	78	15	48	Smethport 9g	M. Manning	11	10		*8.0	11		2		Reporter estimated there was enough rain to have filled container again.
293	41	49	06	78	08	35	Coudersport 8c	T. Gross		7:30	P. m.	*9.0				E15.1	
294	41	49	04	78	25	09	Smethport 7a	W. Raymer				9.0				9.0	
295	41	49	02	78	17	56	9k	L. Scherer		12:30 to 8:30 8:30	 12 m.+	5.0 5.0 10.0		12:30	12 m.+	10.0	
296	41	49	02	78	22	54	8c	G. Smith				6.4				6.4	
297	41	49	00	78	17	13		O. Crossman				*12.0					
298	41	49	00	78	16	52	Smethport 9f	E. Dolaway		8	12:30 12:30 to end of storm	*9.5 1.7	DN		P. m.	E>18.9	
299	41	48	55	78	25	09	7b	E. Kibble				*11.2 8.0 5.8				8.0 5.8	Container may have been sheltered by house.
300	41	48	53	77	53	10	Genesee 8b	A. Gleason	11:30		P. m.	*15.4	11:30		P. m.		Very heavy rain 11:30 p. m. 17 to 8 a. m. 18 and hard rain 8:30 a. m. to 1:30 p. m. 18.
301	41	48	47	78	17	02	Smethport 9h	Minnier		9:50	P. m.	18.2				E35.8	
302	41	48	44	77	54	36	Genesee 8c	Butler	11:30		P. m.	11.0	11:30		P. m.	11.0	Very heavy rain 11:30 p. m. 17 to 4:30 a. m. 18 and hard rain 4:30–12 a. m. 18.
303	41	48	15	77	53	30	8d	Abbey	11		7:30	*24.2	11		7:30		Heavy rain 11 p. m. 17 to 10:30 a. m. 18.
304	41	48	13	78	17	11	Smethport 9i	J. Carlson		12:15	1	*14.6		12:15	1		Hard rain 7 to 8:30 and downpour 8:30 to 10 a. m. 18.
305	41	48	09	77	54	10	Genesee 8e	E. Boucher	12			14.0				14.0	Very heavy rain 12 to 6 a. m. and 7 a. m. to 1 p. m. 18.
306	41	47	56	78	25	10	Smethport 7c	A. Moser				2.8	12:30		4:30+		Amount for night of 17 only.
307	41	47	44	77	56	45	Genesee 7a	R. Yentzer	11	12 m.		6.5	11	12 m.		6.5	Very heavy rain 11 p. m. 17 to 9 a. m. 18.
308	41	47	38	78	14	58	Coudersport 7b	E. Johnson		12:15 to 11		*9.2		12:15	1		Downpour 8 to 11 a. m. 18.

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

No. on pl. 2	Latitude (deg., min., sec.)	Longitude (deg., min., sec.)	Quadrangle designation [1]	Reporter or resident	Rainfall between times shown: July 17 p. m.	Rainfall between times shown: July 18 A. m.	Rainfall between times shown: July 18 P. m.	Amount measured (inches)	Storm period between times shown: July 17 p. m.	Storm period between times shown: July 18 A. m.	Storm period between times shown: July 18 P. m.	Total rainfall measured (inches)	Remarks
Allegheny River drainage basin—Continued													
			Pennsylvania—Con.										
309	41 47 34	78 12 57	Coudersport 7d	F. Fuller		1 to 9:30		*7.7		1	12 m.		Downpour 5 to 10 a. m. 18. Reporter estimated there was enough rain to have filled container again.
310	41 47 34	77 53 31	Genesee 8f	O. Knickerbocker	6		P. m.	24.0	6		P. m.	24.0	Heavy rain 8 p. m. 17 to 9:45 a. m. 18.
311	41 47 33	78 08 56	Coudersport 8d	T. Fitzsimmons	12 12	8 11:30		1.8 *8.7	 12		 P. m.	 E>16.0	Heavy rain started 10 a. m. 18. Reporter estimated there was enough rain to have filled container again.
312	41 47 27	78 13 39	7c	V. Tyler	10:30	4 4–6 7:30 to 9:30		*1.2* **5.5* **8.0*	10:30		8	E>18.1	Downpour 4:30 to 5 a. m. and cloudburst 7:30 to 9:30 a. m. 18.
313	41 47 19	78 16 32	Smethport 9j	T. Fitzsimmons		8:30 to 10:45		*14.7 *15.9		1 to 12 m.			
314	41 47 13	77 54 21	Genesee 8g	Blough	6	5:30		*6.2	6		1		Heavy rain 11 p. m. 17 to 6:30 a. m. 18.
315	41 47 09	78 07 09	Coudersport 8b	C. Clark		1	2:30	*8.3	1		2:30		
316	41 47 07	78 18 45	Smethport 9e	Moss		8	P. m.	10.0	DN		P. m.	E18.2	
317	41 47 06	78 01 42		Water Co				7.7				7.7	Standard rain gage operated Coudersport Water Co.
318	41 47 05	78 11 28	Coudersport 7g	O. Saiers	11:40		P. m.	14.3	11:40		P. m.	14.3	Downpour period 8–12 a. m. 18.
319	41 47 04	78 14 43	7e	E. Anderson		A. m. after 8:30		*7.2	DN		2		Hard rain 12 to 4:15 a. m. and 8:30 a. m. to 2 p. m. 18.
320	41 46 56	78 03 42	9d	O. Senak	11	9		*9.6					Very hard rain 5 to 9 a. m. 18.
321	41 46 52	78 12 21	7f	R. McAlpine	DN	7		*11.9	DN		3:30		No rain 8 to 8:30 a. m. 18.
322	41 46 50	78 16 00	Smethport 9l	M. Turner		4	2	*12.5	4		2		Downpour started 9 a. m. 18.

323	41 46 48	78 09 04	Coudersport 8f	G. Amthor	12		P. m.	*13.5	12		P. m.		Downpour 8 a. m. to 1 p. m. 18.
324	41 46 46	78 25 09	Smethport 7d	C. Haven	11		P. m.	6.1	11		P. m.	6.1	
325	41 46 39	78 12 54	Coudersport 7h	McKervey		12:30	1	15.6		12:30	1	15.6	Heavy rain 9:30-12 a. m. 18.
326	41 46 37	78 09 29	8h	A. Lyman				*1.8					Record for night of 17 only.
327	41 46 35	78 09 42	8i	C. Lute				*7.8					
328	41 46 32	78 10 54	7i	C. Marshner				*14.1					
329	41 46 19	78 08 13	8j	P. Seymour	11	9:30		7.2	11	11			
330	41 46 01	78 01 53	9c	J. Colcord	11	10		*3.9*	11		3	7.7	Downpour 7:45-12 a. m.; heaviest 9-12 a. m. 18.
						10	2	*3.7*					
							2-3	Est. 1					
								7.7					
331	41 45 56	78 09 28	8k	O. Bly	DN		2	4.0	DN		2	4.0	
332	41 45 56	77 54 50	Genesee 8i	A. Lyman	12	8		**8.1*	12	11:15			Heavy rain 12 to 11:15 a. m. 18; heaviest 3 to 9 a. m.
						8 to 11:15		**8.1*					
333	41 45 53	78 07 01	Coudersport 8m	Reed		8-10		*16.2 *8.1	11	12 m. +		E>18.3	Downpour period 8 to 12 a. m. 18.
334	41 45 47	78 07 50	8l	L. Brown	11:30	10		9.3					Heavy rain 9:15 to 10:45 a. m. 18.
335	41 45 30	78 00 33	9e	Harris	10	7		8.6					Reporter estimated there was enough rain to have filled container ⅔ full after 7 a. m. 18.
336	41 45 26	78 24 10	Smethport 8d	F. Coleman		12:30	3:30	*6.9		12:30	3:30		
337	41 45 08	78 14 51	Coudersport 7j	B. Sawyer	9:30		2	*9.5	9:30		2		Downpour period 9:30 a. m. to 1 p. m. 18.
338	41 45 06	78 01 34	9f	E. Vater				*9.5					Some hail for about 15 minutes about 4 p. m. 17.
339	41 44 54	78 14 25		H. Wasmer		8:30	P. m.	*4.9	About 12		Before 5		
340	41 44 37	78 14 17	Emporium 1a	D. Fortner		10	3:30	10.0	12:30		3:30		Downpour 9-12 a. m. 18.
341	41 44 31	78 30 23	Mount Jewett 3a	P. Bloomster		11:30	4:30	1.4	12:30		4:30	E3.4	No rain 6:30 a. m. to 1 p. m., heavy rain 1 to 2:50 p. m. 18.
342	41 44 30	78 09 29	Emporium 2a	M. Obliski				5.6				5.6	Reporter not certain that top of jar was unbroken. Record therefore is maximum possible.
343	41 44 28	78 17 46	Colegrove 3a	Zlobec	9	5:30		**5.9*				E>14.6	Very heavy rain 12 to 5:30, 7 to 8:45, and 9-12 a. m. 18. No rain 5:30 to 7 and 8:45 to 9 a. m. 18. Container too close to eaves during first filling, and that part of record may be too great.
						7 to 8:45		**5.9*					
								*11.8					

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

No. on pl. 2	Latitude (deg., min., sec.)	Longitude (deg., min., sec.)	Quadrangle designation [1]	Reporter or resident	Rainfall between times shown				Storm period between times shown				Remarks
					July 17 p. m.	July 18		Amount measured (inches)	July 17 p. m.	July 18		Total rainfall measured (inches)	
						A. m.	P. m.			A. m.	P. m.		
Allegheny River drainage basin—Continued													
344	41 44 26	77 56 33	*Pennsylvania*—Con. Short Run 1a	Klesa	11:55	8 8 to short time after	------ ------	8.8 2.5 11.3	11:55	------	3	------	Very hard rain 6:30 a. m. to 1 p. m. 18. Reporter estimated container would have more than filled again after 8 a. m.
345	41 44 23	78 13 08	Emporium 1b	F. Fortner	DN ------	5:40 8 to 11:30 11:30	------ ------ 4	*8.2 *7.8 5.2 *13.0	DN	------	4	E18.1	Downpour 10 a. m. to 3:30 p. m. 18.
346	41 44 15	78 21 38	Colegrove 2b	H. Williams	DN	9	------	*5.5	------	------	------	------	Container nearly full early in morning of 18.
347	41 44 00	78 23 46	2a	McDowell	11:30	------	4	5.7	11:30	------	4	5.7	
348	41 43 51	77 57 07	Short Run 1d	H. Predmore	------	6 to 6:15	------	1.5	DN	------	2	------	Extremely heavy rain 5:45 to 6:15 a. m. 18. Catch period may have been less than 15 minutes.
349	41 43 29	78 04 35	Emporium 3c	W. Buchsenschutz	12	12 m.	------	26.6	12 m.	12 m.	------	26.6	Shower 4 to 4:20 p. m. 17. Heavy rain 12–8 a. m. and 8:30–12 a. m. 18. Small stream carried along boulders weighing 4 to 5 tons.
350	41 43 11	78 33 19	Mount Jewett 3b	A. Capwell	11:30	A. m.	------	4.6	11:30	------	------	------	Some hail about 11:30 p. m. 17. Heavy rain 12 to 4:30 p. m. 18.
351	41 42 53	78 39 10	2a	A. Johnson	------	------	------	*9.4	------	------	------	E>21.1	Amount for p. m. 18 only. Heavy rain 2:15 to 4:15 p. m. 18.
352	41 42 46	78 12 50	Emporium 1c	W. Clark	11:30	------	2:30 or 3	25.6	11:30	------	2:30 or 3	25.6	Very hard rain at 4 a. m. and cloudburst 9 a. m. to 1:30 p. m. 18.
353	41 42 26	78 11 29	1d	V. Mantz	DN	------	2:30	*8.2	DN	------	2:30	E>15.0	Downpour 12:30 to 3 a. m. and 9 a. m. to 2:30 p. m. 18.
354	41 42 18	78 29 18	Colegrove 1a	C. Silfius	------	------	------	*7.1	------	------	------	------	Container overflowed before noon 18.

355	41	42	00	78	30	00	Mount Jewett 3c	F. Anderson				8.0				8.0	Heavy rain 8:30 a. m. to 2 p. m. 18.
356	41	41	11	78	23	30	Colegrove 2c	J. Ashby	DN		3:30	7.1	DN		3:30	7.1	Container 6 or 8 feet from side of house, which may have decreased catch.
357	41	41	08	78	10	20	Emporium 1e	J. Barth				1.2					Amount caught in 30 minutes a. m. 18.
358	41	40	56	78	10	47	1f	H. McCloud		1–12		*9.7		1	3		
359	41	40	34	78	40	47	Mount Jewett 1a	G. Jeffords		12:45	4	9.0+		12:45	4	9.0+	Downpour 2 to 4 p. m. 18. Rain probably more than 9.0" as container had a pin hole leak when examined over 1 month later.
360	41	40	22	78	40	52	1b	C. Weaver		A. m.	P. m.	*5.5					Hard rain 2 to 5 a. m. and 2 to 4 p. m. 18. Amount is for daytime 18 only and is small as container was wood-stave keg that leaked while being soaked up.
361	41	40	20	78	25	00	Colegrove 1b	H. Minnier				*12.0					
362	41	40	17	78	23	14	2d	F. Oviatt			12:30 to 3	3.9	10		3	E8.5	
363	41	40	14	78	24	47	1c	G. Rawley				*4.2					Amount measured early a. m. 18. Reporter estimated as much rain fell p. m. 18. as in two other periods of which only the first was measured.
364	41	39	27	78	27	27	4a	B. Hertzog				*8.1					Heavy rain 1 to 4:30 p. m. 18.
365	41	38	57	78	34	04	Mount Jewett 6a	R. Howard			1 to 4:30	*4.2		12:30	4:30		No rain 5 a. m. to 1 p. m., hail as large as marbles for 10 minutes about 3 p. m. 18.
366	41	37	10	78	34	45	6b	J. Szymanski				8.0	12		3:30	E17.6	Amount for p. m. 18 only.
367	41	37	07	78	34	59	5a	L. Allegretto			1:20 to 6	4.6	DN		6	E7.8	Container may have overflowed. A little hail just before 1 p. m. 18. Reporter stated it rained as much before 1:20 p. m. as after.
368	41	36	14	78	34	34	6c	Bodistow	DN		P. m.	18.5	DN		P. m.	18.5	
369	41	36	11	78	37	30	5c	J. Surman	DN		P. m.	*9.0	DN		P. m.		Heaviest rain 2 to 4 p. m. 18.
370	41	36	08	78	38	18	5b	J. Clopp	DN	A. m. A. m.	 6	*2.4* *5.7* 8.1	DN		6	8.1	Hard rain 2:30 to 6 p. m. 18; both containers under apple tree with dense foliage.
371	41	36	00	78	37	02	5d	R. Market	DN	A. m. A. m.	 P. m.	*3.2* *4.0* 7.2	DN		P. m.	7.2	
372	41	35	56	78	34	27	6d	A. Smith				*8.3					

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

No. on pl. 2	Latitude (deg., min., sec.)	Longitude (deg., min., sec.)	Quadrangle designation [1]	Reporter or resident	Rainfall between times shown: July 17 p. m.	Rainfall between times shown: July 18 A. m.	Rainfall between times shown: July 18 P. m.	Rainfall between times shown: Amount measured (inches)	Storm period between times shown: July 17 p. m.	Storm period between times shown: July 18 A. m.	Storm period between times shown: July 18 P. m.	Storm period between times shown: Total rainfall measured (inches)	Remarks
			Allegheny River drainage basin—Continued										
			Pennsylvania—Con.										
373	41 35 43	78 34 30	Mount Jewett 6e	M. Wolf				*12.4					Container exposed 16 to 18.
374	41 35 30	78 36 08	5e	J. Krollcyzk		11:30	6	6.6	DN		6	E13.7	Heavy rain 2:30 to nearly 6 p. m. 18.
375	41 34 55	78 42 06						11.0				11.0	
376	41 34 50	78 38 46	Mount Jewett 5f	W. Elmquist	DN		P. m.	*9.5	DN		P. m.		
377	41 34 38	78 37 48	8a	A. Zimmerman				*9.9					
378	41 34 25	78 41 16						11.6				11.6	Most of rain fell between 4:30 and 7:30 p. m. 18.
379	41 32 59	78 35 51	Mount Jewett 8b	L. Rosencrans				9.0				9.0	Container 6 feet from building.
			Genesee River drainage basin										
			New York										
380	42 25 58	78 00 14	Angelica 3a	L. Aylor	9	6		6.5	9	6		6.5	Very heavy rain about 4 a. m. 18.
381	42 25 58	77 59 42		C. White	6	10:30		3.0	6	10:30			Container sheltered by house.
382	42 25 12	77 58 15	Canaseraga 1a	S. Jones	9	5		5.8	9	5		5.8	
383	42 24 50	77 58 13	4a	M. Closser				4.6				4.6	Heaviest rain early 18.
384	42 24 31	78 01 06	Angelica 6a	J. Bentley				5.7				5.7	Heavy rain about 3 a. m. 18.
385	42 22 09	77 57 28	Canaseraga 4b	M. Amidon	6	5:30		2.9	6	5:30		2.9	Heavy rain 8 to 10 p. m. 17 and 12 to 3 a. m. 18.
386	42 21 15	77 56 48	4c	F. Watkins	9	6:30		*25.0	9	6:30			Very heavy rain about 11 p. m. 17 and 2:30 a. m. 18.
					9	6:30		*11.7					
387	42 20 45	78 00 55	Angelica 6b	W. Breneka	10	4:30		7.0	10	4:30		7.0	Very heavy rain 10 to 11 p. m. 17; also later in night.
388	42 20 40	77 59 42	Canaseraga 4d	T. Link				3.5				3.5	
389	42 20 27	77 54 26	5a	K. George	10:30	5		*9.3	10:30	10			Heavy rain 2 to 6 a. m. 18.
390	42 20 19	78 02 28	Angelica 6c	J. Shafer, Sr.	10+	7		*4.4	10+	10			Heavy rain from about 1 a. m. 18 through night. Amount for 7 to 10 a. m. 18 considered unreliable.
						7–10		*4.4					
								*8.8					

391	42	20	01	77	53	22	Canaseraga 5b	C. Almeter	10	6:30		5.0	10	6:30		5.0	Very heavy rain 4 to 5 a. m. 18.
392	42	19	58	77	55	11	7a	J. Herdman				5.1				5.1	
393	42	19	58	77	54	19	8a	J. Almeter	10	5:30		7.9	10	5:30		7 9	Heaviest rain 3 to 4 a. m. 18.
394	42	19	30	78	02	19	Angelica 9a	J. Shafer	9	6		5.3	9	6		5.3	
395	42	19	23	78	00	51	9b	L. Graham	8	A. m.		6.9	8	A. m.		6.9	Heavy rain started about 10 p. m. 17; heaviest rain 3 to 4 a. m. 18.
396	42	19	18	77	56	51	Canaseraga 7b	J. Young		2 to 4		*4.9					Reporter estimated that total storm rainfall did not exceed 6″ or 7″.
397	42	19	13	77	57	06	7c	R. Jennings	11	8		5.1	11	8		5.1	Very heavy rain 4 to 5 a. m. 18.
398	42	17	33	77	55	05	7d	L. Ives	11	5		*8.2	11	5:45			Heaviest rain 4 to 5 a. m. 18.
399	42	15	29	77	53	48	8b	F. Lonsbery				6.8				6.8	
400	42	14	45	77	57	35	Wellsville 1a	W. Keenan	12	5:30		3.8	12	5:30		3.8	Heaviest rain about 3 a. m. 18.
401	42	13	59	77	56	07	1b	R. Day	8:30	5		*15.5	8:30	5			Heaviest rain 3 to 4 a. m. 18.
402	42	13	10	78	03	39	Belmont 3a	R. Stowell	10	6		5.0					Heaviest rain about 4 a. m.; very little rain after 6. a. m. 18.
403	42	12	45	77	49	22	Wellsville 3a	L. Snyder				4.0				4.0	
404	42	10	28	77	51	15	2a	H. Beckwith	10:45	6		*14.1	10:45	6			Heaviest rain about 3 a. m. 18.
405	42	09	38	77	51	26	5a	F. Mead	10		P. m.	9.0	10		P. m.	9.0	
406	42	08	20	77	54	02	5b	C. Burdick	6+	6+		4.0	6	6+		4.0	
407	42	07	04	77	56	53	4a	E. Rowe	5:30	7		3.5	5:30	7		3.5	Standard rain gage located near buildings. Heaviest rain about 1 a. m. 18.
							Pennsylvania										
408	41	55	04	77	54	09	Genesee 2a	R. Storey	9:30	12 m.		32.7	9:30	12 m.		32.7	Downpour 5 to 6 a. m. 18.
409	41	54	44	77	55	17	4a	T. Trebik	10		1+	3.6	10		1+	3.6	Light hail for 10 or 15 minutes 3 p. m. 17.
410	41	54	10	77	54	16	5a	James				8.8				8.8	Container held 6.2″ at 8:30 a. m. 18.
411	41	54	02	77	55	50	4b	E. Burch				5.6					Heavy thundershowers 12 to 3 a. m. and heavy rain 8:30 to 9:30 a. m. 18.
412	41	50	54	77	50	40	5b	A. Torok	12	6		*5.8	12	12 m.			Heavy rain 12 to 7 a. m. 18.

[1] See, Storm of July 17–18, 1942, New York-Pennsylvania, supplement to Daily and Hourly Precipitation compiled by Hydrologic Unit, U. S. Weather Bureau Office, Albany, N. Y.

THE ISOHYETAL MAP

The drawing of an isohyetal map is anything but an accurate procedure. The best precipitation gage can catch only the rain that falls at that particular spot. It is generally assumed that rainfall varies rather uniformly between points of measurement, except for possible topographic considerations. Such an assumption may not be true. An intermediate gage as little as a hundred feet from one of the points of measurement might have caught a rainfall significantly different from that indicated by the adjacent points of measurement for the same storm, especially if the rainfall were spotty, as during the storm of July 18, 1942. When an isohyetal map is to be based on miscellaneous observations of rainfall, such as given in table 2, the task of drawing the isohyetal lines is exceedingly difficult. Did a container that overflowed, barely overflow, or would it have been filled two or three times more if it had been emptied? Do two containers quite close together, but apparently catching radically different amounts of rainfall, represent an actual variation in rainfall, a poor location for a catch, or inaccurate information supplied by one or both reporters? In using miscellaneous observations of rainfall, the most satisfactory procedure is to accept all data at face value—and this was done. There are usually several ways of interpreting the same data, however, and it is frequently impossible to show that any one interpretation is better than another.

The center of greatest precipitation shown on plate 2 is at Port Allegany. There an isohyetal line was drawn to indicate a precipitation of 35 inches. That amount of rainfall is based on miscellaneous measurements 275 and 301. The rain at measurement point 275 was caught in the glass jar shown in figure 37, which shows also the exposure conditions of the jar as well as could be reenacted about a month after the rain. This jar was set out about 7:45 a. m.; it filled with rain for a catch of 30.8 inches, and then overflowed. Considering the unmeasured rainfall prior to 7:45 a. m. and the unknown amount lost by overflow, it would appear that the rainfall at this point was at least 35 inches. That a tremendous rainfall occurred is further indicated by the runoff conditions described under Flood Flows. Measurement 301 showed 18.2 inches of rain after 9:50 a. m. The latest that any rain was reported in the vicinity was at 2 p. m., for measurement 292. That would mean that the 18.2 inches fell in less than 4 hours and 10 minutes. The curve in figure 36 shows that 50.8 percent of the total rainfall occurred in that time, from which an estimated total rainfall of 35.8 inches was obtained for measurement point 301. If the 18.2 inches fell in less than 4 hours, the computation procedure would indicate an amount much greater than 35 inches. At the recording gage in Smethport, about 8 miles away, only 32 percent of the storm

FIGURE 37.—Glass jar (table 2, No. 275), on Appolt farm, that overflowed after catching 30.8 inches of rain. Scene was enacted about a month after the rain to show that nearby objects probably had little effect on the catch.

rainfall occurred after 10 a. m., and practically no rain fell after 1 p. m. That record thus indicates also that measurement 301 should be greater than 35 inches for the storm total. For computations of average rainfall the maximum precipitation was assumed to be 36 inches.

In addition to the precipitation center of more than 35 inches at Port Allegany, there are two centers of more than 30 inches at Turtlepoint and northeast of Coudersport. These centers are based on measurements 251 (34.5 inches) and 408 (32.7 inches), respectively. All three centers are within the main area of heavy precipitation. Off to the northeast, at Angelica, N. Y., there is an area of heavy precipitation that, from the appearance of the map, one might think was a separate storm. It should be noted, however, that the lowest isohyetal line drawn is for 4 inches. The two areas of heavy precipitation are in reality part of a general storm that covered practically the entire region shown on the map with precipitation of at least an inch.

The isohyetal map for the storm of July 18, 1942, given in plate 2, is the fourth such map to be compiled. It was drawn by the author using the other three maps as basic references. The first map, drawn by Stewart, was based on precipitation records, topography, and relative erosion in small streams. For the last-mentioned, Stewart used an arbitrary scale of 0 to 10 to compare the relative amounts of eroded material at the mouths of the smaller streams. These data were helpful, particularly in the areas where rainfall measurements could not be obtained. Stewart's map was reviewed by the Weather Bureau and modified slightly to take into account the meteorologic characteristics of the storm. The map was reproduced in the Weather Bureau report. Subsequently, the Corps of Engineers made an extensive hydrologic analysis of the storm. As a result of that analysis, it was concluded by the Corps of Engineers that the Weather Bureau map showed too much total precipitation over the storm area for the runoff observed. The Corps of Engineers therefore prepared a new map, for use in the studies being made, that shows considerably less precipitation. The map for this report (pl. 2) is basically the Weather Bureau map redrawn in such a manner that wherever an acceptable interpretation of the data could be made showing less precipitation than the Weather Bureau map, that one was used. The resulting map is quite similar to the one prepared by the Corps of Engineers. The isohyetal lines were drawn to be fully consistent with the data in tables 1 and 2.

AREA-DEPTH RELATIONS

The areas enclosed within the several isohyetal lines on plate 2 were measured with a planimeter. The total area within the heavier lines, 25- and 8-inch, is 14 and 1,215 square miles, respectively. The 4-inch lines enclose a total area of 3,100 square miles. The greatest average precipitation over areas of various sizes is given in table 3. Differences between these values and similar ones based on the isohyetal map drawn by the Corps of Engineers are believed to be insignificant. No attempt was made to distribute the precipitation with respect to time; only the total storm was studied.

TABLE 3.—*Maximum average precipitation over indicated areas for storm of July 17–18, 1942*

Area (square miles)	Precipitation (inches)	Area (square miles)	Precipitation (inches)	Area (square miles)	Precipitation (inches)
1	35.8	50	25.1	500	16.4
5	32.6	100	22.6	1,000	13.5
10	30.5	200	20.0	2,000	10.5
20	28.3				

FLOOD FLOWS

Flood flows within the storm area were the greatest ever recorded on many of the streams, including those in Allegheny River basin above Kinzua, in the upper part of Clarion River drainage basin, Driftwood Branch Sinnemahoning Creek, and First Fork Sinnemahoning Creek (Pa.), and Karr Valley Creek (N. Y.). In the major stream channels leaving the area, however, the flood flows diminished rapidly in relation to previous maximum flows. The absence of outstanding floods in the lower reaches of the streams outside the storm area probably was because the heavy rainfall was divided among three major drainage basins.

Peak flows in the smaller streams in the area of intense precipitation must have been tremendous, as evidenced by the enormous erosion that took place. On the Appolt farm near Port Allegany, the only channel for draining the hillside before the storm was a worn place in the meadow hardly more than a foot wide (figure 38). The runoff from this storm cut a new channel about 5 feet deep and more than 10 feet wide. It was here that rainfall measurement 275 was obtained, as discussed on page 114. On the neighboring Taylor farm much the same events took place. The road between the two farms was blocked in several places by mud flows and slides. A view of the upper end of the debris cone formed as a result of the tremendous erosion is shown in figure 33.

The drainage basins for the channels on the Appolt and Taylor farms extend only a short distance on each side and to the top of the hill shown in figures 33 and 38. Although the hill had dense forest cover, it was evident that overland flow occurred under the trees. The forest litter had been cut up by a myriad of channels as the water from the intense rain flowed away. An attempt was made to estimate the maximum discharge in the channels draining these two areas. Both channels were scoured out to bedrock in many places and at several points the ledge of bedrock formed the head of a falls. At one of these places on the Appolt farm and at two on the Taylor farm, the channel was surveyed for computation of the flow by the critical-depth method. This method assumes that critical flow occurred at the brink of the falls where the cross-sectional area was surveyed. The discharge is then given by the formula (King, 1939, p. 373):

$$Q=5.67\sqrt{\frac{A^3}{T}}$$

in which Q=discharge in second-feet,
A=cross-sectional area in square feet,
and T=top width of cross section in feet.

FIGURE 38.—Old and new drainage channels on Appolt farm near Port Allegany, Pa. Man in dark suit points to previous channel, while man with cap aloft stands in channel cut July 18, 1942. Note party surveying critical-depth section, circled in right background.

The upper critical-depth section on the Taylor farm is shown in figure 39. The highwater marks used to obtain the depth of water in the channel were quite well defined. This indicates that they were made late in the storm and after the channel had been scoured out,

FIGURE 39.—Upper critical-depth section on Taylor farm. Photographed by R. C. Culler.

otherwise they would have been obliterated by the tremendous inflow. It is more than likely that velocities were much greater than critical and that the computed discharge is too small. These three measurements indicate the highest discharge in second-feet per square mile of any in the flood area. It should be realized however that the drainage areas are extremely small, and that the errors in measuring them on the small-scale map available may be quite large. Both channels were dry at the time of the author's visit on August 26.

Several parties searched the flood area to locate streams in which outstanding flood flows occurred. Wherever possible, slope-area, contracted-opening, and flow-over-dam measurement sites were chosen and surveyed for the computation of discharge. The slope-area reach on Nelson Run—a tributary of First Fork Sinnemahoning Creek in the area of high precipitation—is shown in the foreground of figure 40. This slope-area reach is about average for those used. Slope-area and other measurements of flow of these small streams made after the flood and under conditions that existed are not regarded as precise

FIGURE 40.—Slope-area reach on Nelson Run. (No. 789.60 in table 4.)

observations in any sense. They do provide, however, the best method of evaluating the discharge. The contracted opening at the new highway bridge at Port Allegany—destroyed by the flood just 3 days after it was opened to traffic—provided a site where a peak discharge of 77,000 second-feet was measured, the largest in Allegheny River drainage basin. (See fig. 41.) In addition to those made at gaging stations and the critical-depth measurements described above, about 50 miscellaneous measurements were made, including several by the Corps of Engineers. The results of those measurements are summarized in table 4. The methods and procedures used are described by Corbett and others (1943, pp. 98–109).

On many streams where flood flows are known to have been quite large, no sites for measurements could be found. Thus, the fact that a stream is shown on plate 2 with no point of measurement indicated does not mean that the flood flow in that stream was not excessive. On the other hand, some streams that produced little flood runoff were measured to show that they did not contribute to the excessive runoff in the larger streams to which they are tributary.

Following are some of the streams in which excessive flood flow occurred that were examined for measuring sites without success: Norcross, Loque, and Muley Runs tributary to First Fork Sinnema-

FIGURE 41.—Bridge opening on Allegheny River at Port Allegany, Pa., used for contracted-opening measurement. (No. 000.7 in table 4.)

honing Creek; Sevenmile Creek tributary to East Fork Clarion River; Dodge Creek, and Haskell Creek (Pa.), and the upper tributaries of Fivemile Creek in the vicinity of Olean, N. Y.; and Baker Creek near Angelica, N. Y.

In the headwaters of the larger streams, Driftwood Branch Sinnemahoning Creek, Allegheny River, and Clarion River, the flood of July 1942 was the largest known. As the floods progressed downstream and left the storm area they rapidly became smaller in relation to previous floods. That was true also in Genesee River although at the uppermost gaging station at Scio, N. Y., the peak discharge approached, but did not exceed, that for the flood of May 1919, the maximum in 26 years of record.

It is interesting to note the effect of the shape of the river valleys on the shape of the flood wave as it progressed downstream, as illustrated in figure 42. The streams in the Susquehanna River drainage basin flow through narrow valleys with very small flood plains. Consequently very little of the flood waters was held in channel storage, and the flood wave passed down the valley with little change in form. On the other hand, Allegheny River above Red House, N. Y., flows through a broad valley with large flood plains. During the flood of July 1942, those flood plains were inundated to a considerable depth with correspondingly large amounts of channel storage. As a result,

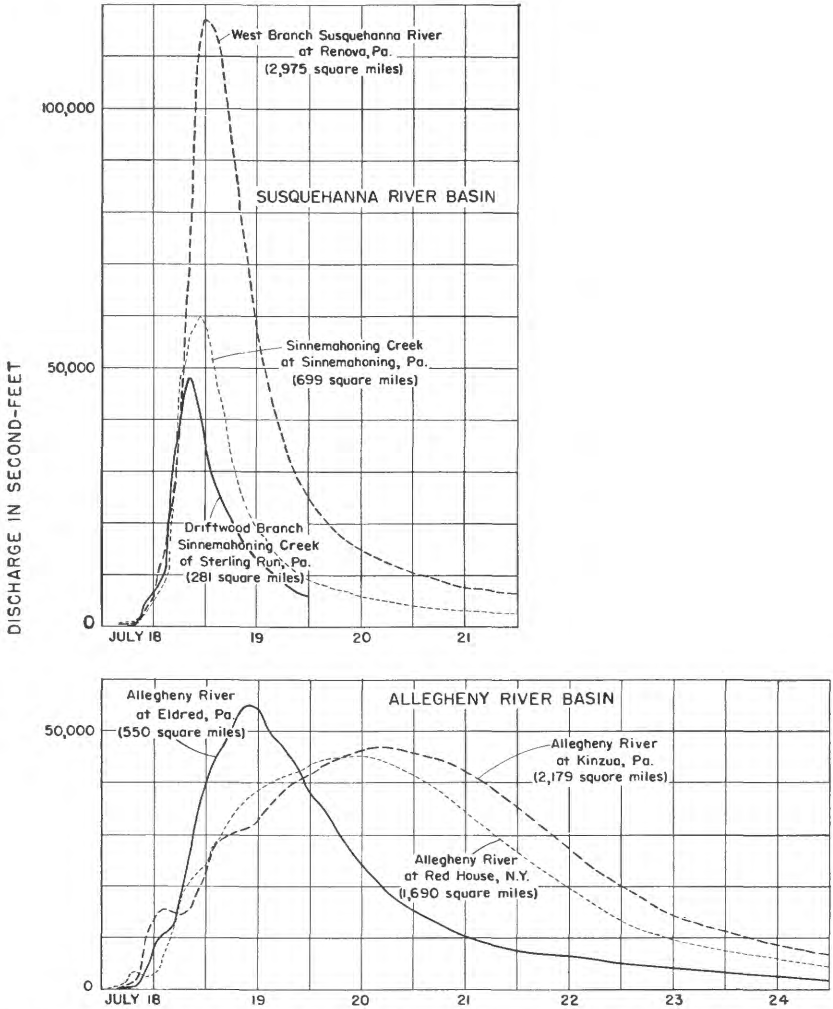

FIGURE 42.—Comparative hydrographs of flood flows in Susquehanna and Allegheny Rivers drainage basins.

the hydrograph of the flood wave at Red House was much flatter and broader than at Eldred. Below Red House, however, the valley of Allegheny River becomes much narrower, which probably accounts for the lack of change in the shape of the hydrograph between Red House and Kinzua. Other factors such as amount and distribution of precipitation have important effects on the size and shape of a flood hydrograph, but computations of channel storage for the flood of July 1942 between Eldred and Red House indicate that this factor alone could account for the diminution of the peak discharge between those two points.

STAGES AND DISCHARGES AT STEAM-GAGING STATIONS

Stage and discharge records at stream-gaging stations within and adjacent to the flood area are given on the following pages. For each station there is given a station description, a table of daily mean discharge for July and August 1942, and a table of gage heights and discharges at indicated times for use in plotting hydrographs of the flood. Daily mean discharges at these stations for the entire water year 1942 have been published in Water-Supply Papers 951, 953, and 954, Surface Water Supply of the United States 1942: Part 1, North Atlantic slope basins (includes Susquehanna River drainage basin); Part 3, Ohio River basin (includes Allegheny River drainage basin); and Part 4, St. Lawrence River basin (includes Genesee River drainage basin), respectively. Methods of obtaining the records are described briefly in those reports and at greater length in the manual, Stream-Gaging Procedure (Corbett and others, 1943).

Records of daily mean discharge alone are usually inadequate for making any detailed studies of a flood such as that of July 1942. To supply the data for the detailed studies necessary in connection with flood control and forecasting, channel improvement, bridge openings, and the design of hydraulic structures in relation to the flood channels of streams is the object of this report. The table of stages and discharges at indicated times has been included for that purpose. Some of the gage heights in those tables, and the discharges based on them, were not obtained from an actual gage-height record, perhaps because the gage used was a nonrecording one, because the recording-gage record was destroyed by the flood, or for some other reason. It is often possible to obtain a fair record of gage height and discharge by drawing a hydrograph through the plotted points representing observed data, using other available information such as observers' notes, meteorological information, studies of runoff at other gaging stations on the same or adjacent streams, interpreted in the light of intimate knowledge of the peculiar local conditions inherent to a particular gaging station. As Geological Survey engineers usually have access to more of such information than would normally be available to other users of the records, and to complete the report where it could be done with reasonable accuracy, they have made estimates of detailed records wherever necessary.

The station description and the tables are largely self-explanatory. The section headed "maxima" may need additional explanation: The first paragraph gives the maximum stage and discharge during the flood of July 1942; the second paragraph gives the maxima during the preceding period of stream-flow record; and the third paragraph gives the maxima known outside the period of record, usually restricted to those greater than within the period of record.

The gaging-station records are arranged by parts in the order used in the annual reports on Surface Water Supply of the United States referred to previously. The stations are grouped by parts in numerical order of the parts and within each part are arranged in downstream order, the stations on the main stem being given first followed by each tributary in turn.

SUSQUEHANNA RIVER DRAINAGE BASIN

CANACADEA CREEK NEAR HORNELL, N. Y.

LOCATION.—Lat. 42°20′05″, long. 77°41′00″, 35 feet downstream from Morris Bridge, near city limits of Hornell, Steuben County, and 2 miles upstream from mouth.

DRAINAGE AREA.—58.7 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph, except for period 4 p. m. July 31 to 11 p. m. August 3.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 3,200 second-feet and extended to crest stage by logarithmic plotting. Discharge July 31 to August 3 computed on basis of records for nearby stations. Shifting-control method used August 4–31.

MAXIMA.—July 1942: Discharge, 6,080 second-feet 6:40 a. m. July 18 (gage height, 7.07 feet).

1924–29, 1938 to June 1942: Discharge, 6,600 second-feet Mar. 17, 1942 (gage height, 7.35 feet).

The flood of July 1935 reached a stage of about 12.3 feet at present site, obtained in 1940 from floodmarks (discharge, 21,000 second-feet by slope-area method).

Daily mean discharge, in second-feet, 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	7.9	35	9	6.6	16	17	7.9	16	25	15	10
2	11	26	10	7.4	23	18	712	14	26	16	9.8
3	7.0	20	11	43	16	19	81	13	27	17	9.2
4	7.0	16	12	16	14	20	49	12	28	42	9.2
5	7.4	15	13	11	22	21	24	10	29	49	9.8
6	7.9	14	14	9.2	39	22	19	11	30	37	9.2
7	7.4	13	15	7.9	18	23	17	14	31	44	8.6
8	6.6	14	16	7.9	16	24	16	13			

	July	Aug.
Monthly mean discharge, in second-feet	42.5	15.7
Runoff, in inches	0.83	0.31

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
July 17			*July 18—* Con.			*July 18—* Con.			*July 19—* Con.	1.53	99
6	1.11	7.0	3	1.18	14	2	2.28	352	6	1.43	77
11	1.12	7.9	4	1.28	26	3	2.18	309	N	1.35	60
6	1.12	7.9	5	1.40	44	4	2.10	276	6	1.29	48
8	1.11	7.0	6	5.95	4,170	5	2.01	242	12		
10	1.11	7.0	7	6.20	4,570	6	1.94	217	*July 20*		
12	1.16	12	8	4.50	2,190	9	1.79	168			
			9	3.67	1,320	12	1.68	137	3	1.45	81
July 18			10	3.25	954				6	1.36	62
			11	2.88	681	*July 19*			N	1.29	48
1	1.16	12	N	2.61	517				6	1.22	36
2	1.16	12	1	2.42	418	3	1.59	114	12	1.17	28

SUPPLEMENTAL RECORD.—July 18, 6:40 a. m., gage height 7.07 feet, discharge 6,080 second-feet.

KARR VALLEY CREEK AT ALMOND, N. Y.

LOCATION.—Lat. 42°18′40″, long. 77°45′05″, 500 feet downstream from McHenry Valley Creek, three-quarters of a mile upstream from mouth, and 1 mile upstream from Almond, Allegany County. Datum of gage is 1,353.68 feet above mean sea level (levels by Corps of Engineers).

DRAINAGE AREA.—27.6 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph except for period 5 a. m. July 18 to 3 a. m. July 20 for which a graph was drawn based on floodmarks and frequent readings of staff gage.

DISCHARGE RECORD.—Artificial control of concrete. Stage-discharge relation defined by current-meter measurements up to 1,600 second-feet and extended to slope-area measurement for crest gage height.

MAXIMA.—1942: Discharge, 5,900 second-feet 5:45 a. m. July 18 (gage height, 8.8 feet from floodmarks).

1937–41: Discharge, 3,800 second-feet March 31, 1940 (gage height, 5.8 feet, from floodmark) from rating curve extended above 1,600 second-feet by logarithmic plotting.

Daily mean discharge, in second-feet, 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	1.1	11	9	0.8	3.0	17	1.4	4.0	25	2.6	1.6
2	1.0	6.3	10	1.2	6.8	18	513	3.2	26	2.9	1.5
3	.9	4.7	11	18	4.4	19	51	2.6	27	4.0	1.4
4	.9	3.4	12	5.7	3.4	20	28	2.1	28	10	1.4
5	.9	2.8	13	3.0	11	21	14	1.8	29	15	1.3
6	1.0	2.4	14	2.0	15	22	7.9	1.6	30	12	1.2
7	1.0	2.1	15	1.6	5.8	23	5.2	1.7	31	16	1.1
8	.9	2.5	16	1.4	4.2	24	3.6	1.6			

	July	Aug.
Monthly mean discharge, in second-feet	23.5	3.77
Runoff, in inches	.98	.16

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
July 17			*July 18—Con.*			*July 18—Con.*			*July 19*		
N	1.73	1.3	6	8.13	4,980	4	3.20	201	3	2.72	70
12	1.82	2.8	7	5.70	2,120	5	3.13	176	6	2.68	63
			8	4.90	1,350	6	3.06	154	9	2.63	54
July 18			9	4.40	910	7	3.01	139	N	2.59	48
			10	4.06	658	8	2.96	126	6	2.52	38
1	1.89	4.7	11	3.77	479	9	2.92	115	12	2.48	33
2	1.91	5.4	N	3.58	376	10	2.88	105			
3	1.92	5.7	1	3.46	315	11	2.84	96			
4	1.98	8.1	2	3.36	268	12	2.80	87			
5	3.00	180	3	3.28	233						

SUPPLEMENTAL RECORD.—July 18, 5:45 a. m., gage height 8.80 feet, discharge 5,900 second-feet.

WEST BRANCH SUSQUEHANNA RIVER AT KARTHAUS, PA.

LOCATION.—At mouth of Mosquito Creek at Karthaus, Clearfield County. Gage is at lat. 41°06′55″, long. 78°06′40″, 900 feet upstream from highway bridge, 1,200 feet upstream from Mosquito Creek, and 3.3 miles downstream from Moshannon Creek. Datum of gage is 830.59 feet above mean sea level, datum of 1929, New York-Pennsylvania supplementary adjustment of 1943.

DRAINAGE AREA.—1,462 square miles, including that of Mosquito Creek.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Includes flow of Mosquito Creek. Stage-discharge relation defined by current-meter measurements up to 52,000 second-feet.

MAXIMA.—July 1942: Discharge during flood period, 1,120 second-feet 2 a. m. July 19 (gage-height, 2.15 feet).

1918–20, 1940 to June 1942: Discharge, 50,900 second-feet Apr. 1, 1940 (gage-height, about 13.9 feet).

1889–1917, 1921–39: Discharge, about 135,000 second-feet March 18, 1936 (gage-height, about 24.5 feet, from floodmark at highway bridge).

Daily mean discharge, in second-feet, 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	633	386	9	410	312	17	308	527	25	348	701
2	786	441	10	379	431	18	550	481	26	317	576
3	930	416	11	384	481	19	874	420	27	316	453
4	722	415	12	379	400	20	588	359	28	311	390
5	594	359	13	350	359	21	457	321	29	290	354
6	521	326	14	335	447	22	407	316	30	301	326
7	510	280	15	321	405	23	372	552	31	348	298
8	458	263	16	289	359	24	346	800			

	July	Aug.
Monthly mean discharge, in second-feet	456	418
Runoff, in inches	0.36	0.33

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
July 17			*July 18*—Con.			*July 19*—Con.			*July 20*—Con.		
6	0.97	302	4	1.60	652	2	1.71	730	N	1.48	576
N	1.00	316	6	1.68	708	4	1.76	769	4	1.43	545
6	1.00	316	8	1.82	817	6	1.84	834	8	1.38	515
12	1.00	316	10	1.93	912	8	1.82	817	12	1.34	492
July 18			12	2.08	1,050	10	1.77	777	*July 21*		
2	1.00	316	*July 19*			12	1.72	738	N	1.28	458
4	1.07	350	2	2.15	1,120	*July 20*			12	1.22	426
6	1.08	354	4	2.07	1,040	2	1.67	701	*July 22*		
8	1.13	379	6	2.01	984	4	1.62	666	N	1.18	405
10	1.17	400	8	1.93	912	6	1.57	633	12	1.15	390
N	1.27	453	10	1.84	834	8	1.53	607			
2	1.47	570	N	1.77	777	10	1.51	594			

WEST BRANCH SUSQUEHANNA RIVER AT RENOVO, PA.

LOCATION.—Lat. 41°18′50″, long. 77°44′45″, at highway bridge at Renovo, Clinton County, 1 mile upstream from Paddy Run. Datum of gage is 633.99 feet above mean sea level, unadjusted.

DRAINAGE AREA.—2,975 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 90,000 second-feet and extended to slope-area measurement for crest gage height of flood of Mar. 18, 1936.

MAXIMA.—1942: Discharge, 117,000 second-feet 11:55 p. m. July 18 (gage height, 18.92 feet).

1895–1903, 1905–42: Discharge, 236,000 second-feet March 18, 1936 (gage height, 29.39 feet, from floodmark in gage shelter).

1846–94, 1904: Discharge, about 211,000 second-feet June 1, 1889 (gage height, 27.3 feet, from floodmark).

Daily mean discharge, in second-feet, 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	870	1,510	9	860	780	17	445	2,130	25	2,460	1,540
2	880	1,370	10	683	840	18	26,800	2,300	26	2,130	1,220
3	1,050	1,330	11	683	1,100	19	64,800	1,910	27	1,890	990
4	1,040	1,150	12	691	957	20	15,800	1,540	28	1,980	820
5	860	990	13	651	830	21	8,010	1,250	29	1,650	744
6	806	850	14	566	2,180	22	5,180	1,080	30	1,440	700
7	1,620	762	15	500	2,380	23	3,820	1,070	31	1,330	643
8	1,280	736	16	465	1,910	24	2,960	1,500			

	July	Aug.
Monthly mean discharge, in second-feet	4,974	1,262
Runoff, in inches	1.93	0.49

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
July 17			*July 19*			*July 20*—Con.			*July 22*—Con.		
4	0.16	438	2	18.70	115,000	2	5.92	14,200	4	2.91	4,800
8	.18	452	4	17.93	107,000	4	5.72	13,400	8	2.80	4,560
N	.18	452	6	16.65	93,900	6	5.51	12,600	12	2.70	4,320
4	.18	452	8	15.15	80,700	8	5.31	11,800			
8	.16	438	10	13.75	68,100	10	5.10	11,000	*July 23*		
12	.16	438	N	15.50	57,400	12	4.92	10,400			
			2	11.38	48,600				4	2.60	4,080
July 18			4	10.50	41,400	*July 21*			8	2.52	3,850
			6	9.77	36,300				N	2.44	3,740
2	.18	452	8	9.05	30,700	4	4.57	9,500	4	2.43	3,740
4	.27	515	10	8.47	27,700	8	4.28	8,600	8	2.40	3,630
6	.37	588	12	7.97	24,700	N	4.05	7,700	12	2.31	3,420
8	.78	968				4	3.85	7,250			
10	2.17	3,120	*July 20*			8	3.67	6,680	*July 24*		
N	3.06	5,180				12	3.50	6,300			
2	5.64	13,000	2	7.56	22,300				N	2.06	2,920
4	7.40	21,300	4	7.19	20,300	*July 22*			12	1.88	2,650
6	10.12	38,400	6	6.84	18,300						
8	14.10	70,800	8	6.58	17,300	4	3.32	5,800			
10	18.10	109,000	10	6.35	16,300	8	3.16	5,420			
12	18.92	117,000	N	6.12	15,000	N	3.03	5,180			

SUPPLEMENTAL RECORD.—July 18, 11:55 p. m., gage height 18.92 feet, discharge 117,000 second-feet.

SINNEMAHONING CREEK AT SINNEMAHONING, PA.

LOCATION.—Lat. 41°18′45″, long. 78°05′30″, a quarter of a mile upstream from Grove Run and 3,500 feet upstream from Pennsylvania Railroad bridge at Sinnemahoning, Cameron County. Datum of gage is 769.36 feet above mean sea level, datum of 1929, New York-Pennsylvania supplementary adjustment of 1943.

DRAINAGE AREA.—699 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 17,000 second-feet and extended to slope-area measurement for crest gage height.

MAXIMA.—1942: Discharge, 59,800 second-feet 10:45 p. m. July 18 (gage height, 21.58 feet).

1938–41: Discharge, 19,100 second-feet March 31, 1940 (gage height, 10.57 feet). Maximum stage known, 21.94 feet March 18, 1936, from floodmark (discharge, 61,200 second-feet).

Daily mean discharge, in second-feet, 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	155	518	9	246	217	17	116	502	25	951	288
2	170	416	10	196	362	18	18,400	437	26	729	221
3	149	422	11	200	333	19	24,400	339	27	768	177
4	133	316	12	233	231	20	6,250	277	28	721	158
5	126	256	13	177	212	21	3,150	241	29	588	150
6	236	221	14	149	486	22	1,920	217	30	516	147
7	934	199	15	133	370	23	1,500	284	31	481	129
8	382	190	16	118	437	24	1,040	383			

	July	Aug.
Monthly mean discharge, in second-feet	2,105	295
Runoff, in inches	3.47	0.49

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
July 17			*July 18—Con.*			*July 19—Con.*			*July 21*		
6	1.66	113	4	9.28	14,800	2	10.10	17,200	6	4.74	3,520
N	1.68	118	6	18.22	46,200	4	9.19	14,500	N	4.53	3,160
6	1.68	118	8	20.32	54,600	6	8.59	12,700	6	4.33	2,800
12	1.69	120	10	21.32	58,600	8	8.07	11,300	12	4.09	2,370
			12	21.12	57,800	10	7.62	9,930			
July 18						12	7.28	9,150			
			July 19						*July 22*		
2	1.77	145				*July 20*					
4	2.06	260	2	19.02	49,400				N	3.81	1,900
6	2.47	485	4	17.22	42,200	6	6.60	7,410	12	3.63	1,620
8	3.26	1,210	6	14.77	33,200	N	6.05	6,020			
10	4.26	2,640	8	12.97	26,900	6	5.55	5,060			
N	5.73	5,480	10	11.75	22,700	12	5.06	4,080			
2	6.61	7,410	N	10.72	19,000						

SUPPLEMENTAL RECORD.—July 18, 10:45 p. m., gage height 21.58 feet, discharge 59,800 second-feet.

DRIFTWOOD BRANCH SINNEMAHONING CREEK AT STERLING RUN, PA.

LOCATION.—Lat. 41°24′25″, long. 78°11′35″, at highway bridge at village of Sterling Run, Cameron County, 300 feet upstream from Sterling Run. Datum of gages is 894.84 feet above mean sea level, datum of 1929, New York-Pennsylvania supplementary adjustment of 1943.

DRAINAGE AREA.—281 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph from recording gage at highway bridge, July 1–19, and thereafter twice-daily readings on staff gage, 800 feet upstream.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 800 second-feet and extended to slope-area measurement for crest gage height.

MAXIMA.—1942: Discharge, 47,800 second-feet 8:45 p. m. July 18 (gage height, 14.7 feet at recording-gage site and 15.0 feet at staff gage; both from floodmarks).

1913–41: Discharge, 28,400 second-feet Mar. 17, 1936 (gage height, 12.0 feet from graph based on staff-gage readings).

Daily mean discharge, in second-feet, 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	69	230	9	47	115	17	31	300	25	442	99
2	45	208	10	26	204	18	16,300	219	26	313	75
3	28	183	11	71	132	19	15,300	170	27	395	64
4	19	138	12	76	99	20	2,870	144	28	317	57
5	18	118	13	30	102	21	1,240	121	29	278	57
6	61	104	14	19	270	22	725	107	30	246	53
7	186	89	15	13	163	23	622	132	31	242	46
8	98	89	16	8.3	170	24	410	132			

	July	Aug.
Monthly mean discharge, in second-feet	1,308	135
Runoff, in inches	5.37	0.55

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
July 17			*July 18*—Con.			*July 19*—Con.			*July 21*		
4	0.28	7.6	2	6.64	9,250	2	7.36	11,600	6	3.91	1,550
8	.33	12	4	10.94	26,400	4	6.86	10,100	N	3.70	1,340
N	.33	12	6	13.25	38,700	6	6.41	8,750	6	3.48	1,140
4	.39	19	8	14.63	47,200	8	5.94	7,510	12	3.28	960
8	.72	84	10	13.89	42,900	10	5.51	6,570			
12	.77	98	12	12.40	34,200	12	5.21	5,900	*July 22*		
July 18			*July 19*			*July 20*			6	3.14	840
									N	3.02	725
2	.74	90	2	11.34	28,400	6	5.44	3,660	6	2.92	655
4	.87	126	4	10.44	23,900	N	4.84	2,720	12	2.86	622
6	1.09	194	6	9.66	20,600	6	4.42	2,170			
8	2.14	750	8	9.01	17,600	12	4.12	1,790			
10	4.54	4,550	10	8.42	15,200						
N	5.72	7,030	N	7.85	13,000						

SUPPLEMENTAL RECORD.—July 18, 8:45 p. m., gage height 14.70 feet, discharge 47,800 second-feet.

KETTLE CREEK AT CROSS FORK, PA.

LOCATION.—Lat. 41°28′15″, long. 77°49′50″, at bridge on State Highway 144, 0.2 mile downstream from Potter-Clinton County line, and 0.9 mile downstream from Cross Fork, Potter County. Datum of gage is 1,027.12 feet above mean sea level, adjustment of 1912.

DRAINAGE AREA.—136 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 2,000 second-feet and extended above.

MAXIMA.—July 1942: Discharge, 2,960 second-feet 11:45 a. m. July 18 (gage height, 5.97 feet).

1940 to June 1942: Discharge, 6,100 second-feet May 22, 1942 (gage height, 7.98 feet).

Maximum stage known, about 14.0 feet March 18, 1936, from information by local residents (discharge, about 20,000 second-feet).

Daily mean discharge, in second-feet, 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	37	100	9	27	66	17	25	410	25	140	98
2	33	84	10	25	62	18	1,720	353	26	119	82
3	29	79	11	40	50	19	1,400	288	27	130	73
4	26	66	12	30	44	20	703	230	28	102	65
5	25	60	13	24	146	21	436	184	29	106	64
6	44	58	14	21	320	22	302	150	30	96	58
7	57	52	15	18	265	23	227	147	31	109	56
8	33	60	16	16	278	24	178	124			

	July	Aug.
Monthly mean discharge, in second-feet	203	135
Runoff, in inches	1.72	1.14

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
July 17			*July 18*—Con.			*July 19*—Con.			*July 21*		
N	1.17	26	3	5.63	2,640	8	4.58	1,600	6	2.87	486
12	1.20	29	4	5.62	2,580	10	4.47	1,460	N	2.77	445
			5	5.60	2,580	N	4.35	1,380	6	2.63	388
July 18			6	5.53	2,520	2	4.23	1,300	12	2.52	342
			7	5.48	2,470	4	4.11	1,180			
2	1.25	34	8	5.38	2,370	6	3.99	1,110	*July 22*		
4	1.28	38	9	5.31	2,270	8	3.88	1,040			
6	1.58	82	10	5.24	2,220	10	3.79	970	6	2.47	327
7	4.50	1,510	11	5.17	2,120	12	3.72	910	N	2.40	302
8	4.88	1,870	12	5.10	2,070				6	2.32	275
9	4.75	1,740				*July 20*			12	2.25	252
10	5.24	2,220	*July 19*								
11	5.73	2,740				6	3.52	793			
N	5.95	2,960	2	4.97	1,920	N	3.33	703			
1	5.82	2,800	4	4.83	1,820	6	3.12	599			
2	5.65	2,640	6	4.71	1,690	12	2.97	530			

SUPPLEMENTAL RECORD.—July 18, 11:45 a. m., gage height 5.97 feet, discharge 2.960 second-feet.

PINE CREEK AT CEDAR RUN, PA.

LOCATION.—Lat. 41°31′20″, long. 77°26′55″, at highway bridge at village of Cedar Run, Lycoming County, 2,000 feet downstream from Cedar Run. Datum of gage is 781.96 feet above mean sea level (New York Central Railroad bench mark).

DRAINAGE AREA.—604 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 10,000 second-feet and extended to slope-area measurement for crest gage height of flood of March 18, 1936.

MAXIMA.—July 1942: Discharge, 10,200 second-feet 7 p. m. July 18 (gage height, 6.50 feet).

1918–41: Discharge, 30,900 second-feet March 18, 1936 (gage height, 11.39 feet).

Daily mean discharge, in second-feet, 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	123	522	9	117	209	17	69	1,030	25	454	263
2	119	383	10	100	199	18	4,940	802	26	376	224
3	104	330	11	104	189	19	5,570	637	27	412	189
4	93	274	12	143	156	20	2,320	522	28	474	170
5	90	235	13	105	148	21	1,310	417	29	476	373
6	112	209	14	80	1,400	22	882	356	30	454	272
7	223	184	15	75	792	23	654	330	31	449	194
8	166	189	16	69	620	24	522	311			

	July	Aug.
Monthly mean discharge, in second-feet	683	391
Runoff, in inches	1.30	0.75

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
July 17			*July 19—Con.*			*July 20—Con.*			*July 23*		
N	1.12	69	4	5.63	7,520	6	3.19	1,970	6	2.15	690
12	1.14	75	6	5.43	7,090	8	3.13	1,880	N	2.11	654
			8	5.23	6,530	10	3.06	1,770	6	2.08	628
July 18			10	5.00	5,850	12	2.99	1,670	12	2.04	595
			N	4.82	5,330						
2	1.47	209	2	4.62	4,830	*July 21*			*July 24*		
4	1.86	454	4	4.46	4,470						
6	2.02	578	6	4.32	4,120	6	2.83	1,440	6	1.98	545
8	2.27	802	8	4.17	3,780	N	2.72	1,300	N	1.93	506
10	3.00	1,680	10	4.03	3,560	6	2.62	1,170	6	1.90	483
N	4.92	5,590	12	3.89	3,250	12	2.52	1,060	12	1.88	468
2	5.78	8,100									
4	5.97	8,700	*July 20*			*July 22*			*July 25*		
6	6.42	9,900									
7	6.50	10,200	2	3.78	3,050	6	2.42	952	6	1.84	439
8	6.43	9,900	4	3.68	2,860	N	2.34	870	N	1.88	468
10	6.23	9,300	6	3.58	2,670	6	2.28	811	6	1.84	439
12	6.05	8,700	8	3.52	2,490	12	2.22	754	12	1.81	417
			10	3.44	2,390						
July 19			N	3.38	2,290						
			2	3.32	2,180						
2	5.83	8,100	4	3.24	2,050						

ALLEGHENY RIVER DRAINAGE BASIN

ALLEGHENY RIVER AT ELDRED, PA.

LOCATION.—Lat. 41°57′50″, long. 78°23′10″, at site of former highway bridge, 1,000 feet upstream from Knapp Creek, and half a mile north of Eldred, McKean County. Datum of gage is 1,416.20 feet above mean sea level, unadjusted.

DRAINAGE AREA.—550 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph, except for period 10:30 p. m. July 18 to 11:30 a. m. July 26 for which a graph was drawn based on floodmark, twice-daily readings of inside gage July 21–25, information from local residents, and records for station at Red House, N. Y.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 12,000 second-feet and extended to crest gage height on the basis of slope-area measurement at Bullis Mills, 4.2 miles downstream.

MAXIMA.—1942: Discharge, 55,000 second-feet 9:30 a. m. July 19 (gage height, 27.60 feet, from floodmark).

1915–41: Discharge, 12,900 second-feet Apr. 5, 1940 (gage height, 18.48 feet).

Daily mean discharge, in second-feet, 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	126	1,240	9	159	604	17	96	493	25	1,840	304
2	140	930	10	130	556	18	11,400	524	26	1,240	257
3	120	842	11	439	508	19	48,100	406	27	1,260	228
4	109	652	12	349	379	20	24,600	353	28	1,560	210
5	111	540	13	208	366	21	10,500	316	29	1,320	203
6	263	463	14	151	540	22	6,150	304	30	1,320	199
7	392	406	15	125	463	23	4,180	392	31	1,180	183
8	242	406	16	105	379	24	2,770	392			

	July	Aug.
Monthly mean discharge, in second-feet	3,893	453
Runoff, in inches	8.16	0.95

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
July 17			*July 18*—Con.			*July 19*—Con.			*July 20*—Con.		
4	2.32	96	4	18.00	11,900	6	26.35	47,000	8	20.65	17,600
8	2.32	96	6	19.80	16,400	8	26.00	44,600	10	20.30	16,600
N	2.32	96	8	22.00	24,000	10	25.55	42,200	12	20.00	15,600
4	2.31	95	10	24.15	34,200	12	25.05	38,600			
8	2.30	94	12	25.20	39,800				*July 21*		
12	2.39	105				*July 20*					
			July 19						6	19.10	12,800
July 18						2	24.60	36,200	N	18.15	10,600
			2	25.90	44,000	4	24.15	34,200	6	17.20	8,680
2	2.50	119	4	26.40	47,000	6	23.70	31,700	12	16.30	7,600
4	2.83	169	6	26.90	50,100	8	23.25	29,200			
6	3.70	353	8	27.45	53,600	10	22.80	27,200	*July 22*		
8	4.72	652	10	27.60	55,000	N	22.30	24,800			
10	9.65	2,600	N	27.50	54,300	2	21.85	22,600	N	14.95	6,240
N	15.10	7,080	2	27.10	51,500	4	21.40	20,800	12	13.65	5,120
2	17.10	10,200	4	26.70	48,800	6	20.95	19,200			

SUPPLEMENTAL RECORD.—July 19, 9:30 a. m., gage height 27.6 feet, discharge 55,000 second-feet.

ALLEGHENY RIVER AT RED HOUSE, N. Y.

LOCATION.—Lat. 42°06′50″, long. 78°48′15″, at site of old highway bridge in Red House, Cattaraugus County, and 0.7 mile upstream from Meetinghouse Run. Datum of gage is 1,327.68 feet above mean sea level, datum of 1929.

DRAINAGE AREA.—1,690 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements.

MAXIMA.—1942: Discharge, 45,300 second-feet 8:30 a. m. July 20 (gage height, 14.55 feet).

1903–41: Discharge observed, 41,000 second-feet March 2, 1910 (gage height, 13.6 feet); gage height, 13.78 feet March 4, 1934 (ice jam).

Daily mean discharge, in second-feet, 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	392	2,650	9	506	1,170	17	324	936	25	3,720	872
2	401	2,180	10	392	1,360	18	8,210	1,030	26	2,970	726
3	366	1,840	11	866	1,360	19	36,800	975	27	2,530	636
4	348	1,620	12	1,140	1,120	20	44,200	846	28	2,570	576
5	324	1,360	13	726	962	21	34,700	774	29	2,610	558
6	348	1,170	14	515	1,030	22	20,000	726	30	2,710	548
7	589	1,030	15	410	1,120	23	10,000	910	31	2,550	529
8	690	949	16	357	949	24	6,040	1,030			

	July	Aug.
Monthly mean discharge, in second-feet	6,074	1,082
Runoff, in inches	4.14	0.74

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
July 18			*July 19—Con.*			*July 20—Con.*			*July 23—Con.*		
2	3.56	401	10	13.13	37,200	6	14.33	43,900	6	8.23	11,200
4	3.75	589	N	13.35	38,400	8	14.23	43,200	N	7.81	9,680
6	4.53	1,730	2	13.54	39,500	10	14.12	42,500	6	7.52	8,690
8	5.29	3,300	4	13.72	40,500	12	14.00	41,800	12	7.22	7,710
10	4.97	2,590	6	13.86	41,200						
N	5.08	2,830	8	13.98	41,900	*July 21*			*July 24*		
2	6.03	5,180	10	14.11	42,700						
4	7.65	10,400	12	14.24	43,400	6	13.51	38,600	N	6.65	6,000
6	9.17	16,900				N	12.93	34,800	12	6.13	4,590
8	9.87	20,200	*July 20*			6	12.26	30,800			
10	10.31	22,400				12	11.58	26,900	*July 25*		
12	10.73	24,400	2	14.35	44,100						
			4	14.44	44,600	*July 22*			N	5.75	3,650
July 19			6	14.49	44,900				12	5.52	3,120
			8	14.53	45,200	6	10.91	23,200			
2	11.26	27,100	10	14.54	45,200	N	10.24	19,900			
4	11.90	30,400	N	14.52	45,100	6	9.53	16,700			
6	12.42	33,300	2	14.48	44,900	12	8.80	13,500			
8	12.81	35,500	4	14.42	44,500						

SUPPLEMENTAL RECORD.—July 20, 8:30 a. m., gage height 14.55 feet, discharge 45,300 second-feet.

ALLEGHENY RIVER NEAR KINZUA, PA.

LOCATION.—Lat. 41°50′50″, long. 78°59′30″, at Pennsylvania Railroad bridge, half a mile upstream from Bent Run, 2 miles southwest of Kinzua, Warren County, and 2.3 miles downstream from Kinzua Creek. Datum of gage is 1,200.00 feet above mean sea level (Corps of Engineers, U. S. Army, bench mark).

DRAINAGE AREA.—2,179 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements. Shifting-control method used July 1–17.

MAXIMA.—1942: Discharge, 46,800 second-feet 5 p. m. July 20 (gage height, 17.70 feet).

1935–41: Discharge, 42,000 second-feet March 28, 1936 (gage height, 16.69 feet).

Daily mean discharge, in second-feet, 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	563	3,290	9	775	1,420	17	486	1,220	25	5,260	1,200
2	556	2,960	10	612	1,760	18	10,500	1,220	26	3,980	1,010
3	510	2,480	11	947	1,700	19	34,300	1,250	27	3,400	870
4	510	2,160	12	1,480	1,510	20	45,300	1,100	28	3,180	784
5	486	1,830	13	1,140	1,290	21	41,500	997	29	3,290	748
6	849	1,570	14	811	1,250	22	26,700	1,010	30	3,290	714
7	802	1,380	15	612	1,380	23	14,500	1,200	31	3,290	681
8	900	1,240	16	517	1,310	24	8,630	1,310			

	July	Aug.
Monthly mean discharge, in second-feet	7,086	1,414
Runoff, in inches	3.75	0.75

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
July 17			*July 19—Con.*			*July 21—Con.*			*July 24*		
4	5.31	468	10	14.51	31,400	6	17.21	44,400	4	9.54	9,990
8	5.33	480	N	14.76	32,900	8	17.06	43,900	8	9.32	9,300
N	5.35	492	2	15.10	34,300	10	16.90	42,900	N	9.11	8,630
4	5.35	492	4	15.50	36,200	N	16.71	42,000	4	8.89	7,970
8	5.35	492	6	15.87	38,100	2	16.51	41,000	8	8.69	7,330
12	5.34	486	8	16.17	39,600	4	16.28	40,000	12	8.49	6,710
			10	16.43	40,500	6	16.06	39,100			
July 18			12	16.65	41,500	8	15.79	37,600	*July 25*		
						10	15.52	36,200			
2	5.33	480	*July 20*			12	15.25	34,800	N	8.00	5,260
4	5.42	543							12	7.66	4,340
6	5.76	840	2	16.85	42,400	*July 22*					
8	6.36	1,670	4	17.06	43,900				*July 26*		
10	9.05	8,300	6	17.25	44,400	4	14.70	32,400			
N	10.41	13,800	8	17.41	45,300	8	14.14	29,600	N	7.46	3,860
2	10.89	15,400	10	17.52	45,800	N	13.56	27,300	12	7.41	3,740
4	10.76	15,000	N	17.61	46,300	4	13.01	24,500			
6	10.66	14,600	2	17.67	46,800	8	12.51	22,300			
8	10.81	15,000	4	17.69	46,800	12	12.01	20,100			
10	11.63	18,400	6	17.69	46,800						
12	12.65	22,700	8	17.65	46,300	*July 23*					
			10	17.59	46,300						
July 19			12	17.51	45,800	4	11.56	18,400			
						8	11.10	16,200			
2	13.55	27,300	*July 21*			N	10.67	14,600			
4	14.01	29,100				4	10.30	13,000			
6	14.22	30,000	2	17.42	45,300	8	10.00	11,800			
8	14.35	31,000	4	17.32	44,800	12	9.75	11,100			

SUPPLEMENTAL RECORD.—July 20, 5:00 p. m., gage height 17.70 feet, discharge 46,800 second-feet.

CLARION RIVER AT RIDGWAY, PA.

LOCATION.—Lat. 41°25′, long. 78°44′, at bridge on Main Street in Ridgway, Elk County, 50 feet downstream from Elk Creek. Datum of gage is 1,361.62 feet above mean sea level, unadjusted.

DRAINAGE AREA.—303 square miles.

GAGE-HEIGHT RECORD.—From graph based on floodmark, twice daily readings of chain gage, and local information.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 12,000 second-feet and extended to slope-area measurement for crest gage height. Shifting-control method used except July 16–25.

MAXIMA.—July 1942: Discharge, 34,000 second-feet 1 a. m. July 19 (gage height, 16.4 feet).

1940 to June 1942: Discharge, 6,940 second-feet March 9, 1942 (gage height, 8.0 feet). The flood of March 1936 reached a stage of 14 feet (discharge, 24,000 second-feet).

Daily mean discharge, in second-feet 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	158	444	9	88	326	17	86	412	25	792	191
2	93	326	10	73	326	18	4,550	276	26	545	165
3	73	326	11	183	235	19	12,100	227	27	1,210	148
4	75	280	12	117	187	20	3,020	199	28	905	135
5	77	244	13	83	327	21	1,620	180	29	615	141
6	207	218	14	73	448	22	1,060	176	30	545	126
7	288	195	15	61	252	23	1,620	326	31	511	120
8	117	231	16	58	280	24	980	257			

	July	Aug.
Monthly mean discharge, in second-feet	1,032	249
Runoff, in inches	3.93	0.95

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
July 17			*July 18—Con.*			*July 19—Con.*			*July 21—Con.*		
4	0.80	63	6	6.50	4,720	8	6.50	4,720	N	3.30	1,620
8	.82	67	8	8.60	8,080	10	6.20	4,370	4	3.20	1,540
N	.88	79	10	13.40	21,200	12	6.00	4,150	8	3.10	1,460
4	.98	103	12	16.10	32,600				12	3.00	1,380
8	1.06	126				*July 20*					
12	1.20	172	*July 19*						*July 22*		
						4	5.60	3,710	4	2.90	1,300
July 18			1	16.4	34,000	8	5.30	3,400	8	2.70	1,140
			2	16.10	32,600	N	4.90	3,020	N	2.50	980
2	1.32	218	4	13.70	22,400	4	4.60	2,750	4	2.50	980
4	1.48	290	6	11.30	14,500	8	4.30	2,480	8	2.70	1,140
6	1.68	412	8	10.20	11,600	12	4.00	2,220	12	3.00	1,380
8	1.98	615	10	9.30	9,560						
10	2.45	942	N	8.50	7,880	*July 21*					
N	3.00	1,380	2	7.80	6,580						
2	3.90	2,130	4	7.30	5,780	4	3.80	2,040			
4	5.00	3,110	6	6.80	5,080	8	3.50	1,790			

GENESEE RIVER DRAINAGE BASIN

GENESEE RIVER AT SCIO, N. Y.

LOCATION.—Lat. 42°09′50″, long. 77°58′50″, at highway bridge, 0.4 mile upstream from Vandermark Creek, and three-quarters of a mile upstream from Scio, Allegany County.

DRAINAGE AREA.—309 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph except for period August 15–21.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements. Discharge for period August 15–21 computed on basis of records for nearby stations.

MAXIMA.—1942: Discharge, 9,740 second-feet 12:30 p. m. July 18 (gage height, 9.74 feet).

1916–41: Discharge observed, 10,600 second-feet May 22, 1919 (gage height, 10.1 feet, present datum) from rating curve extended above 3,600 second-feet by logarithmic plotting.

Daily mean discharge, in second-feet, 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	104	539	9	60	194	17	44	161	25	266	161
2	82	363	10	58	378	18	5,830	206	26	233	136
3	67	311	11	166	221	19	3,100	209	27	331	119
4	60	249	12	112	180	20	1,190	180	28	955	112
5	60	212	13	76	185	21	686	161	29	1,050	115
6	73	180	14	64	364	22	500	235	30	634	106
7	107	159	15	52	209	23	420	276	31	616	95
8	74	159	16	44	183	24	318	212			

	July	Aug.
Monthly mean discharge, in second-feet	562	212
Runoff, in inches	2.10	0.79

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
July 17			*July 18—Con.*			*July 19—Con.*			*July 21*		
4	1.19	43	11	9.41	9,000	8	5.95	3,340	6	3.07	734
8	1.19	43	N	9.71	9,670	10	5.57	2,900	N	2.98	684
N	1.19	43	1	9.58	9,380	N	5.29	2,590	6	2.89	637
6	1.19	43	2	9.38	8,940	2	5.01	2,300	12	2.74	562
10	1.19	43	3	9.02	8,190	4	4.82	2,110			
11	1.33	65	4	8.81	7,770	6	4.59	1,890	*July 22*		
12	1.46	90	5	8.73	7,620	8	4.37	1,690	6	2.64	514
			6	8.72	7,600	10	4.18	1,520	N	2.60	495
July 18			7	8.75	7,660	12	4.01	1,390	6	2.54	468
			8	8.77	7,690				12	2.59	490
1	1.90	201	9	8.73	7,620	*July 20*					
2	2.84	588	10	8.67	7,500						
3	3.29	856	11	8.53	7,240	2	3.92	1,320	*July 23*		
4	3.83	1,240	12	8.33	6,870	4	3.91	1,310	N	2.44	424
5	4.64	1,940				6	3.94	1,330	12	2.27	356
6	5.68	3,020	*July 19*			8	3.95	1,340			
7	6.67	4,260				10	3.94	1,330	*July 24*		
8	7.30	5,170	2	7.79	5,940	N	3.88	1,280			
9	7.89	6,110	4	7.11	4,880	6	3.57	1,050	N	2.17	318
10	8.58	7,330	6	6.46	3,980	12	3.25	838	12	2.08	286

SUPPLEMENTAL RECORD.—July 18, 12:30 p. m., gage height 9.74 feet, discharge 9,740 second-feet.

GENESEE RIVER AT ST. HELENA, N. Y.

LOCATION.—Lat. 42°37′20″, long. 77°59′20″, at highway bridge in St. Helena, Wyoming County, 1½ miles downstream from Wolf Creek, and 3 miles east of Castile.

DRAINAGE AREA.—1,017 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements.

MAXIMA.—July 1942: Discharge, 18,900 second-feet 12:15 a. m. July 19 (gage height, 10.06 feet).

1908–41: Discharge, 44,400 second-feet May 17, 1916 (gage height, 12.8 feet), from rating curve extended above 29,000 second-feet by logarithmic plotting.

Daily mean discharge, in second-feet, 1942

Day	July	Aug.	Day	July	Aug.	Day	July	Aug.	Day	July	Aug.
1	221	1,330	9	185	400	17	167	438	25	695	600
2	242	1,020	10	160	586	18	8,820	586	26	605	552
3	220	775	11	310	783	19	11,200	446	27	636	359
4	184	720	12	533	604	20	4,070	376	28	700	242
5	158	602	13	348	448	21	2,030	336	29	1,700	354
6	156	487	14	268	529	22	1,260	308	30	1,740	446
7	184	411	15	195	694	23	1,010	334	31	1,310	440
8	184	368	16	173	472	24	874	439			

	July	Aug.
Monthly mean discharge, in second-feet	1,308	532
Runoff, in inches	1.49	0.60

Gage height, in feet, and discharge, in second-feet, at indicated time, 1942

Hour	Gage height	Dis-charge	Hour	Gage height	Dis-charge	Hour	Gage height	Dis-charge	Hour	Gage height	Dis-charge
July 17			*July 18—Con.*			*July 19—Con.*			*July 21*		
4	2.55	163	7	9.61	16,600	8	6.75	6,060	6	4.80	2,290
8	2.54	159	8	9.72	17,200	9	6.61	5,700	N	4.53	1,930
N	2.60	182	9	9.83	17,800	10	6.51	5,460	6	4.37	1,730
4	2.53	155	10	9.92	18,200	11	6.40	5,200	12	4.19	1,530
8	2.48	137	11	10.00	18,600	12	6.29	4,950			
10	2.50	144	12	10.05	18,800				*July 22*		
12	2.74	245				*July 20*					
			July 19						N	3.90	1,210
July 18						1	6.20	4,750	12	3.75	1,060
			1	10.03	18,800	2	6.13	4,600			
1	2.86	307	2	9.96	18,400	3	6.07	4,480	*July 23*		
2	2.84	296	3	9.84	17,800	4	6.04	4,410			
3	2.82	285	4	9.69	17,000	5	6.06	4,460	6	3.74	1,050
4	2.91	335	5	9.55	16,300	6	6.09	4,520	N	3.65	960
5	3.29	614	6	9.37	15,500	7	6.09	4,520	6	3.72	1,030
6	3.45	762	7	9.17	14,600	8	6.13	4,600	12	3.68	990
7	3.49	800	8	8.95	13,600	9	6.15	4,640			
8	3.45	762	9	8.73	12,600	10	6.12	4,580	*July 24*		
9	3.48	791	10	8.56	11,900	11	6.09	4,520			
10	7.38	7,740	11	8.35	11,100	N	6.04	4,410	6	3.67	980
11	8.24	10,700	N	8.21	10,500	2	5.92	4,170	N	3.52	830
N	8.21	10,500	1	8.06	9,950	4	5.74	3,830	6	3.53	840
1	8.30	10,900	2	7.87	9,260	6	5.53	3,440	12	3.44	752
2	8.56	11,900	3	7.68	8,640	8	5.35	3,140			
3	8.81	12,900	4	7.48	8,030	10	5.22	2,920			
4	9.05	14,000	5	7.26	7,410	12	5.12	2,760			
5	9.26	15,000	6	7.07	6,890						
6	9.46	15,900	7	6.91	6,470						

SUPPLEMENTAL RECORD.—July 19, 12:15 a. m., gage height 10.06 feet, discharge 18,900 second-feet.

SUMMARY OF FLOOD DISCHARGES

The maximum discharges at gaging stations in and adjacent to the flood area, together with the miscellaneous measurements of peak discharge by slope-area, contracted-opening, and similar methods, are summarized in table 4. The gaging stations are indicated in the proper column by the period of record available, to and including 1942. The places of miscellaneous measurement are indicated in the same column by the method of measuring. When slope-area and similar methods of measuring the peak discharge are used at a gaging station, there is usually additional information available so that the peak discharge given for the gaging-station record is not based on the measurement alone. There is, therefore, no particular point in indicating, in table 4, slope-area and similar measurements made at gaging stations, especially as they are discussed in the station descriptions in the preceding section.

The index numbers used in table 4 are those used for the same points in tables 1, 3, 4, 1–A, 3–A, and 4–A of Water-Supply Paper 847, Maximum discharges at stream-measurement stations through December 31, 1937, with a supplement including additions and changes through September 30, 1938. For those places not given in Water-Supply Paper 847, new index numbers were assigned using the same decimal system. The places of measurement also are identified on plate 2 by these index numbers.

The maximum flood previously known may include a flood outside the period of record, the general aim being to list the highest flood for which the discharge is known. The gage heights of all floods listed are the gage heights of the maximum discharge unless qualified otherwise. Other information in table 4 is considered self-explanatory.

TABLE 4.—*Summary of flood discharges in north-central Pennsylvania for the flood of July 1942*

No. on pl. 2	Stream and place of determination	Drainage area (square miles)	Period of record or method of measuring	Maximum flood previously known				Maximum during present flood			
				Date	Gage height (feet)	Discharge		Time	Gage height (feet)	Discharge	
						Second-feet	Second-feet per square mile			Second-feet	Second-feet per square mile
	SUSQUEHANNA RIVER DRAINAGE BASIN										
753	Canacadea Creek near Hornell, N. Y.	58.7	1924-29 1938-42	July 1935	[1] 12.3	21,000	358	6:40 a. m. July 18	7.07	6,080	104
754	Karr Valley Creek at Almond, N. Y.	27.6	1937-42	Mar. 31, 1940	[1] 5.8	3,800	143	5:45 a. m. July 18	[1] 8.8	5,900	214
781.5	West Branch Susquehanna River at Karthaus, Pa.	1,462	1918-20 1940-42	Mar. 18, 1936	[1] 23.0	[2] 135,000	92	2 a. m. July 19	2.15	1,120	.8
783	West Branch Susquehanna River at Renovo, Pa.	2,975	1895-1903 1905-42	do	[1] 29.39	236,000	79	11:55 p. m. July 18	18.92	117,000	39
784	West Branch Susquehanna River at Williamsport, Pa.	5,682	1895-1942	do	[1] 33.57	264,000	46.5	2:30 p. m. July 19	18.76	110,000	19.4
787.5	Sinnemahoning Creek at Sinnemahoning, Pa.	699	1938-42	do	21.94	61,200	88	10:45 p. m. July 18	21.58	59,800	86
787.8	Driftwood Branch Sinnemahoning Creek at Emporium, Pa.	91.7	Slope area					6:30 p. m. July 18		28,000	310
789	Driftwood Branch Sinnemahoning Creek at Sterling Run, Pa.	281	1913-42	Mar. 17, 1936	12.0	28,400	101	8:45 p. m. July 18	[3] 15.00	47,800	170
789.1	North Creek near Lockwood, Pa.	20.3	Contracted opening					5 p. m. July 18		4,700	230
789.2	West Creek near Emporium, Pa.	55.9	do					July 18		11,000	200
789.3	Sinnemahoning Portage near Emporium, Pa.	63.8	Slope area					do		18,000	280
789.4	Salt Run near Emporium, Pa.	7.67	Dam					do		1,900	250
789.50	First Fork Sinnemahoning Creek near Costello, Pa.	103	Slope area					1 p. m. July 18		31,000	300
789.52	First Fork Sinnemahoning Creek near mouth, near Sinnemahoning, Pa.	250	2 slope area					4 p. m. July 18		81,000	324
789.54	South Fork of First Fork Sinnemahoning Creek near Costello, Pa.	17.8	Slope area					July 18		7,500	420
789.56	Freeman Run above Austin Dam, near Odin, Pa.	12.1	do					do		9,800	810
789.58	Freeman Run below Austin Dam, near Austin, Pa.	14.3	2 slope area and a dam					11 a. m. July 18		17,000	1,200
789.60	Nelson Run near Wharton, Pa.	10.2	Slope area					July 18		6,600	650
789.62	East Fork of First Fork Sinnemahoning Creek, near Wharton, Pa.	49.1	Contracted opening					do		6,100	120
789.64	Bailey Run near Wharton, Pa.	11.7	Slope area					do		5,300	450
789.66	Rattlesnake Run near First Fork, Pa.	4.43	do					do		1,300	290
789.68	Brooks Run at Lushbaugh, Pa.	4.73	do					do		1,600	340

789.8	Kettle Creek at Cross Fork, Pa.	136	1940–42	May 22, 1942	[4] 7.98	6,100	44.9	11:45 a. m. July 18	5.97	2,960	22
792	Pine Creek at Cedar Run, Pa.	604	1918–42	Mar. 18, 1936	11.39	30,900	51.2	7 p. m. July 18	6.50	10,200	16.9
	ALLEGHENY RIVER DRAINAGE BASIN										
000.3	Allegheny River above Roulette, Pa.[5]	114	Slope area					2 p. m. July 18		25,000	220
000.7	Allegheny River at Port Allegany, Pa.	249	Contracted opening					3:30 p. m. July 18		77,000	310
001	Allegheny River at Eldred, Pa.	550	1915–42	Apr. 5, 1940	18.48	12,900	23	9:30 a. m. July 19	[1] 27.60	55,000	100
001.5	Allegheny River at Bullis Mills, Pa.	608	Slope area					July 19		52,000	86
002	Allegheny River at Red House, N. Y.	1,690	1903–42	Mar. 2, 1910	13.6	[6] 41,000	24	8:30 a. m. July 20	14.55	45,300	27
002.5	Allegheny River near Kinzua, Pa.	2,179	1935–42	Mar. 28, 1936	16.69	42,000	19.3	5 p. m. July 20	17.70	46,800	21
002.8	Allegheny River at West Hickory, Pa.	3,660	1941–42	Mar. 18, 1942	13.44	58,000	15.8	1 a. m. July 21	12.82	50,000	14
003	Allegheny River at Franklin, Pa.	5,982	1905–42	Mar. 17, 1865	25.0	196,000	32.8	8 a. m. July 21	12.78	58,300	10
004	Allegheny River at Parkers Landing, Pa.	7,671	1932–42	do	29.0	250,000	33	10 a. m. July 21	11.79	58,600	8
016.02	Run 2.5 miles north of Coudersport, Pa.	[2] .82	Slope area					July 18		190	230
016.05	Laninger Creek near Roulette, Pa.	.45	Dam					do		850	1,900
016.08	Sartwell Creek near Burtville, Pa.	9.86	Slope area					do		11,000	1,100
016.10	Run tributary to Sartwell Creek above Meachum Hollow, 1¾ miles north of Burtville, Pa.	[2] .094	Critical depth					do		310	3,300
016.12	Dexter Run near Burtville, Pa.	.83	Slope area					do		840	1,000
016.14	Lillibridge Creek at Port Allegany, Pa.	6.7	2 slope area [7]					11 a. m.[2] July 18		16,000	2,400
016.16	Run at north city limit of Port Allegany, Pa.	[2] .39	Slope area					July 18		1,400	3,600
016.18	Twomile Creek near Port Allegany, Pa.	7.06	do					11 a. m.[2] July 18		15,000	2,100
016.20	Hollow tributary to Twomile Creek at Taylor farm, near Port Allegany, Pa.	[2] .032	Critical depth					July 18		200	6,200
016.21	do	.053	do					do		640	12,000
016.22	Hollow tributary to Twomile Creek at Appolt farm, near Port Allegany, Pa.	[2] .087	do					do		400	4,600
016.25	Annin Creek near Turtlepoint, Pa.[5]	11.4	Slope area					11 a. m.[2] July 18		24,000	2,100
016.28	Rock Run near Turtlepoint, Pa.	1.82	do					July 18		2,300	1,300
016.30	East Branch Open Brook near Smethport, Pa.	[2] .32	Contracted opening					do		410	1,300
016.32	Newell Creek near Larabee, Pa.	2.14	Slope area					11 a. m.[2] July 18		5,200	2,400
016.34	Marvin Creek near Hazelhurst, Pa.	5.82	do					July 18		2,200	380
016.36	Sherman Run at Hazelhurst, Pa.	[2] .24	Dam					do		70	290
016.38	Blacksmith Run near Smethport, Pa.	2.03	do					do		590	290
016.40	Ice Pond Brook at Smethport, Pa.	[2] .56	do					do		140	250
016.42	Kent Run near Farmers Valley, Pa.	1.35	Slope area					do		2,000	1,500
016.45	Marilla Brook near Bradford, Pa.	4.73	Dam					do		640	140
016.48	Hubert Run at Kane, Pa.	2.53	do					do		110	43
028.2	East Branch Clarion River at Instanter, Pa.	19.9	Contracted opening					3:30 p. m. July 18		9,500	480
028.3	East Branch Clarion River near Johnsonburg, Pa.	104	Contracted opening,[5] and slope area.					9 p. m. July 18		27,000	260
028.4	Clarion River at Ridgway, Pa.	303	1940–42	March 1936	14.0	24,000	79	1 a. m. July 19	16.4	34,000	112
028.5	Clarion River at Cooksburg, Pa.	807	1938–42	Mar. 17, 1936	19.0	56,000	69	9:30 a. m. July 19	14.96	32,700	41
030.3	Fivemile Run near Rasselas, Pa.	6.20	Contracted opening					July 18		1,900	310

See footnote at end of table.

TABLE 4.—*Summary of flood discharges in north-central Pennsylvania for the flood of July 1942*—Continued

No. on pl. 2	Stream and place of determination	Drainage area (square miles)	Period of record or method of measuring	Maximum flood previously known				Maximum during present flood			
				Date	Gage height (feet)	Discharge		Time	Gage height (feet)	Discharge	
						Second-feet	Second-feet per square mile			Second-feet	Second-feet per square mile
	ALLEGHENY RIVER DRAINAGE BASIN—Continued										
030.4	Straight Creek near Instanter, Pa.	21.7	Slope area					July 18		15,000	690
030.5	South Fork Straight Creek near Instanter, Pa.	8.41	do					do		5,300	630
030.6	Johnson Run at Ketner Dam, near Johnsonburg, Pa.	7.78	Dam					do		2,500	320
030.8	Windfall Run at Halsey Dam, near Mount Jewett, Pa.	1.61	do					do		410	250
	GENESEE RIVER DRAINAGE BASIN										
143	Genesee River at Scio, N. Y.	309	1916–42	May 22, 1919	[6] 10.1	10,600	34.3	12:30 p. m. July 18	9.74	9,740	31.5
144	Genesee River at St. Helena, N. Y.	1,017	1908–42	May 17, 1916	12.8	44,400	43.7	12:15 a. m. July 19	10.06	18,900	18.6
147.5	Angelica Creek at Angelica, N. Y.	61.0	Slope area					July 18		14,000	230

[1] From floodmark.
[2] About.
[3] From floodmark at staff gage.
[4] Greater flood occurred Mar. 18, 1936; discharge not determined.
[5] Furnished by Corps of Engineers.
[6] Observed.
[7] One furnished by Corps of Engineers.

The maximum discharges, in second-feet per square mile, for the flood of July 1942 as given in table 4 are plotted with respect to the drainage area, in figure 43. Such a diagram is helpful in comparing the relative size of the flood in streams draining basins of different size. The size of a drainage basin, though important, is only one of many factors that influence the magnitude of the runoff. Some of the other factors are slope and shape of drainage basin, vegetative cover, and underlying rocks. As an aid to those who use a flood formula expressing the discharge in terms of the square root of the drainage area, a guide line representing $5{,}000/\sqrt{\text{drainage area}}$ has been drawn on figure 43. All measurements of drainage areas of less than 1 square mile and especially those less than 0.1 square mile are subject to errors that may be quite large owing to the small-scale maps on which they were measured.

RAINFALL AND RUNOFF STUDIES

Studies of the volume of flood runoff and the precipitation required to produce it are often made to obtain basic information useful in other flood studies and in estimating floods produced by other storms. To obtain such basic information requires that both the data on rainfall and the data on runoff be complete in themselves and reasonably free of error.

There were only six gaging stations with drainage basins lying within, or mostly within, the 4-inch isohyetal lines on plate 2. At one of the gaging stations there was a staff gage only, and at two others staff-gage readings were used to fill in some of the gaps in the record from water-stage recorders. In preparing flood hydrographs for periods not based on continuous records of gage height, rainfall information was used as a matter of course as an aid in their definition. Thus at three gaging stations the runoff cannot be considered as having been obtained independently of the rainfall. With only three gaging stations at which the runoff was computed independently of the rainfall, and a total of six gaging stations in the storm area, it would seem that little basic rainfall-runoff information could be obtained for this flood. This conclusion is supported by the fact that, as explained on page 116, the interpretations made in drawing the isohyetal map were influenced strongly by the runoff as computed for the stream-gaging stations.

The rainfall-runoff studies made for this report are considered as a test of the reasonableness of the data given. They also show what is believed to be the actual relationship between the two quantities. The data are not considered good enough for use in other flood studies.

The results of the rainfall-runoff studies are given in table 5. The average depth of rainfall on each drainage basin was obtained by planimetering the isohyetal map (pl. 2). The direct storm runoff and

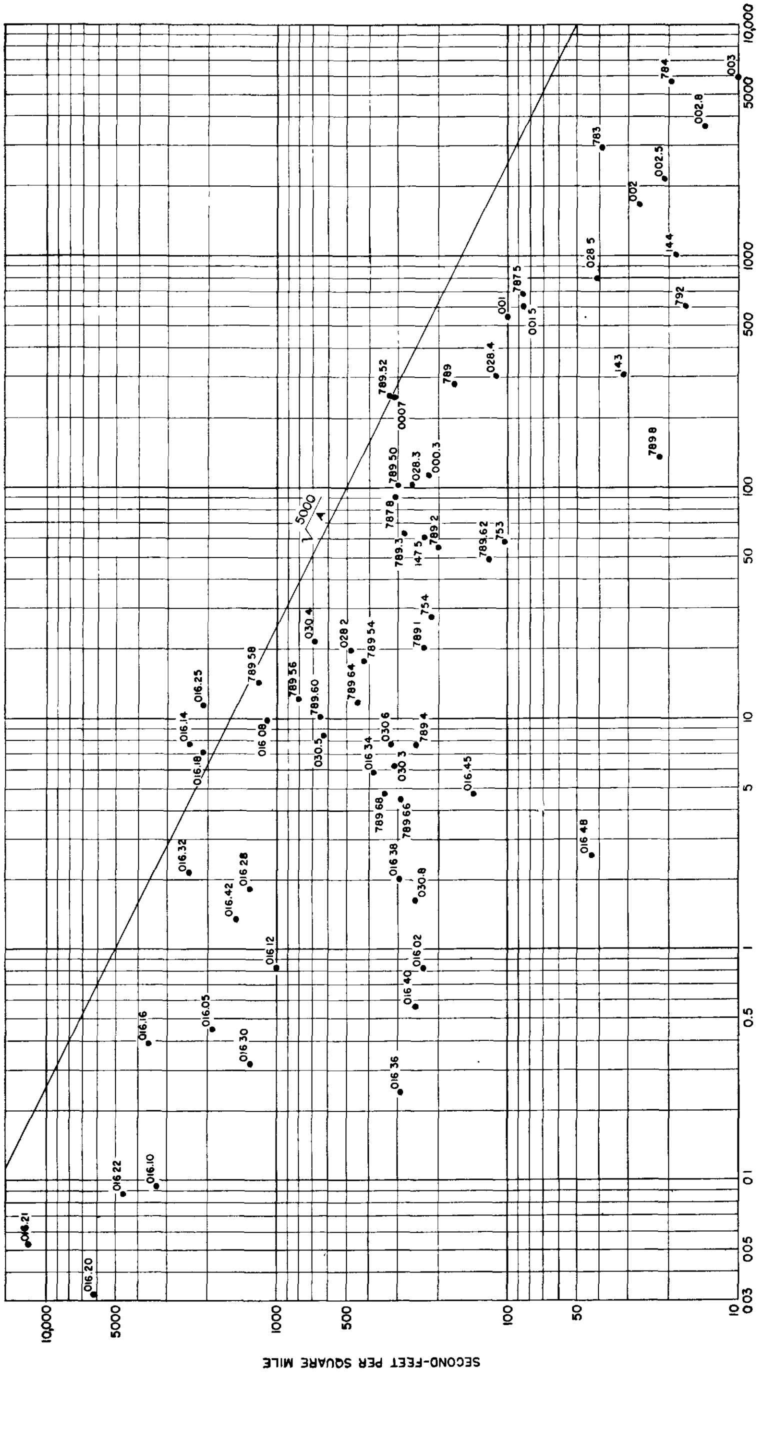

FIGURE 43.—Flood discharge, in second-feet per square mile, in relation to drainage area.

apparent ground-water recharge were obtained from the discharge hydrograph in the following manner: The recession curve, for flow before the flood, was extended through the flood period. The recession curve for the flood was drawn to exclude runoff from subsequent storms and was extended until it approached the recession curve of antecedent flow closely enough that the volume of runoff between the two curves beyond that point could be neglected without appreciable error. The volume of runoff represented by the flood hydrograph and recession curve, in excess of the recession curve of antecedent flow, was taken as the total storm runoff—the sum of the volume of direct storm runoff and the volume of apparent ground-water recharge. The separation between these last two quantities was obtained by arbitrarily drawing a straight line connecting the antecedent-flow recession curve, at about the time of the flood-peak discharge, with the point on the flood recession curve representing the end of direct runoff. This point was taken at the break in slope of the hydrograph when plotted semilogarithmically. The principles involved in this type of analysis are discussed in modern texts on hydrology and in previous flood reports of the Geological Survey (Langbein and others, 1947).

TABLE 5.—*Rainfall and associated direct runoff in selected drainage basins*

No. on pl. 2	Stream and point of measurement	Drainage area (square miles)	Rainfall (inches)	Direct storm runoff (inches)	Apparent ground-water recharge (inches)	Basin retention (inches)	Infiltration index
789	Driftwood Branch Sinnemahoning Creek at Sterling Run, Pa	281	9.5	4.2	0.7	4.6	0.8
789.8	Kettle Creek at Cross Fork, Pa	136	4.0	1.0	.5	2.5	.6
001	Allegheny River at Eldred, Pa	550	11.5	5.6	2.0	3.9	.9
002	Allegheny River at Red House, N. Y	1,690	7.8	2.8	.8	4.2	.9
028.4	Clarion River at Ridgway, Pa	303	6.7	2.3	.4	4.0	.8
143	Genesee River at Scio, N. Y	309	4.7	1.1	.2	3.4	.7

The ground-water recharge could be measured either as the volume of water in the ground represented by a rise in the water table, or it can be computed as the volume reaching the streams as ground-water seepage in excess of the ground-water seepage that would have reached them had there been no recharge. The latter method was used in this report. The overly simplified way in which it was obtained, however, makes it necessary to label it apparent ground-water recharge. As computed it is sufficiently accurate for the purpose of this study but for use in studies of ground-water supplies it may be appreciably in error.

The basin retention is the rainfall minus direct runoff and apparent ground-water recharge. It represents initial basin losses, replenishment of soil moisture, water stored in perched water tables and other forms of temporary storage. For the most part the basin retention probably will become part of the water loss from the basin. Some of the retention may be expected eventually to reach the zone of saturation. As used in this study, however, it is significant only as the difference between rainfall and runoff.

The infiltration index was computed in the usual manner (Langbein and others, 1947). It is given in table 5 to show the general agreement among the several drainage basins.

FLOOD CRESTS

Records of available flood-crest elevations and the time of their occurrence are given in table 6. These data are basic for the study of time of travel of flood crests, amount of valley and channel storage, and of the limit of future development along a river.

The elevations given are referred to mean sea level, Sandy Hook datum, using the latest adjustment to the precise level net that was available at the time of the surveys in 1942. In a few instances the elevations given for gaging stations are slightly different from the ones that would be computed from information given in the station description, because the gage datum is referred to a later adjustment in the description.

Flood-crest elevations are never precise observations. The water surface of a stream during flood is wavy and frequently is higher on one bank than on the other. Crest elevations for points far back from the main channel must always be used with caution.

TABLE 6.—*Flood-crest elevations*

Stream and location	Miles above month	Day and hour (July)	Elevation (feet)
SUSQUEHANNA RIVER DRAINAGE BASIN			
Bennett Branch Sinnemahoning Creek:			
Caledonia, Pa	23.2		1,108.4
Medix Run, mouth of	19.5		1,043.2
Benezette Run, mouth of	16.1		989.1
Dents Run, mouth of	9.0		898.2
Hicks Run, mouth of	7.8		891.7
Pennsylvania R. R. bridge	1.2		810.6
Sinnemahoning Creek:			
Driftwood, Pa., confluence of Bennett Branch and Driftwood Branch.	15.5		
Sinnemahoning, Pa., USGS gage	12.9	18, 10:45 p. m.	790.6
Sinnemahoning, Pa., Baltimore & Ohio R. R. bridge—upstream, right bank.	12.6		787.2
R. R. bridge—upstream, left bank	12.5		786.8
R. R. bridge—downstream, left bank	12.5		786.8
First Fork Sinnemahoning Creek, mouth of	11.8		786.6
Mouth, Keating, Pa	0	18, 11:30 p. m.	711.3
Driftwood Branch Sinnemahoning Creek:			
Lockwood, Pa., mouth of North Creek	22.0	18, 5 p. m.	1,076.7
Emporium, Pa	20.3	18, 6:30 p. m.	1,034.3
Emporium Junction, Pa., mouth of Sinnemahoning Portage.	19.3		1,017.2
Cameron, Pa., highway bridge	14.0		957.4
Sterling Run, Pa., USGS staff gage	10.1		909.6
Sterling Run, Pa., highway bridge, USGS recording gage	9.9	18, 8:45 p. m.	909.3
Driftwood, Pa., Pennsylvania R. R. bridge	.05		808.0

TABLE 6.—*Flood-crest elevations*—Continued

Stream and location	Miles above month	Day and hour (July)	Elevation (feet)
SUSQUEHANNA RIVER DRAINAGE BASIN—Continued			
First Fork Sinnemahoning Creek:			
Costello, Pa., mouth of Freeman Run	25.2	18, 1 p. m.	1,195.4
Nelson Run, 0.6 mile below mouth of	21.4		1,132.7
Wharton, Pa., mouth of East Fork	19.7	18, 2 p. m.	1,094.5
Bailey Run, mouth of	17.2		1,063.5
First Fork, Pa	12.0	18, 3 p. m.	
Lushbaugh, Pa., 1.1 miles downstream at mouth of Short Bend Run.	8.1		907.4
Lick Island	4.3	18, 4 p. m.	844.7
Mouth	0	18, 5 p. m.	
Freeman Run:			
Austin, Pa., above, at dam that failed	5.6	18, 11 a. m.	
Austin, Pa., Ford garage	3.3	18, 11:30 a. m.	1,353.5
Highway bridge	.6		1,223.4
East Fork Sinnemahoning Creek: Highway bridge	2.5		1,172.8
ALLEGHENY RIVER DRAINAGE BASIN			
Allegheny River: [1]			
Seven Bridges, Pa., Dunn farm	317.9	18, 7:30 a. m.	1,930.9
Coudersport, Pa., highway bridge	308.6	18, 1:30 p. m.	1,646.7
Roulette, Pa., highway bridge	298.3	18, 2 p. m.	1,535.1
Burtville, Pa., highway bridge	295.1		1,505.4
Port Allegany, Pa., State Highway 155, bridge	289.6		1,482.1
Port Allegany, Pa., U. S. Highway 6, old bridge	288.9	18, 3:30 p. m.	1,479.0
Port Allegany, Pa., U. S. Highway 6, new bridge (destroyed by flood).	288.0		1,477.4
Turtlepoint, Pa., highway bridge	281.7		1,453.7
Larabee, Pa., highway bridge, USGS gage (discontinued)	276.4	19, 1 a. m.	1,447.4
Eldred, Pa., highway bridge, USGS gage	269.0	19, 9:30 a. m.	1,443.8
Mill Grove, N. Y., highway bridge	262.9		1,434.5
Portville, N. Y., fire department building	261.4	19, 3 p. m.	1,434.5
Olean, N. Y., highway bridge	255.5	19, 6:30 p. m.	1,423.3
North Allegany, N. Y., highway bridge	250.7		1,413.9
Vandalia, N. Y., highway bridge	246.4	19, 11:30 p. m.	1,404.7
Riverside Junction, N. Y., Erie R. R. bridge	242.1		1,393.5
South Carrollton, N. Y., railroad bridge	240.4		1,388.6
Salamanca, N. Y., highway bridge	233.7	20, 5 a. m.	1,374.2
Red House, N. Y., highway bridge, USGS gage	226.0	20, 8:30 a. m.	1,342.2
Quaker Bridge, N. Y., highway bridge	220.4		1,320.2
Onoville, N. Y., highway bridge	214.0		1,290.6
Kinzua, Pa., railroad bridge, USGS gage	200.0	20, 5 p. m.	1,217.7
Clarion River:			
Instanter	109.4	18, 3:30 p. m.	
Johnsonburg, Pa., lower highway bridge	94.0	18, 9 p. m.	1,439.8
Ridgway, Pa., West Penn power station	88.4		1,390.0
Ridgway, Pa., Main Street bridge, USGS gage	87.4	19, 1 a. m.	1,378.0
Carman, Pa., highway bridge	80.1		1,330.4
Bell Town, Pa., highway bridge	62.2		1,225.2
Cooksburg, Pa., dam site gage	49.3		1,170.6
Cooksburg, Pa., highway bridge, USGS gage	47.6	19, 9:30 a. m.	1,161.4
Clarion, Pa., Piney Dam, upper pool	25.1		1,093.1
St. Petersburg, Pa., highway bridge, USGS gage	4.5	19, 2 p. m.	891.0

[1] Data other than for gaging stations furnished by Corps of Engineers.

RECORDS OF PREVIOUS FLOODS

The floods of July 18, 1942, were unprecedented in the area of heaviest rainfall. That such extreme floods have occurred in the past in other parts of Pennsylvania and adjoining States is shown by the following descriptions of earlier floods. Perhaps the earliest flood from the cloudburst type of storm in Pennsylvania of which there is accurate record is that of August 5, 1843, in Delaware County. In view of the description of the storm given in an earlier section of this report it seems appropriate to include a description of the flood flows also. Following that description are short descriptions of recent floods caused by intense local rains in Pennsylvania and New Jersey. The section closes with a few notes on previous floods in Allegheny River at Salamanca, N. Y.

FLOOD OF AUGUST 5, 1843, IN DELAWARE COUNTY, PA.

Although confined to a smaller area, the flood of August 5, 1843, in Delaware County was every bit as large as the flood of July 1942 in the north-central part of the State. The following description of that flood is included in this report so that comparisons between the two can be made and to emphasize the fact that previous floods of this magnitude have occurred. Descriptive details of the storm have been given in a previous section by Mr. Stewart. The measured amounts of rainfall given in the original report (Delaware County Inst. Sci., 1910) on that flood have been summarized in table 7.

TABLE 7.—*Rainfall records for storm of August 5, 1843, in Delaware County*

Place	Amount (inches)	Remarks
Haverford School	5.82	Measured in a rain gage.
Upper Darby	3.75	0.5 inch before 12 m., heavy rain 3 to 7 p. m., 1 inch in 15 minutes just before 7 p. m.
Newtown Township	Between 11 and 13	2 to 5 p. m.
Newtown Square	5.5	4:20 to 5 p. m.
Concord Township	16	2:45 to 5:45 p. m.
Brandywine Hundred, Del.	10	2 to 4 p. m.

NOTE.—"The amount of rain which fell on that part of the County which borders on the Delaware River and embraces the mouths and lower parts of the inundated creeks was not sufficient to produce even an ordinary rise in the stream" (Delaware County Inst. Sci., 1910, p. 9).

The heavy rainfall apparently did not last more than about 3 hours, but the time of its occurrence varied throughout the county. The area covered by the cloudburst was less than the area of Delaware County although small areas of adjacent counties were affected. It followed on the heels of a general storm that extended much beyond the limits of Delaware County in every direction. The total rain prior to the cloudburst probably did not exceed three-quarters of an inch and little rise was noted in the streams. As a result of the general rain, however, the ground was soaked, thus reducing the infiltration and increasing the direct runoff from the cloudburst storm that followed. The heavy rain occurred near the headwaters of the streams unknown to residents of the lower valleys. The floods burst on them with devastating suddenness, causing the loss of 12 lives. The rapid rise of water is attested to by the many accounts of an almost instantaneous rise in the water from 5 to 8 or 10 feet. At one point on Crum Creek the water rose 7 or 8 feet in 10 minutes. Farther downstream at Avondale it was observed that (Delaware County Inst. Sci., 1910, p. 28):

* * * the water at this place rose 19 feet—6 feet higher than the great ice freshet of 1839. The rise in the creek commenced at about half past seven o'clock. The water rose very suddenly as well as unexpectedly, and was at its highest point a little after eight o'clock.

The fall of the flood waters was equally rapid; in Chester Creek at Flower's Mill the waters fell 10 feet in 50 minutes.

The maximum stages above low water reached by the major streams in the County were: Darby Creek, 17.5 feet; Crum Creek, 20 feet; Ridley Creek, 21 feet; and Chester Creek, 33 feet. There is little quantitative information available on peak discharges in these streams other than the description of a cross section on each:

Darby Creek, a short distance below the West Chester Road (Delaware County Inst. Sci., 1910, p. 22):

The flood attained a height of 15 feet at this place, with a cross section of 80 yards, which with proper allowances, would give an area of 2,800 feet.

Crum Creek (Delaware County Inst. Sci., 1910, p. 26):

Immediately below the point where the road from Newtown Square crosses the creek, the flood reached the height of 9 feet upon a cross section at the surface of 330 feet.

Ridley Creek (Delaware County Inst. Sci., 1910, p. 29):

* * * on the farm of George Howard, in Edgmont. At this place the water attained a height of 12 feet 6 inches, which was 6 feet 6 inches higher than the great freshet of 1839, and 6 feet 4 inches higher than that of 1795; this last being the highest which had previously occurred at the same place during a period of at least 90 years. * * * A cross section of the flood of 1795 gives but 900 square feet, while that of 1843 gives upwards of 2,500 square feet.

Chester Creek. A detailed description of a cross section on this stream is given by John F. Frazer of Philadelphia, who was visiting at the farm of Samuel West (Delaware County Inst. Sci., 1910, p. 43).

The height of the flood I measured with as much accuracy as my means would permit, and am confident that my measures are correct within one or two inches, at the same time I must observe that the elevations are taken above the level of the creek, a day or two after the flood, when from the continuance of wet weather, the creek was still above its ordinary level; how much it is impossible for me to say. At the position where I first measured it (upon Mr. West's upper meadow) the creek was sixty feet wide, and averaged about six feet in depth (it is the upper end of the backwater from Flower's dam). The vertical height of the flood was 20.58 feet above the water line, or 26.5 feet above the bottom of the channel of the creek. The breadth of the water line at the highest point of the flood (measured at right angles to the direction of the creek) was 534.8 feet (say 535 feet). The meadows overflowed, on either side, are quite flat, and appear to have been at some former time, the banks of the stream or current, so that I think we may assume the area of the cross section as at least two-thirds of the rectangular area given by multiplying the breadth by the height. Assuming then the number 535 and 21 are representing these (neglecting the channel actually occupied by the creek) we shall have the area of the cross section 7,490 square feet. Assuming the creek to be sixty feet wide and six feet deep, and its cross section a rectangle (as it is very nearly) we have an area of 360 square feet for the creek at its ordinary high water, by which we see that the cross section was increased twenty times. The increase of velocity I had no means of ascertaining, as the greater breadth at this point give rise to the formation of extensive eddies. * * * Professor Frazer is of the opinion that at Mr. West's (judging from the motion of the cotton bales) the velocity of the middle of the stream was not less than from fifteen to twenty miles per hour.

The cross section described by Professor Frazer is about a mile below the present Geological Survey gaging station at Dutton Mill Bridge.

For the four cross sections just described, I. E. Houk (1922) estimated velocities after a personal field inspection of the locations and a study of the channel slopes. The results of his calculations are as follows:

TABLE 8.—*Summary of flood discharges in Delaware County, Aug. 5, 1843*

Stream	Drainage area (square miles)	Runoff	
		Cubic feet per second per square mile	Inches per hour
Darby Creek	[1] 32	880	1.36
Crum Creek	22	410	.64
Ridley Creek	20	750	1.16
Chester Creek	62	1,000	1.55

[1] Careful investigation indicates that 32 square miles is a better figure for this location than 48 square miles as given by Houk. Other figures have been revised based on the same peak discharge.

The destruction caused by the storm and flood was calamitous, the losses in Delaware County being estimated at nearly a quarter of a million dollars. This amount of damage is not surprising when one reads of the dams and bridges destroyed and stone buildings being knocked down "stone by stone." The force of the flood is shown in the accounts of a rock weighing 2½ tons that was carried 200 yards, a meadow that was excavated to depths of 4 and 5 feet, and a rock weighing between 10 and 12 tons that was moved about 75 feet.

FLOOD OF SEPTEMBER 1, 1940, IN SOUTHERN NEW JERSEY

Peak flood discharges in southern New Jersey streams Sept. 1, 1940, were as great as many of those in the flood of July 1942 in Pennsylvania from drainage basins of comparable size. The greatest discharge, both in actual amount and in relation to size of drainage area, was the flow of 26,100 second-feet in Salem Creek below Woodstown. The floods resulted primarily from extraordinary rainfalls associated with the passing of a hurricane off the New Jersey coast. Contributing factors were the breaching of many small dams and the week of antecedent rainfall that soaked the ground and weakened earth dams.

The rainfalls that produced these floods included the maximum 12-hour rainfall in the United States—24 inches in 9 hours at Ewan. The average rainfall on 2,000 square miles was 7.8 inches according to the Corps of Engineers. The flood caused the death of four persons and damage amounting to $1,000,000 according to the Weather Bureau. In addition many thousands of persons were seriously inconvenienced by washed out railroad and highway bridges and flooded highways during Labor Day week-end. Some communities were virtually isolated. A large part of the damage was caused by the breaking of many small dams.

Miscellaneous measurements of peak discharge were made by the Geological Survey and the New Jersey State Water Policy Commission. The results of these measurements are given in table 9 together with peak discharges at stream-gaging stations. Daily discharges at the stream-gaging stations are published in Water-Supply Paper 891, Surface-water supply of the United States, part 1, north Atlantic slope basins.

TABLE 9.—*Summary of flood discharges in southern New Jersey for the flood of September 1, 1940*

Stream and place of determination	Drainage area (square miles)	Period of record or method of measuring	Maximum flood previously known				Maximum during present flood			
			Date	Gage height (feet)	Discharge		Time	Gage height (feet)	Discharge	
					Second-feet	Second-feet per square mile			Second-feet	Second-feet per square mile
GREAT EGG HARBOR RIVER DRAINAGE BASIN										
Great Egg Harbor River at Folsom	56.3	1925–40	Sept. 23, 1938	6.59	718	12.8	Sept. 3	9.09	1,440	25.6
MAURICE RIVER BASIN										
Maurice River at Norma	113	1932–40	Sept. 8, 1935	5.30	1,090	9.6	Sept. 2, 1 p. m.	8.72	7,360	65.1
Maurice River at Millville [1]	218	Dam					Sept. 2		6,500	29.8
Manantico Creek, near Millville	22.3	1931–40	Aug. 20, 1939	6.21	1,050	47.1	Sept. 2, 2 p. m.	3.88	363	16.3
COHANSEY CREEK BASIN										
Cohansey Creek at Bostwick Dam, at Beals Mill.[1]	8.3	Dam					Sept. 1		2,100	253
Barrett Run at Mary Elmer Dam at, Bridgeton [1]	7.5	do					do		1,850	247
DELAWARE RIVER DRAINAGE BASIN										
Assunpink Creek at Trenton	89.4	1923–40	Sept. 22, 1938	10.74	3,320	37.1	Sept. 3, 3–4 a. m.	6.00	1,230	13.8
Crosswicks Creek at Extonville	83.6	1940					Sept. 1	12.05	3,360	40.2
North Branch Rancocas Creek at Pemberton	111	1921–40	Aug. 21, 1939	10.77	1,730	15.6	Sept. 1, about 3 p. m.	9.65	1,480	13.3
Haynes Creek at Medford Lakes [1]	3.3	Orifice					Sept. 1		223	67.6
Kettle Run at Taunton [1]	7.3	do					do		500	68.5
Sharps Run at Pa. R. R. culvert at Medford [1]	4.9	do					do		700	143
Big Timber Creek at Clementon Park Dam, at Clementon.[1]	2.8	Critical depth					do		800	286
Mantua Creek at Pitman	6.75	Dam					do		4,200	622
Racoon Creek at State Highway 45, at Mullica Hill.[1]	14.0	Critical depth					do		2,900	207
Oldmans Creek at Jessups Mills	4.15	Contracted opening					do		2,950	711
Oldmans Creek near Woodstown	19.3	1931–40	June 27, 1938	9.08	1,190	61.6	do	20.3	8,100	420
Salem Creek at Woods Mill	4.3	Dam					do		7,090	1,650
Salem Creek below Woodstown	17.5	Slope area					do		26,100	1,490
Branch of Salem Creek 3 miles east of Woodstown.	3.2	do					do		3,880	1,210
Branch of Alloway Creek 1½ miles northeast of Alloway.	8.7	do					do		10,800	1,240
Branch of Alloway Creek east of Alloway	5.5	Contracted opening					do		3,300	600

[1] Furnished by New Jersey State Water Policy Commission.

FLOODS OF JUNE 4–5, 1941, IN SOUTHWESTERN PENNSYLVANIA

Outstanding floods occurred in many small streams in Monongahela River Basin as a result of heavy rains June 3 and 4. The flood discharge of Castile Run at Riggle Farm, Pa., was comparable with the higher discharges in the 1942 flood in the north-central part of the State.

The flood-producing rains were preceded by showers that began on May 30. The heavy rains occurred in the afternoon and night of June 3 and again in the afternoon of June 4. They were described by the official in charge, Weather Bureau office, Pittsburgh (Monthly Weather Review, June 1941):

> The rains were unprecedented for several of the southwestern counties in Pennsylvania, and adjacent counties in West Virginia, being in excess of 6 inches for the 24 hours ending at 7 a. m. of the 5th. At Brownsville, Pa., Government lock No. 5, the precipitation on the morning of the 5th measured 6.27 inches.

The Geological Survey made an extensive investigation of the flood area to obtain the peak discharges of the small streams. The results of that investigation are given in table 10. Also given in table 10 are the peak discharges at the stream-gaging stations in the area; daily discharges at these stations are published in Water-Supply Paper 923, Surface-water supply of the United States, 1941, part 3, Ohio River Basin.

Table 10.—*Summary of flood discharges in southwestern Pennsylvania for the floods of June 4–5, 1941*

Stream and place of determination	Drainage area (square miles)	Period of record or method of measuring	Maximum flood previously known: Date	Maximum flood previously known: Gage height (feet)	Maximum flood previously known: Discharge: Second-feet	Maximum flood previously known: Discharge: Second-feet per square mile	Maximum during present flood: Time	Maximum during present flood: Gage height (feet)	Maximum during present flood: Discharge: Second-feet	Maximum during present flood: Discharge: Second-feet per square mile
Ohio River at Sewickley	19,500	1933–41	Mar. 18, 1936	34.75	574,000	29	June 5	16.68	234,000	12
Monongahela River at Greensboro	4,407	1939–41	Mar. 18, 1936	28.4	147,000	33	June 4	24.28	[1]117,000	
Monongahela River at Charleroi	5,213	1886–1905, 1933–41	July 11, 1888	26.1	[2] 156,000	30	June 5	20.85	[1]133,000	
Monongahela River at Braddock	7,337	1939–41	Mar. 18, 1936	38.8	[3]		June 5	31.20	[1]201,000	
Dunkard Creek at Shannopin	229	1941					June 4, 12 p. m.	14.02	16,800	73
South Fork Tenmile Creek at Jefferson	180	1931–41	Nov. 4, 1936	13.8	8,100	45	June 4	18.45	13,800	77
Tenmile Creek in West Bethlehem Township [4]	99.3	Dam					June 4 or 5		7,800	79
Wisecarver Run near Waynesburg	3.91	do					do		[5] 827	
Ruff Creek at Grimes School	21.1	Slope area					do		8,900	422
Ruff Creek at Lippincott School	23.8	do					do		9,490	399
Castile Run at Old Castile School	1.76	do					do		2,320	1,320
Castile Run at Riggle Farm	4.25	do					do		10,000	2,350
Twomile Run near Brownsville	2.68	do					do		3,650	1,360
Tributary to Monongahela River in East Pike Run Township.[4]	.17	Dam					do		286	1,680
Dunlap Creek at Dunlap	36.0	Slope area					do		3,560	99
Branch of Dunlap Creek in Redstone Township [4]	.19	Dam					do		45	237
Fourmile Run in Redstone Township [4]	.24	do					do		58	242
Redstone Creek at Braznell [6]	105	Slope area					do		12,800	122
Allen Run, near Smock	3.17	Dam					do		3,070	968
Crabapple Run at Spillway Lake	1.33	do					do		[5] 860	
Washwater Run in Jefferson Township [4]	1.58	do					do		1,320	835
Colvin Run at Grindstone	2.68	do					do		2,000	746
Pike Run at Daisytown	20.1	Contracted opening					do		7,710	384
Pike Run near Coal Center	20.7	Slope area					do		7,860	380
North Branch Little Redstone Creek in Jefferson Township.[4]	.28	Dam					do		154	550
Youghiogheny River below Confluence	1,029	1940–41					June 4	16.42	43,800	43
Youghiogheny River at Connellsville	1,326	1908–41	Mar. 18, 1936	20.28	[1] 92,500		June 5	17.02	[1]63,600	
Youghiogheny River at Sutersville	1,715	1915–29, 1931–36, 1938–41	do	30.65	100,000	58	June 5	27.34	78,000	45
Casselman River at Markleton	382	1913–41	Mar. 17, 1936	16.4	35,800	94	June 5, 12:30 a. m.	10.24	18,700	49
Laurel Hill Creek at Ursina	121	do	do	10.28	10,300	85	June 4, 10:30 p. m.	7.98	9,400	78
Indian Creek at Indian Run Dam	110	Dam					June 4 or 5		6,430	58
Branch of Washington Run at Upper Dam, at Star Junction.	.65	do					do		730	1,120
Branch of Washington Run at Lower Dam, at Star Junction.	1.02	do					do		[5] 620	
Jacobs Creek at Upper Dam, at Bridgeport	31.8	do					do		[5] 1,970	

[1] [illegible]. [2] About. [3] Discharge not determined. [4] Furnished by Pennsylvania Department of Forests and Waters. [5] Affected by storage. [6] Furnished by Corps of Engineers.

PREVIOUS FLOODS AT SALAMANCA, N. Y.

In the course of his investigation of the flood of July 1942, Hollister Johnson obtained interesting information concerning previous floods in Allegheny River at Salamanca, N. Y. Although the information may not be very accurate owing to the lapse of time and the changes that have taken place in the river channel, they are reported for possible future use.

Floods of June 1889 and June 1892.—Although there is some doubt as to which of these two floods was the higher, there is little doubt that both were higher than the flood of 1942. Mr. A. R. Eaton remembered that the flood of 1889 reached the bottom of the floor boards in the basement of the Eaton Department Store on Broad St. (now the S and S store) in which he was living. (Flood elevation was 1,374.3 feet compared with 1,373.7 feet in 1942.) Mr. Fred F. Nies has photographs presumably taken during the flood of 1892. From one of these photographs, the flood elevation at the Shultz Bros. tailoring shop, about 200 feet above the highway bridge, was found to be 1,375.7 feet. Mr. Nies also stated that the flood of 1892 just covered plumbing benches in the basement of Andrews Hardware Store, just downstream from the highway bridge, at elevation 1,374.9 feet. The 1942 flood at these locations was 1,374.9 and 1,374.0 feet, respectively. The significance of these old flood elevations is largely dissipated by the statement of Mr. Eaton that there have been important changes in the river channel since then. There used to be a mill race on the left bank, about three-quarters of a mile long, with a dam for diverting water into it.

Flood of March 1913.—Mr. Fred F. Nies built his garage and plumbing shop on the right bank of the river about 100 feet below the highway bridge. Although the flood of 1913 was about 18 inches below the floor of this garage, according to Mr. Nies, no flood prior to 1942 ever reached the floor. (Flood elevations, 1,371.2 and 1,373.9 feet, respectively.)

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