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DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

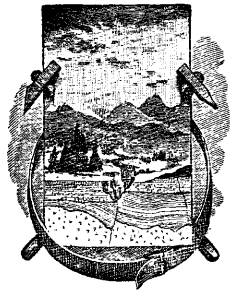
THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART V.—Ohio and Lower Eastern Mississippi River Drainages

BY

M. R. HALL, F. W. HANNA, and J. C. HOYT



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CONTENTS.

ILLUSTRATIONS.

PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

PART V.

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INTRODUCTION.

ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (Stat. L., vol. 28, p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

Annual appropriations for hydrographic surveys for the fiscal years ending June 30, 1895 to 1906.

1895	$12,500	1901	$100,000
1896	20,000	1902	100,000
1897	50,000	1903	200,000
1898	50,000	1904	200,000
1899	50,000	1905	200,000
1900	50,000	1906	200,000

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systematized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. There is also collected information concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely upon the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information

concerning the minimum flow; if the water is to be stored the maximum flow receives special attention. In all sections of the country permanent stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations, and their records, in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. "The Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165–178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and Eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based upon the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, as far as practicable, geographically.

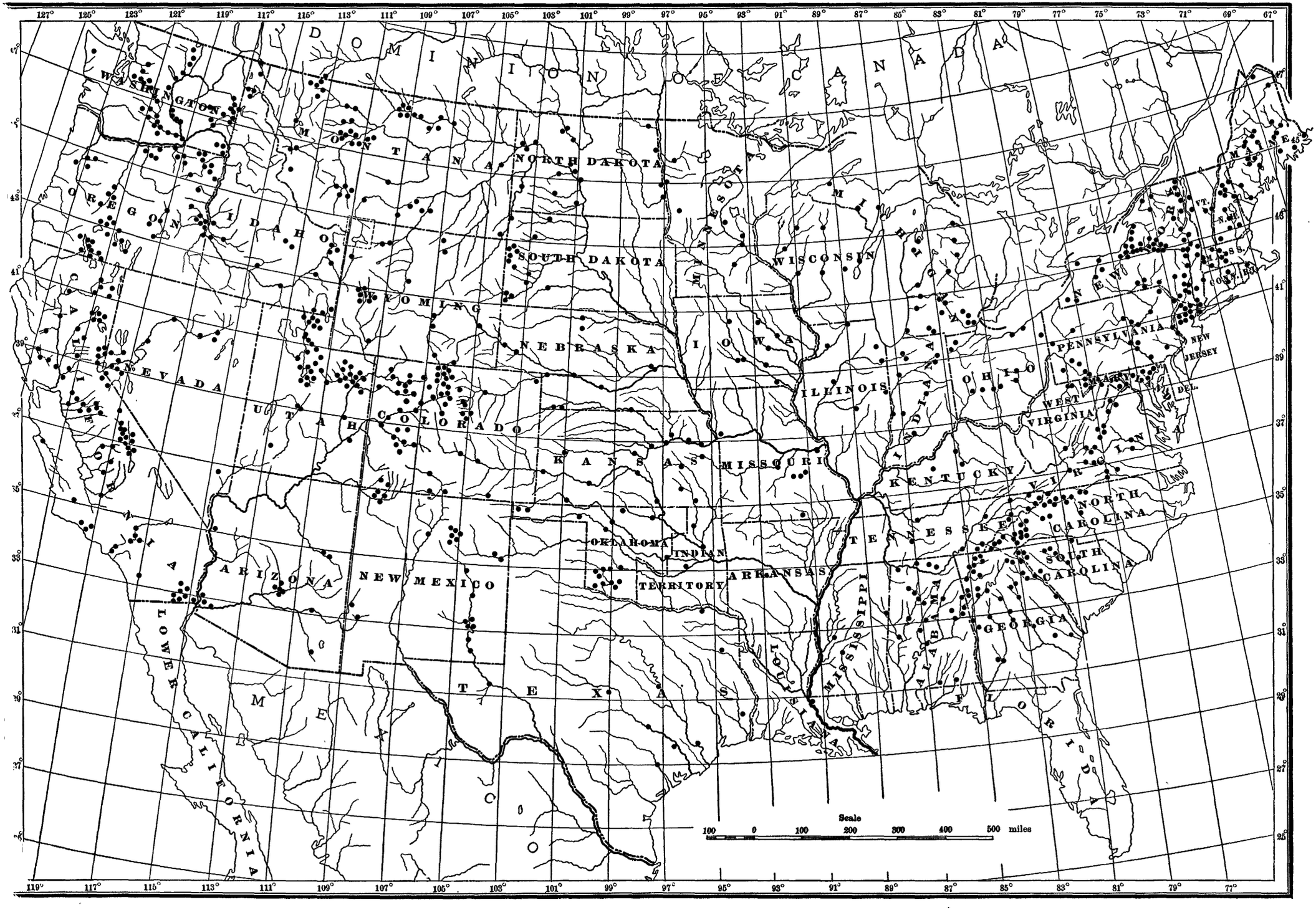
List of drainage basins in the United States.

NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.	Thames.
St. Croix.	Housatonic.
Penobscot.	Hudson.
Kennebec.	Passaic.
Androscoggin.	Raritan.
Presumpscot.	Delaware.
Saco.	Susquehanna.
Merrimac.	Potomac.
Connecticut.	Minor Chesapeake Bay.
Blackstone.	Minor Northern Atlantic.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.	Great Pedee (Yadkin).
Chowan.	Santee.
Roanoke.	Savannah.
Tar.	Ogeechee.
Neuse.	Altamaha.
Cape Fear	Minor Southern Atlantic.



MAP OF THE UNITED STATES, SHOWING LOCATION OF PRINCIPAL RIVER STATIONS MAINTAINED DURING 1905.

List of drainage basins in the United States—Continued.

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.	Pearl.
Apalachicola.	Minor Eastern Gulf of Mexico.
Mobile.	

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.	Upper eastern Mississippi.
Ohio.	

ST. LAWRENCE DRAINAGE BASINS.

Lake Superior.	Niagara River
Lake Michigan.	Lake Ontario.
Lake Huron.	Lake Champlain (Richelieu River).
Lake St. Clair.	Minor St. Lawrence.
Lake Erie.	

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.	Lower western Mississippi.
Missouri.	Arkansas.
Meramec.	Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.	Guadelupe.
Neches.	San Antonio.
Trinity.	Nueces.
Brazos.	Rio Grande.
Colorado (of Texas).	Minor Western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountains.	Sierra Nevada.
Humboldt.	Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.	Columbia.
San Francisco Bay.	Puget Sound.
Northern Pacific.	

HUDSON BAY DRAINAGE BASINS.

DEFINITIONS.

The volume of water flowing in a stream, the "run-off" or "discharge," is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-foot. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the quantity of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly, both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based upon all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station, and they also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. Upon this the computations for the two remaining columns, which are defined on page 9, are based.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two and not more than four significant figures.
3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is 5 times the average per cent of error of all the other measurements should be rejected.
4. In reducing the number of significant figures, or the number of decimal places by dropping the last figure, the following rules apply:

(*a*) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(*b*) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(*c*) When the figure in the place to be rejected is 5 and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(*d*) When the figure in the place to be rejected is 5 and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

Special rules for computation.

1. Rating tables are to be constructed as close as the data upon which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep; 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equals 15 United States gallons per second.
100 California miner's inches equals 77 Colorado miner's inches.
100 California miner's inches for one day equals 4 acre-feet.
100 Colorado miner's inches equals 2.60 second-feet.
100 Colorado miner's inches equals 19.5 United States gallons per second.
100 Colorado miner's inches equals 130 California miner's inches.
100 Colorado miner's inches for one day equals 5.2 acre-feet.
100 United States gallons per minute equals .223 second-foot.
100 United States gallons per minute for one day equals 0.44 acre-feet.
1 million United States gallons per day equals 1.55 second-feet.
1 million United States gallons equals 3.07 acre-feet.
1 million cubic feet equals 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.

1 square meter equals 10,764 square feet; equals 1,196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch, equals 1 ton per square foot, equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1⅓ horsepowers equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft. x fall in feet}}{11}$=net horsepower on water wheel, realizing 80 per cent of the theoretical power.

Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\sqrt{h^3}$: l=length of weir in inches; h=head in inches flowing over weir, measured from surface of still water.

To change miles to inches on map:

Scale 1:125000, 1 mile=0.50688 inch.
Scale 1: 90000, 1 mile=0.70400 inch.
Scale 1: 62500, 1 mile=1.01376 inches.
Scale 1: 45000, 1 mile=1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geological Survey) and No. 95 (Accuracy of Stream Measurements). In order that persons using this report may readily become acquainted with the general methods employed, the following brief description is given:

Streams may be divided, with respect to their physical conditions, into three classes: (1) Those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data upon which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends upon the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{r\,s}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n, which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes: (1) Those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q=c\ b\ h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (*f*) either no flash boards, or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, a dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured either by a weir, a current meter, or a simple system of water wheels which are of standard make or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve for a critical stage of considerable duration the use of a head on a broad-crested dam of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

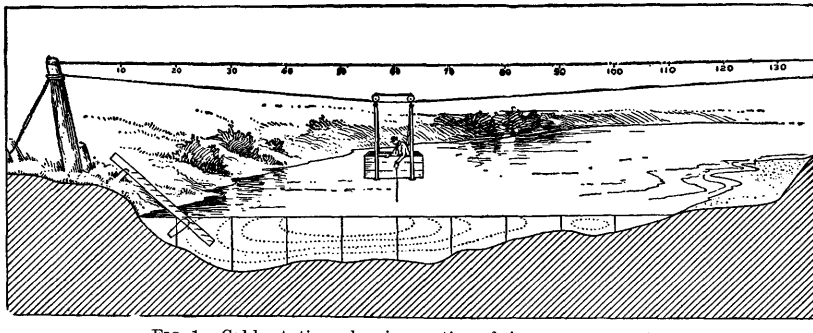


FIG. 1.—Cable station, showing section of river, car, gage, etc.

A gaging station at a weir or dam has the general advantage of continuity of record through the period of ice and floods, and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends upon the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same, whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character; and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams, dams, or other artificial obstructions that the gage height shall be an index of the discharge.

There are generally pertinent to a gaging station certain permanent or semipermanent structures which are usually referred to as equipment. These are: A gage for determining the fluctuations of the water surface; bench marks, to which the datum of the gage is referred; permanent marks on a bridge or a tagged line indicating the points of measurement, and where the current is swift some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates, and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, a boat, or by wading, and gaging stations may be classified in accordance with such use. (Fig. 1 shows a typical cable station.)

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending upon the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

There are in general use three classes of methods of measuring velocity with current meters—multiple point, single point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve, 0.2 and 0.8 depth, and top, bottom, and mid depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method can be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending upon the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable, or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as shown in figure 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to the lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge, varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pp. 141–148.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending upon whether or not the bed of the stream is permanent.

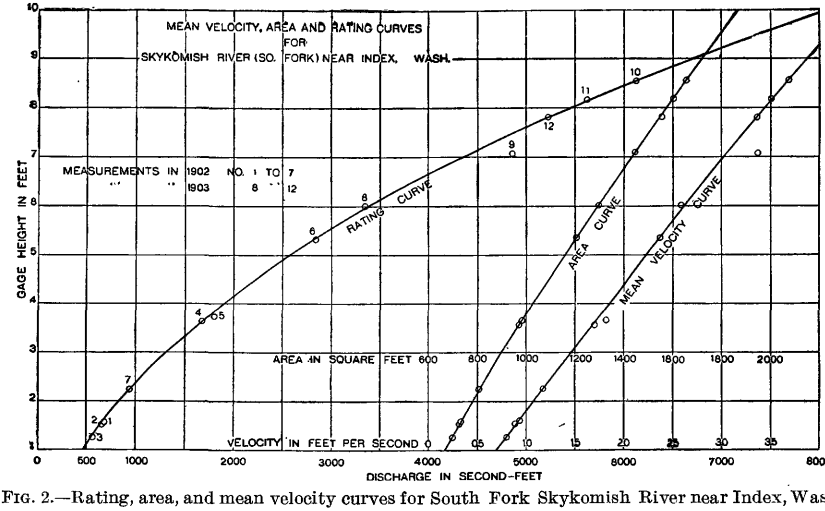


FIG. 2.—Rating, area, and mean velocity curves for South Fork Skykomish River near Index, Wash.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends upon the method used in measuring flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend upon the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river

at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of the water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends upon the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant; (2) neglecting the change of slope due to the rise and fall of the stream, the discharge will be the same whenever the stream is at a given stage; (3) the discharge is a function of and increases gradually with the stage.

The plotting of the results of the various discharge measurements using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean volocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Figure 2 shows a typical rating curve with its corresponding mean velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean velocity curve depends chiefly upon the surface slope, the roughness of the bed, and the cross section of the stream. Of these the slope is the principal factor. In accordance with the relative change of these factors the curve may be either a straight line, convex, or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. This curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes, and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days, and the discharges for intervening days obtained either by interpolation modified by gage height, or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in anyway, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the district hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

Alabama.—District hydrographer, M. R. Hall,[a] assisted by W. E. Hall and F. A. Murray.

Illinois.—District hydrographer, F. W. Hanna,[b] assisted by M. S. Brennan and Sidney K. Clapp.

Indiana.—District hydrographer, F. W. Hanna, assisted by M. S. Brennan and Sidney K Clapp. Acknowledgment should also be made to Joseph M. Steiner and O. H. Griest, who have assisted the Survey in establishing stations and supplying voluntary readings at Cataract and Shoals, Ind.

Kentucky.—District hydrographer, F. W. Hanna, assisted by M. S. Brennan and Sidney K. Clapp.

Mississippi.—District hydrographer, M. R. Hall, assisted by W. E. Hall.

New York.—District hydrographer, R. E. Horton,[c] assisted by C. C. Covert.

North Carolina.—District hydrographer, M. R. Hall, assisted by W. E. Hall, B. S. Drane, and O. P. Hall. Dr. C. A. Schenck, director of the Biltmore School of Forestry, paid the gage readers at Davidsons River, Sitton, and Pinkbed.

Ohio.—District hydrographer, F. W. Hanna, assisted by M. S. Brennan and Sidney K. Clapp. Acknowledgment should also be made to the Baltimore and Ohio Railroad for passes issued to F. W. Hanna and R. W. Pratt.

Pennsylvania.—District hydrographer, N. C. Grover, assisted by members of the computing section.

Tennessee.—District hydrographer, M. R. Hall, assisted by W. E. Hall, B. S. Drane, and O. P. Hall. Gage heights for stations at Nashville, Chattanooga, Knoxville, Rogersville, Bluff City, and McGhee were furnished by the following United States Weather Bureau officials: H. C. Bate, L. H. Pindell, and Levi A. Judkins.

Virginia.—District hydrographer, N. C. Grover, assisted by members of the computing section.

West Virginia.—District hydrographer, N. C. Grover, assisted by members of the computing section.

OHIO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Ohio River, which is formed by the junction of Allegheny and Monongahela rivers at Pittsburg, flows in a southwesterly direction, forming the boundaries between and draining the States of Ohio, Indiana, and Illinois on the north and West Virginia and Kentucky on the south. Its tributaries also drain portions of New York, Pennsylvania, Maryland, Virginia, North Carolina, Georgia, Alabama, and Mississippi.

The length of the stream, as surveyed by the United States Army engineers, from Pittsburg to Cairo is 967 miles.[d]

The river presents an interesting series of shoals and riffles, separated by pools in which the water is deeper and the fall very low. The summary of the profile made by the army engineers shows 187 pools with over 7 feet depth at low water. These occupy 632.5 miles and have an average length of 3.47 miles. Of these, 127 pools above Louisville, Ky., average 2.8 miles, with a total length of 363 miles; and 60 pools below Louisville, with a total length of 266 miles, have an average length of 4.4 miles.

On the borders of Ohio the riffles (103 in number) cover a combined length of 137 miles and have a total fall of 170 feet. The pools, with a combined length of 309 miles, have a fall of 64 feet, or but 2.5 inches per mile. The greatest fall noted for a single mile on the border of this State is at Letart Falls, Meigs County, where a descent of 3.2 feet is made. There are 11 riffles, with a descent exceeding 2 feet per mile. The least fall reported is in

[a] Office of the district hydrographer for southern Atlantic States and eastern Gulf of Mexico, 409 Temple court, Atlanta, Ga.

[b] Office of the district hydrographer for Mississippi Valley, 876-877 Federal Building, Chicago, Ill.

[c] Office of the district hydrographer for New York and Michigan (Lower Peninsula), 75 Arcade, Utica, N. Y.

[d] Ex. Doc. No. 72, House of Representatives, Forty-first Congress, third session, January, 1871, pp. 139-153.

a pool 8 to 15 miles below Cincinnati. This pool, with a length of 7 miles, has a fall of but 3.5 inches. Another pool with about as low a fall is found 23 to 30 miles above Cincinnati. These are the most conspicuous pools in this section of the Ohio.

On the borders of Indiana there are 55 riffles aside from the Louisville rapids. These show a total fall of 80.28 feet in a combined distance of 134.5 miles. At the Louisville rapids there is a fall of 23.09 feet in 2.25 miles. There is left but 18.13 feet for the fall of the stream in about 215 miles embraced in the pools, or only 1 inch per mile.

In general the rock floor of the valley is 30 to 50 feet below the level of the stream at low water. It rarely reaches a lower level than 75 feet below the stream. Its level is 65 or 75 feet below the stream between Evansville, Ind., and Shawneetown, Ill. It is thought that no place occurs in the whole length of the valley where a rock barrier crosses its entire width at a level as high as the bed of the present stream. In several places rock shelves extend out part way across the river bed, leaving a channel deep enough for the passage of boats along the opposite bank. At Letart Falls the rock is stated to extend across the entire breadth of the stream, but it dips toward the east bank sufficiently to allow the passage of boats when the rock of the western part of the stream bed is above the water surface. Well data indicate that this descent continues eastward beneath the bottom lands to a level as low as in the neighboring parts of the channel. Near Ravenswood, W. Va., rocky reefs are exposed at low water fully halfway across the stream bed, but wells on the bottom lands near the village show the rock floor to be at least 25 feet below the stream at low water. At Louisville it is found by wells and bridge soundings that a channel 25 feet or more lower than the present surface at the head of the rapids leads southwestward from near the south end of the Jeffersonville bridge a short distance and then turns westward, passing through the midst of the city.[a] Thus at the side of each of the three most conspicuous rock reefs touched by the stream a buried channel apparently occurs.

Notwithstanding the great number of riffles and shoals, the Ohio is generally navigable throughout the entire season for small boats drawing less than 3 feet of water. It is navigable for vessels drawing 6 feet of water during a few months of the early part of the season, but there is usually little traffic with such boats after the month of July. The canal at Louisville affords opportunity for passing around the rapids during low water. During high-water stages the boats are able to pass over the rapids.

The valley of Ohio River along the southern boundary of Ohio and Indiana is very narrow except for a few miles near Louisville, where it has expanded itself in the Devonian shales, and for a similar widening in the southwestern portion of Indiana, in the Coal Measures. Its narrowness has been a subject of remark from the early days of settlement. There are very few places between Pittsburg and Louisville where its width exceeds 2 miles, and usually it is scarcely more than 1 mile wide. In the vicinity of Louisville, where it crosses the low tract formed in the Devonian shales, it has a width of perhaps 4 miles, but on entering the Knobstone escarpment below the mouth of Salt River it narrows abruptly to a width of about 1 mile, and remains narrow for nearly 100 miles in its passage through the hard beds of Lower Carboniferous age. It then enters the Coal Measures and soon attains a width of 6 or 8 miles, which it maintains for much of its course to Cairo. The only exception is found at the point where it passes the elevated ridge below Shawneetown. Here its width is reduced to about 2½ miles. The depth of the valley ranges from about 600 feet down to scarcely 100 feet, being greatest on the border of the "panhandle" of West Virginia and least in the lower portion of its course. Its depth seldom falls below 300 feet in the portion above Louisville, and probably averages 450 feet. The narrow portion below Louisville is about 300 feet in depth. The broad portions at Louisville and in the lower parts of its course are but 100 to 150 feet in depth. The work done by the river in excavating a narrow valley through the elevated districts is apparently commensurate with that accomplished in eroding a wide valley in the low districts.

[a] Data on this subject were furnished by Maj. William J. Davis, of the Louisville school board, and by Messrs. John Ryan and John C. Oestrich, of the Louisville Pump Works.

The entire work of the stream, however, is less than should have been accomplished by a drainage line of this size in the time since the beginning of development of drainage lines. It is far less in proportion to its size than the work accomplished by the small tributaries which enter it from southern Indiana. The explanation of this meager amount of work is found in the enlargement of Ohio River in recent times. Investigations now in progress indicate that several independent drainage lines which formerly led northward from the Appalachian Mountains across southwestern New York, northwestern Pennsylvania, and Ohio into the Lake Erie basin have been united to form the present Ohio. The full extent of these changes is not yet determined, nor are all of the outlets for the old river systems satisfactorily traced; but enough is known to justify the statement that the small size of the valley of the Ohio is attributable to the recent union of the several independent drainage systems.

OHIO RIVER AT WHEELING, W. VA.

The United States Weather Bureau has made observations of the stage of Ohio River at Wheeling, W. Va., since 1882. In 1905 measurements of the flow were begun by the United States Geological Survey.

A large island divides the river at this point into two channels. This island is almost entirely overflowed during extreme floods. The right channel is straight above and below the station. The current is sluggish for gage heights from 6 to 8 feet. Below 5 feet the velocity is zero, owing to a low rock dam 3,444 feet below the measuring section. In high and medium stages the dam is submerged. The right bank is high, clean, and does not overflow. The left bank overflows in extreme high water. The bed of the stream is rocky and sandy, and is permanent. There is but one channel, broken by the piers of the bridge.

The left channel is straight above and below the station. The current is swift. The left bank is high, clean, and does not overflow. The right bank overflows in extreme high water. The bed of the stream is composed of gravel, and is permanent. There is but one channel, broken by two piers.

Discharge measurements in the left channel are made from the downstream side of a steel trolley and highway bridge about 100 feet above the water surface. An extra length of cable and 30 pounds of lead for use in making measurements at this point are stored in the basement of the upstream tollhouse on the Wheeling side.

Discharge measurements in the right channel are made from the downstream side of a steel trolley and highway bridge 50 feet above the water surface.

The "Government" gage, from which continuous records are furnished by the United States Weather Bureau, consists of sandstone blocks set in the riprap of the left bank of the left channel about 150 feet below the Pennsylvania depot. One foot vertical equals 5 feet on the incline.

In order to compare the relative heights of the water surface in the two channels, the United States Geological Survey installed a standard chain gage in the right channel June 1, 1905. It is bolted to the outside of the upstream hand rail in the second span from the Ohio side of the bridge, from which discharge measurements are made; length of chain, 58.46 feet. The datum of the two gages is the same. This gage is but temporary, and during 1905 was read twice each day.

The bench mark for the Weather Bureau gage is the high-water mark of February 7, 1884, cut in the stone bottom of the ogee on top of the water table on the southwest corner of the custom-house, corner of Sixteenth and Market streets; elevation, 53.1 feet above the zero of the gage. On June 1, 1905, the elevations of the foot marks of this gage were obtained, the 6.00 mark being assumed to be correct. Thus each foot mark in the stone flagging gage is a bench mark. Elevations below 5.00 feet were not determined.

Bench marks were established for the chain gage as follows: (1) The highest point on the corner of the upstream side of the right abutment of the bridge over the right channel, marked by black paint; elevation, 52.60 feet; (2) the southeast corner of the southwest stone support of the crossing watchman's tower, about 100 feet beyond the west end of the bridge; elevation, 48.96 feet. Elevations refer to the datum of both gages, which is 610.29 feet above sea level.

Discharge measurements of Ohio River at Wheeling, W. Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
Prior to 1893 [a]					8.50	36,260
1892.						
October 10-13 [b]		[c] 642	[c] 3,472	[c] 0.88	1.10	3,050
1905.						
March 14	E. C. Murphy	1,362	19,920	4.10	14.35	81,740
March 14	do	1,352	19,300	4.01	13.94	77,440
March 15	do	1,326	17,410	3.80	12.37	66,280
March 17	do	1,285	15,040	3.45	10.43	51,850
March 20	do	1,457	38,890	5.89	28.20	229,200
March 20	do	1,461	42,750	6.13	30.80	261,900
March 21	do	1,489	54,780	6.23	38.90	341,100
March 21	do	1,489	57,360	6.18	40.70	354,400
March 22	do	1,486	59,580	6.07	42.05	361,600
March 22	do	1,486	60,510	6.05	42.50	365,700
March 23	do	1,488	58,830	5.73	41.60	336,900
March 23	do	1,486	56,790	5.60	40.30	318,100
March 24	do	1,482	49,250	5.20	35.20	255,800
March 24	do	1,482	45,550	4.99	32.70	227,300
March 25	do	1,457	37,560	4.95	27.20	186,100
March 25	do	1,457	35,050	4.80	25.50	168,100
March 27	do	1,452	30,830	4.83	22.44	149,100
April 13	A. H. Horton	1,344	18,700	3.65	13.06	68,380
April 19	do	1,259	11,710	2.46	7.51	28,760
April 21	do	1,266	11,490	2.44	7.35	27,990
June 1	R. H. Bolster	1,192	9,054	1.62	5.20	14,640
August 25	E. C. Murphy	1,201	9,799	1.84	5.78	18,040
August 28	do	1,231	12,310	2.56	7.78	31,500
November 1	do	1,212	10,270	1.93	6.20	19,800

[a] From Weather Bureau Report.
[b] Computed from three measurements at Davis Island Dam, Pa., and two measurements at Marietta, Ohio, made by army engineers in October, 1892.
[c] Left channel (Wheeling side) only.

Daily gage height, in feet, of Ohio River at Wheeling, W. Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10.6	4.4	17.7	14.0	8.8	5.3	6.6	13.4	4.9	2.9	6.5	22.0
2	9.4	4.4	17.7	12.4	8.2	5.0	6.0	11.4	4.5	2.8	6.2	20.9
3	8.8	5.9	16.7	10.9	7.5	5.6	5.9	8.9	4.0	2.8	6.2	19.3
4	8.0	6.8	15.3	9.8	6.8	6.6	6.0	7.3	3.7	3.0	6.6	29.35
5	8.5	7.6	14.3	8.9	6.5	5.9	6.6	6.1	3.1	3.3	6.5	30.6
6	8.8	7.6	14.0	8.2	6.2	5.3	6.9	5.6	3.4	4.0	6.1	23.9
7	7.5	6.9	14.4	7.6	6.0	5.0	7.9	5.2	3.3	4.6	6.2	17.5
8	6.8	6.9	13.4	7.9	7.0	7.6	8.8	4.9	3.1	3.9	6.7	13.7
9	6.1	6.9	17.9	7.9	6.9	9.4	9.5	4.5	2.9	3.4	7.9	11.6
10	6.0	8.9	25.7	8.5	6.9	9.0	9.9	4.6	2.9	3.0	8.6	10.6
11	6.0	9.1	27.7	8,9	7.0	8.0	8.4	4.8	2.8	2.9	8.7	9.9
12	5.9	17.6	26.3	11.6	7.8	8.3	7.7	4.6	3.4	2.9	8.0	9.3
13	6.9	14.7	20.3	13.1	9.0	8.3	7.9	4.7	10.7	3.1	7.9	8.3
14	17.3	15.3	14.9	11.9	13.5	8.8	8.3	5.0	10.3	4.1	7.3	7.9
15	17.4	15.3	13.0	10.6	12.6	7.9	9.6	6.1	8.7	5.9	6.9	7.3
16	13.7	15.1	11.3	8.4	14.2	7.3	9.9	8.1	7.1	6.1	6.6	6.9
17	11.3	14.3	10.5	8.1	14.4	7.1	8.6	11.4	6.2	6.2	6.6	6.3
18	9.3	.....	10.9	7.9	12.1	7.9	6.9	11.3	6.1	5.7	6.6	6.0
19	8.0	.....	14.9	7.6	10.5	7.9	6.9	9.3	6.0	5.1	6.4	5.9
20	7.3	[a]10.3	28.2	7.3	9.2	9.5	6.0	7.9	5.7	6.8	6.6	5.9
21	7.2	.....	39.7	7.3	8.4	9.5	6.1	6.5	5.7	9.0	6.4	6.6
22	7.2	[a]11.8	[b]42.3	8.9	7.9	10.9	9.0	5.7	6.5	15.9	6.1	8.6
23	7.0	.....	41.8	11.8	7.0	13.7	8.0	5.5	5.9	13.1	5.9	13.6
24	6.6	.....	34.0	14.3	6.6	16.3	6.6	5.2	5.1	10.5	5.5	15.9
25	6.5	[a]10.5	26.2	13.4	6.0	14.3	5.9	5.9	4.7	9.0	5.1	15.3
26	6.0	13.8	23.2	11.5	5.9	12.3	6.8	6.1	4.2	8.6	5.0	13.6
27	5.2	15.4	22.6	9.9	5.4	11.0	6.6	7.1	3.8	8.1	5.0	11.3
28	5.0	16.6	21.2	9.1	4.9	9.6	5.0	8.1	3.4	8.2	5.0	10.3
39	3.9	.....	19.9	9.4	5.1	9.0	5.0	6.9	3.1	8.5	6.0	9.3
30	3.1	.....	17.9	9.7	5.2	7.9	4.3	5.7	2.9	7.9	12.6	9.6
31	3.9	.....	15.9	.....	5.6	.....	5.8	5.0	.....	6.9	.....	13.6

[a] Estimated; river frozen February 18–25; gage heights, March 20–26, are means of four or five readings per day as taken by a hydrographer of the Survey.
[b] Crest of flood, 42.7.

NOTE.—These gage heights refer to Weather Bureau gage.

Station rating table for Ohio River at Wheeling, W. Va., from May 1, 1882, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	2,890	4.60	12,330	8.40	35,500	16.50	98,700
1.10	3,050	4.70	12,710	8.60	37,000	17.00	102,830
1.20	3,220	4.80	13,100	8.80	38,500	17.50	107,000
1.30	3,390	4.90	13,500	9.00	40,000	18.00	111,200
1.40	3,570	5.00	13,900	9.20	41,500	18.50	115,450
1.50	3,750	5.10	14,310	9.40	43,000	19.00	119,700
1.60	3,940	5.20	14,740	9.60	44,500	19.50	124,000
1.70	4,140	5.30	15,190	9.80	46,000	20.00	128,330
1.80	4,340	5.40	15,660	10.00	47,500	20.50	132,700
1.90	4,550	5.50	16,150	10.20	49,020	21.00	137,100
2.00	4,760	5.60	16,650	10.40	50,540	21.50	141,550
2.10	4,980	5.70	17,170	10.60	52,060	22.00	146,040
2.20	5,200	5.80	17,700	10.80	53,580	22.50	150,570
2.30	5,430	5.90	18,250	11.00	55,100	23.00	155,140
2.40	5,660	6.00	18,810	11.20	56,640	23.50	159,760
2.50	5,900	6.10	19,390	11.40	58,180	24.00	164,440
2.60	6,150	6.20	19,990	11.60	59,720	24.50	169,150
2.70	6,400	6.30	20,600	11.80	61,260	25.00	173,900
2.80	6,660	6.40	21,230	12.00	62,800	26.00	183,530
2.90	6,930	6.50	21,870	12.20	64,360	27.00	193,300
3.00	7,200	6.60	22,520	12.40	65,920	28.00	203,230
3.10	7,480	6.70	23,180	12.60	67,480	29.00	213,300
3.20	7,760	6.80	23,850	12.80	69,040	30.00	223,500
3.30	8,050	6.90	24,530	13.00	70,600	31.00	233,830
3.40	8,340	7.00	25,220	13.20	72,180	32.00	244,300
3.50	8,640	7.10	25,920	13.40	73,760	33.00	254,900
3.60	8,940	7.20	26,630	13.60	75,340	34.00	265,630
3.70	9,250	7.30	27,350	13.80	76,920	35.00	276,500
3.80	9,570	7.40	28,080	14.00	78,500	36.00	287,500
3.90	9,890	7.50	28,810	14.20	80,100	37.00	298,600
4.00	10,220	7.60	29,540	14.40	81,700	38.00	309,830
4.10	10,560	7.70	30,280	14.60	83,300	39.00	321,200
4.20	10,900	7.80	31,020	14.80	84,900	40.00	332,700
4.30	11,250	7.90	31,760	15.00	86,500	41.00	344,300
4.40	11,600	8.00	32,500	15.50	90,550	42.00	356,030
4.50	11,960	8.20	34,000	16.00	94,600	43.00	367,900

NOTE.—The above table is applicable only for open-channel conditions. It is based on 24 discharge measurements made during 1905, one prior to 1893, and one low-water measurement computed from five measurements made by the United States Army engineers above and below Wheeling in 1892.

It is well defined above gage height 5 feet. Below 5 feet it is based on one measurement at 1.1 feet, computed from the army engineers' measurements, and the extension of the area and velocity curves, and can be considered accurate within a few per cent.

Estimated monthly discharge of Ohio River at Wheeling, W. Va., for 1905.

[Drainage area, 23,820 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	106,200	7,480	33,480	1.41	1.63
February 1-17, 26-28	107,800	11,600	54,110	2.27	1.69
March	359,600	51,300	142,400	5.98	6.89
April	80,900	27,350	46,880	1.97	2.20
May	81,700	13,500	33,660	1.41	1.63
June	97,060	13,900	38,320	1.61	1.80
July	46,750	11,250	27,430	1.15	1.33
August	73,760	11,960	25,930	1.09	1.26
September	52,820	6,660	15,810	.664	.741
October	93,790	6,660	23,280	.977	1.13
November	67,480	13,900	24,000	1.01	1.13
December	229,700	18,250	72,740	3.05	3.52

MISCELLANEOUS MEASUREMENT.

The following discharge measurement was made on Hocking River near Logan, Ohio:

Discharge measurement of Hocking River near Logan, Ohio.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
August 30	R. W. Pratt	34	23.3	2.36	(a)	54.9

a Water 0.3 feet below northwest upper corner of large flat stone 100 yards below bridge.

ALLEGHENY RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Allegheny River, which, with the Monongahela, forms the Ohio at Pittsburg, rises in northern Pennsylvania, flows north into the State of New York, then flows south through western Pennsylvania. The headwaters have an elevation of about 2,500 feet and join those of Genesee River on the north and of the Susquehanna on the east. The total length from the source to the mouth at Pittsburg is about 300 miles, 47 of which are in the State of New York. The principal facts concerning this river have been given in a report by George Lehman, assistant engineer, contained in House Document No. 72, Fifty-fifth Congress, third session. Although this river drains a large area, much of which is of an elevated and even mountainous character, yet it is of comparatively small value for water power. The total fall in 255 miles between Olean, N. Y., and the mouth is only 725 feet, or an average of less than 3 feet per mile. This descent is accomplished without abrupt pitches, and even with few rapids having a fall of much consequence. The drainage basin of Allegheny River above Redhouse is comparatively rugged and precipitous. It is mostly covered with brush and light forest. A considerable amount of snow accumulates in the winter and feeds the stream until late in spring. The basin is underlain by shales of the Chemung series, and the depth of soil is usually small, excepting in stream valleys. There are no lakes and no artificial storage tributary to the stream. The Cuba reservoir, which feeds the Erie Canal through Genesee River, lies on the divide between the Allegheny and Genesee drainage basins. A part of the overflow from this reservoir passes into the Allegheny, the rest passes into Genesee River. During about half of the year the river is navigable for small steamers to Franklin, 123 miles above Pittsburg.

The drainage areas of the river and its chief tributaries are given in the following table:

Drainage areas of Allegheny River and tributaries.

Stream.	Locality.	Drainage area.
		Sq. miles.
Allegheny River	Mouth	11,100
Do	Kittanning	8,688
Do	Above mouth of French Creek	5,950
Do	Franklin	5,670
Do	Warren	3,050
Do	Salamanca	1,560
Do	Olean, below Olean Creek	1,100
Do	Port Allegheny	220
Conewango Creek	Mouth	935
Tionesta Creek	do	458
French Creek	do	1,180
Clarion River	do	1,175
Redbank Creek	do	526
Mahoning Creek	do	397
Kiskiminitas River	do	1,846
Do	Salina	1,770
Blacklick Creek	Blacklick	403

ALLEGHENY RIVER AT REDHOUSE, N. Y.

This station was established September 4, 1903, by R. E. Horton. It is located at the Redhouse Bridge, near the stations of the Erie and Pennsylvania railroads and about 5 miles below Salamanca, N. Y., about 13 miles above the point where the river leaves New York State. At Olean, N. Y., the wasteway from the Cuba reservoir enters the stream through Olean Creek. This reservoir is located on the divide between Oil Creek, tributary to Allegheny River, and Genesee River. The storage is commonly turned into Genesee River through the abandoned summit level of Genesee Valley Canal, but may be diverted into Oil Creek through the guard lock at the head of the canal.

The discharge measurements from which the accompanying rating table has been prepared were mostly made during the gradual decline of the stream after the culmination of the spring freshet of 1905. The stage of the stream remained constant or fell slightly during each measurement, so that the rating table represents the discharge for conditions when the stream is statical or falling slightly.

The channel is straight for 800 feet above and below the station, 494 feet wide between abutments, broken by two piers. The current velocity is well distributed. The right bank is high and does not overflow. The left bank overflows only at flood stages. At extreme high water there is an additional flood channel on the left bank. The bed is of gravel and is regular.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the left end of the downstream side of the bridge.

A standard chain gage is fastened to the upstream side of the bridge near the middle of the left span; length of chain, 24.16 feet. The gage is read twice each day by G. H. Smith. The bench mark is a circle cut on the downstream side of the left abutment; elevation, 21.09 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 240-241; 128, pp 45-46.
Discharge: 98, p 241; 128, p 46.
Gage heights: 98, p. 241; 128, p 46.

Discharge measurements of Allegheny River at Redhouse, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 25	W. B. Freeman	368	3,313	5.88	9.63	19,470
March 27	do	368	3,412	6.25	9.91	21,320
March 28	do	368	3,385	6.07	9.88	20,570
March 28	do	368	3,353	6.01	9.77	20,160
March 29	do	368	3,168	5.65	9.34	17,930
March 30	do	368	3,007	5.33	8.88	16,040
March 31	do	368	2,764	4.73	8.24	13,060
April 1	do	368	2,489	4.09	7.44	10,170
April 1	do	368	2,415	3.89	7.24	9,386
April 2	do	368	2,286	3.51	6.77	8,029
April 3	do	368	2,045	2.94	6.11	6,015
April 3	do	363	2,003	2.84	5.98	5,681
April 4	do	363	1,867	2.40	5.58	4,484
April 5	do	363	1,797	2.32	5.41	4,161
July 31	Murphy and Covert	362	1,214	0.93	3.74	1,135
August 26	C. C. Covert	357	993	0.45	3.05	446

Daily gage height, in feet, of Allegheny River at Redhouse, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.52	4.5	4.43	7.35	4.45	3.48	3.95	3.81	2.95	2.8	3.85	7.0
2	5.76	4.85	4.43	6.45	4.3	3.4	4.02	3.58	2.95	2.8	4.1	5.1
3	5.86	4.95	4.43	6.0	4.25	3.3	4.08	3.44	2.92	2.9	4.0	6.55
4	4.46	4.75	4.43	5.55	4.18	3.3	4.05	3.31	2.9	3.0	4.0	7.15
5	5.16	4.74	4.43	5.35	4.0	3.3	4.6	3.14	2.9	3.12	4.0	6.65
6	5.16	4.69	4.43	5.18	4.0	3.45	5.0	3.11	3.0	3.15	4.8	6.3
7	4.91	4.54	4.43	5.0	4.25	5.2	5.4	3.26	3.0	3.1	5.0	5.85
8	.....	4.54	4.43	4.85	4.35	5.25	5.85	3.38	3.0	2.88	5.0	5.5
9	4.34	4.54	4.58	4.6	4.18	4.85	5.3	3.36	2.9	2.8	5.2	5.25
10	4.21	4.52	4.83	4.55	4.0	4.35	4.45	3.31	2.85	2.72	5.2	5.05
11	4.26	4.44	5.02	4.5	3.9	4.45	4.45	3.26	2.95	2.75	4.6	4.85
12	4.26	4.44	5.22	4.65	3.8	4.7	4.85	3.48	3.7	3.5	4.6	4.75
13	5.06	4.44	5.17	4.9	3.8	4.5	5.1	3.46	3.72	4.5	4.5	4.55
14	5.46	4.44	4.92	4.7	3.8	4.3	5.25	3.61	3.58	4.25	4.38	4.35
15	5.01	4.39	4.92	4.6	3.8	4.02	5.2	3.56	3.35	3.95	4.3	4.15
16	4.81	4.39	4.92	4.6	3.72	3.92	4.6	3.54	3.3	3.75	4.3	3.85
17	4.71	4.39	4.92	4.5	3.7	4.4	4.25	3.46	3.3	3.55	4.2	3.5
18	4.64	4.39	6.52	4.5	3.7	5.25	4.05	3.38	3.5	3.4	4.2	3.6
19	4.5	4.36	11.42	4.55	3.68	5.5	3.98	3.28	3.3	4.05	4.0	3.85
20	4.37	4.34	11.57	4.85	3.6	5.3	3.82	3.21	3.2	4.6	4.0	3.55
21	4.27	4.34	11.67	7.0	3.6	5.6	3.68	3.16	3.2	4.9	3.7	4.1
22	4.23	4.33	11.12	7.65	3.55	7.18	3.56	3.14	3.12	5.0	3.45	6.4
23	4.15	4.33	9.94	6.4	3.5	6.9	3.38	3.06	3.02	5.0	3.45	6.2
24	4.1	4.33	9.64	5.65	3.48	6.3	3.26	3.01	3.0	4.85	3.45	5.75
25	3.85	4.33	9.64	5.35	3.4	5.6	3.51	2.96	2.92	4.6	3.65	5.55
26	3.4	4.33	9.7	5.12	3.4	5.15	3.51	2.98	2.9	4.35	3.35	5.15
27	3.35	4.33	9.92	4.9	3.4	4.85	3.31	3.0	2.9	4.15	3.4	4.85
28	4.1	4.41	9.76	4.7	3.58	4.45	3.26	2.98	2.85	3.95	3.45	4.65
29	4.2	.....	9.3	4.6	3.5	4.25	3.88	2.95	2.8	3.75	6.4	6.0
30	4.4	.....	8.8	4.6	3.5	4.05	4.16	2.95	2.8	3.62	7.3	7.5
31	4.45	.....	8.15	.....	3.5	.....	3.94	2.95	.....	3.6	.....	6.65

NOTE.—River frozen entirely across from January 1 to March 18, with the exception of a narrow channel near one bank, which appeared February 25 and lasted during the remainder of ice period. During frozen period gage was read to surface of ice. Thickness varied from 0.6 to 0.95 feet.

Station rating table for Allegheny River at Redhouse, N. Y., from September 4, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.70	195	4.40	2,043	6.10	5,950	8.40	13,960
2.80	260	4.50	2,200	6.20	6,245	8.60	14,800
2.90	328	4.60	2,365	6.30	6,545	8.80	15,660
3.00	400	4.70	2,540	6.40	6,845	9.00	16,540
3.10	478	4.80	2,725	6.50	7,150	9.20	17,420
3.20	564	4.90	2,920	6.60	7,460	9.40	18,300
3.30	658	5.00	3,130	6.70	7,770	9.60	19,220
3.40	759	5.10	3,350	6.80	8,090	9.80	20,140
3.50	866	5.20	3,580	6.90	8,410	10.00	21,100
3.60	978	5.30	3,820	7.00	8,740	10.20	22,100
3.70	1,095	5.40	4,065	7.20	9,400	10.40	23,100
3.80	1,216	5.50	4,315	7.40	10,080	10.60	24,100
3.90	1,341	5.60	4,570	7.60	10,790	10.80	25,100
4.00	1,471	5.70	4,830	7.80	11,530	11.00	26,200
4.10	1,605	5.80	5,100	8.00	12,300	11.50	28,950
4.20	1,745	5.90	5,375	8.20	13,120	12.00	31,800
4.30	1,891	6.00	5,660				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 19 discharge measurements made during 1903–1905. It is very well defined between gage heights 3.1 feet and 10 feet.

Estimated monthly discharge of Allegheny River at Redhouse, N. Y., for 1903–1905.

[Drainage area, 1,643 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
September 4–30	3,130	708	1,462	0.890	0.894
October	8,905	708	2,262	1.38	1.59
November	12,105	978	2,918	1.78	1.99
December 1–25	1,818	866	1,337	.814	.757
1904.					
March 16–31	26,750	2,365	10,690	6.51	3.87
April	13,750	2,764	6,945	4.23	4.72
May	10,430	1,341	3,927	2.39	2.76
June	9,808	564	2,134	1.30	1.45
July	5,805	611	1,557	.948	1.09
August	2,043	400	797	.485	.559
September	2,632	400	914	.556	.620
October	3,350	1,072	1,985	1.21	1.40
November 1–27	1,341	611	839	.511	.513
December 27–31	12,500	4,190	7,430	4.52	.840
1905.					
March 19–31	29,885	12,910	21,620	13.20	6.38
April	10,980	2,200	3,734	2.27	2.53
May	2,122	759	1,241	.755	.870
June	9,334	658	2,905	1.77	1.98
July	5,238	620	1,992	1.21	1.40
August	1,228	364	640	.390	.450
September	1,119	260	496	.302	.337
October	3,130	208	1,269	.772	.890
November	9,740	708	2,201	1.34	1.50
December	10,430	866	4,275	2.60	3.00

NOTE.—No estimates for frozen period.

ALLEGHENY RIVER AT KITTANNING, PA.

This station, which is located at Market Street Bridge, was established August 18, 1904, by R. J. Taylor.

The channel, which is broken by four piers at the station, is straight for about 500 feet above and 1,000 feet below. The current is swift. Both banks are high, clean, and do not overflow. The bed of the stream is composed of clean gravel and is permanent. The water is approximately 3 to 4 feet deep in the first three channels and 6 to 8 feet deep in the last two at low stages.

Discharge measurements are made from the downstream foot walk of the five-span steel highway bridge. The initial point for soundings is the left end of the hand rail on the downstream side of the bridge.

A standard chain gage, which is read twice each day by S. B. Cochrane, is bolted to the outside of the upstream hand rail in the first span from the left bank; length of chain, 38.67 feet. The bench mark is the west corner of the top course of stones of the left abutment; elevation, 33.83 feet above gage datum.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, page 47.

Discharge measurements of Allegheny River at Kittanning, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
		Feet.	*Square feet.*	*Feet. per second.*	*Feet.*	*Second-feet.*	
March 18	Grover and Morse	869	10,480	4.11	12.00	43,090	Floats and meter.
March 18	do	869	10,340	4.27	11.85	44,150	Floats.
March 19	N. C. Grover	869	14,570	6.92	16.55	100,800	Do.
March 19	Grover and Morse	869	15,500	7.27	17.59	112,700	Do.
March 19	do	869	16,380	7.66	18.57	125,500	Do.
March 19	do	869	17,210	7.93	19.48	136,400	Do.
March 19	do	869	18,270	8.41	20.66	154,600	Do.
March 19	do	869	19,770	9.08	22.33	179,500	Do.
March 19	do	869	20,450	9.20	23.08	188,100	Do.
March 20	do	869	25,330	9.29	28.50	235,300	Do.
March 20	do	869	25,470	9.30	28.69	236,900	Do.
March 20	do	869	25,510	9.48	28.71	241,800	Do.
March 20	do	869	25,540	9.48	28.74	242,000	Do.
March 21	do	869	22,540	8.43	25.40	190,000	Floats and meter.
March 21	do	869	21,860	8.13	24.65	177,800	Floats.
March 21	do	869	21,440	8.28	24.18	177,500	
March 22	do	869	19,740	7.16	22.29	141,400	
March 22	do	869	19,200	7.20	21.69	138,400	
March 22	do	869	18,790	6.91	21.24	129,800	
March 23	do	869	17,000	6.57	19.25	111,700	
March 24	do	869	14,510	5.92	16.48	85,960	
March 25	do	869	14,110	5.94	16.04	83,840	
April 10	A. H. Horton	809	5,000	2.37	5.54	11,860	
April 11	do	860	6,106	2.94	6.83	17,970	
April 14	do	835	5,552	2.58	6.17	14,320	
April 20	do	791	4,919	2.24	5.45	11,040	
June 2	R. H. Bolster	680	3,597	1.45	3.73	5,222	
August 30	E. C. Murphy	666	3,442	1.39	3.53	4,794	
November 3	do	768	4,654	2.13	5.10	9,941	

Daily gage height, in feet, of Allegheny River at Kittanning, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.1	9.8	.....	10.5	5.3	3.8	4.4	7.65	3.1	3.3	4.7	12.8
2	7.4	9.6	.....	8.9	4.9	3.7	4.8	6.3	3.1	3.4	4.6	10.8
3	7.9	9.6	9.4	7.7	4.8	3.6	5.1	5.3	3.1	3.6	4.5	14.9
4	8.5	9.6	.....	7.3	4.5	3.4	5.4	4.7	3.1	5.0	5.0	14.8
5	7.4	.....	.....	7.0	4.2	3.3	6.8	4.3	2.8	4.3	5.1	12.2
6	6.3	.....	.....	6.8	.....	3.6	6.6	3.9	2.8	3.8	5.3	10.7
7	6.1	9.5	.....	6.4	.....	4.3	7.0	3.8	2.8	3.6	6.2	9.0
8	6.2	.....	11.6	5.9	.....	7.0	9.2	3.8	2.6	3.2	7.0	8.2
9	6.3	.....	.....	5.6	.....	6.8	7.7	3.8	2.5	2.8	8.0	7.7
10	6.4	9.0	.....	5.5	5.5	6.3	7.4	3.9	2.5	2.8	7.6	7.3
11	6.6	.....	.....	6.4	5.0	5.9	5.9	4.0	4.85	3.0	7.4	7.0
12	10.4	.....	.....	6.2	4.7	5.6	6.0	3.6	7.4	4.1	6.8	6.6
13	12.3	.....	.....	6.2	5.5	5.2	7.3	5.4	6.8	5.5	6.6	6.4
14	13.6	9.0	.....	5.8	6.5	5.2	8.1	6.2	5.5	5.3	6.5	6.0
15	15.4	.....	.....	5.5	6.9	4.7	8.6	5.8	5.0	5.5	6.3	5.8
16	16.1	.....	.....	5.4	7.1	4.5	8.1	6.0	4.7	5.4	6.1	5.2
17	16.1	8.7	.....	5.3	7.2	4.5	7.6	6.5	4.5	5.25	5.9	4.7
18	14.6	.....	13.0	5.3	6.7	5.0	7.0	5.6	4.5	4.8	5.8	4.5
19	14.4	.....	18.2	5.1	6.3	6.1	6.4	4.8	4.5	5.6	5.6	4.4
20	14.4	.....	28.2	5.3	5.6	7.4	6.1	4.2	4.6	6.2	5.5	4.3
21	14.4	8.4	24.8	6.9	5.1	8.3	5.8	4.2	4.5	9.5	5.2	5.6
22	13.8	.....	21.8	9.2	4.7	10.0	5.4	4.5	4.4	8.2	4.8	7.8
23	13.1	.....	18.4	10.6	4.5	9.6	4.2	4.8	4.1	7.4	4.7	9.7
24	12.3	8.1	16.5	9.4	4.2	9.3	3.8	5.2	3.7	7.3	4.6	9.6
25	11.4	.....	16.0	8.8	4.0	7.8	3.6	4.8	3.5	7.3	4.6	8.1
26	10.6	.....	15.8	7.2	3.9	6.7	3.5	4.6	3.2	6.7	4.5	7.2
27	10.1	.....	15.0	6.8	4.2	6.4	3.4	4.2	3.1	6.3	4.8	6.9
28	10.0	9.1	14.3	6.2	4.2	5.7	3.3	3.8	3.1	5.8	6.0	8.9
29	9.9	.....	13.7	5.9	4.4	5.0	3.1	3.6	3.1	5.3	9.2	9.9
30	9.9	.....	12.6	5.6	4.4	4.6	11.4	3.4	3.2	5.1	12.0	11.2
31	9.8	.....	11.8	.....	4.2	.....	10.6	3.2	.....	4.9	.....	11.3

NOTE.—Ice gorge January 12 to February 12 approximately. River frozen January 12 to March 18. The ice jam below Ford City broke on the morning of March 18. Readings during this period were to the top of the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 14	8.9	9.0	1.9
February 17	8.6	8.7	2.0
February 21	8.4	8.4	2.0
February 24	8.2	8.1	2.0
February 28	9.1	9.1	1.6
March 3	9.4	9.4	.....

The mean gage heights March 18–22 were recorded from several readings made each day by a hydrographer of the Survey. Maximum gage height March 20 was 28.80. The best available testimony is to the effect that this stage was higher than any since 1865, when the river was probably 6 to 8 inches higher. In the freshet of 1832 the stage was probably higher than in 1865.

Station rating table for Allegheny River at Kittanning, Pa., from August 18, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	1,740	4.30	7,065	6.60	16,470	11.50	43,850
2.10	1,840	4.40	7,400	6.70	16,950	12.00	47,150
2.20	1,960	4.50	7,740	6.80	17,430	12.50	50,630
2.30	2,095	4.60	8,085	6.90	17,920	13.00	54,280
2.40	2,245	4.70	8,435	7.00	18,410	13.50	58,120
2.50	2,410	4.80	8,795	7.20	19,390	14.00	62,110
2.60	2,590	4.90	9,165	7.40	20,400	14.50	66,200
2.70	2,785	5.00	9,545	7.60	21,420	15.00	70,410
2.80	2,990	5.10	9,930	7.80	22,470	16.00	79,220
2.90	3,205	5.20	10,320	8.00	23,540	17.00	88,620
3.00	3,430	5.30	10,720	8.20	24,620	18.00	98,620
3.10	3,665	5.40	11,130	8.40	25,700	19.00	109,150
3.20	3,910	5.50	11,550	8.60	26,800	20.00	120,330
3.30	4,165	5.60	11,970	8.80	27,910	21.00	132,210
3.40	4,425	5.70	12,400	9.00	29,030	22.00	144,710
3.50	4,690	5.80	12,830	9.20	30,150	23.00	157,920
3.60	4,960	5.90	13,270	9.40	31,280	24.00	171,720
3.70	5,235	6.00	13,720	9.60	32,420	25.00	185,720
3.80	5,515	6.10	14,170	9.80	33,570	26.00	199,950
3.90	5,805	6.20	14,620	10.00	34,730	27.00	214,360
4.00	6,105	6.30	15,080	10.50	37,660	28.00	229,030
4.10	6,415	6.40	15,540	11.00	40,700	29.00	243,900
4.20	6,735	6.50	16,000				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 24 discharge measurements made during 1904–1905. It is well defined between gage heights 2.25 feet and 29 feet. At the higher stages the rating curve was drawn through measurements made on the falling stage of the river in the 1905 spring flood.

Estimated monthly discharge of Allegheny River at Kittanning, Pa., for 1904–1905.

[Drainage area, 8,688 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
August 25–31	7,740	3,665	5,584	0.642	0.167
September	8,085	1,740	3,094	.356	.397
October	13,720	2,590	6,153	.708	.816
November	5,515	1,960	2,952	.340	.379
December 1–11, 24–31	49,920	2,095	13,870	1.60	1.13
1905.					
January 1–11	26,250	14,170	18,640	2.14	.876
March 18–31	232,000	45,810	97,670	11.24	5.85
April	38,260	9,930	18,020	2.07	2.31
May 1–5, 10–31	19,390	5,805	10,380	1.19	1.20
June	34,730	4,165	13,640	1.57	1.75
July	43,210	3,665	15,870	1.83	2.11
August	21,680	3,910	8,839	1.02	1.18
September	20,400	2,410	6,299	.725	.809
October	31,850	2,990	11,050	1.27	1.46
November	47,160	7,740	14,430	1.66	1.85
December	69,560	7,065	27,090	3.12	3.60

NOTE.—Ice conditions December 12–23, 1904, and January 12 to March 18, 1905; no estimates made. Discharge March 19, 1905, increased 20,320 second-feet to allow for increased discharge due to rising stage.

CHADAKOIN RIVER AT JAMESTOWN, N. Y.

Chadakoin River drains Lake Chautauqua, entering Allegheny River in Pennsylvania through Conewango Creek. Lake Chautauqua extends in a northwest-southeast direction. Its head is 8 miles from Lake Erie and its water surface is at an elevation of 1,308 feet above sea level, or 735 feet above Lake Erie. The drainage area above the foot of the lake is 190.6 square miles, of which 20.8 square miles comprise the lake surface, which represents 10.9 per cent of the drainage area. The land tributary to the lake is very rolling and the soil is impervious. Chadakoin River furnishes water power at numerous dams.

A gaging station was established on Chadakoin River April 3, 1904, by R. E. Horton, at the outlet of Lake Chautauqua, near Jamestown, N. Y. The gage was read once each day by R. L. Carlson. The station was discontinued March 18, 1905.

A description of the station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 48–49.

Daily gage height, in feet, of Chadakoin River at Jamestown, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1	2.2	2.0	1.4	12	2.0	1.8	1.8	22	1.8	1.4	.....
2	2.1	2.0	1.4	13	2.0	1.8	1.8	23	2.0	1.5	.....
3	1.9	1.8	1.4	14	2.0	1.7	1.8	24	2.0	1.5	.....
4	1.8	1.8	1.4	15	1.9	1.7	1.8	25	1.9	1.5	.....
5	1.9	1.7	1.4	16	1.8	1.7	1.8	26	1.8	1.5	.....
6	2.1	1.7	1.4	17	1.8	1.8	1.8	27	1.8	1.5	.....
7	2.1	1.7	1.6	18	1.8	1.6	2.0	28	1.9	1.5	.....
8	2.0	1.7	1.6	19	1.8	1.6	.....	29	2.0	.....	.....
9	2.0	1.8	1.6	20	1.8	1.6	.....	30	2.0	.....	.....
10	1.8	1.8	1.8	21	1.8	1.4	.....	31	2.0	.....	.....
11	2.0	1.8	1.8								

KISKIMINITAS RIVER AT SALINA, PA.

This station was established August 17, 1904, by R. J. Taylor. It is located at the highway bridge between the village of Salina, Pa., and the Pennsylvania Railroad station, and is about 200 feet from the latter.

Both banks are high, rocky, clean, and are not subject to overflow. The bed of the stream is composed of rock and is clean and permanent.

Discharge measurements were made from the highway bridge until March, 1905, when the bridge was carried away by an ice freshet. For the remainder of the year gage heights were referred to temporary gage. The data will be published in the 1906 Progress Report. A new highway bridge will occupy a site about 500 feet below that of the old bridge. A chain gage will be attached to this as soon as it is completed. The stage of the river is read twice each day by J. F. Whitesell. Bench marks were established as follows: (1) A chisel draft on a shelf on the downstream corner of the right abutment; elevation, 5.77 feet. (2) A chisel draft on the top of the downstream corner of the right abutment; elevation, 30.39 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 49–50.

BLACKLICK CREEK AT BLACKLICK, PA.

This station was established August 16, 1904, by R. J. Taylor. It was located at the covered wooden highway bridge one-fourth mile from the railway station at Blacklick, Pa. During September, 1905, this bridge was torn down and replaced.

A standard chain gage was established November 9, 1905, on the new bridge, with its zero referred to the same datum as formerly; length of chain, 20.15 feet. While the new bridge was being erected, the stage of the river was observed on a staff gage reading to the datum of the original gage. The gage is read once each day by Mark Maynard. Bench marks were established as follows: (1) A nail in first maple tree from the door of Mr. Maynard's house, 1 foot above ground, driven horizontally and bent over 1 inch from head; elevation, 13.92 feet. (2) The heads of four spikes driven into the root of a large maple tree 45 feet from the edge of low water and about 190 feet upstream from the bridge; elevation, 12.96 feet. (3) Upper edge of horizontal cross plate at the elevation of the guard rail on the upstream side of the bridge, 4.3 feet from the initial point for soundings; elevation, 14.43 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 50–51.

Discharge measurements of Blacklick Creek at Blacklick, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 14	Grover and Morse	183	413	4.17	4.49	[a] 1,724
March 24	do	187	473	4.45	4.90	[a] 2,108
April 12	A. H. Horton	188	558	4.33	5.45	[a] 2,416
April 15	do	175	304	3.42	3.86	[a] 1,040
June 3	R. M. Packard	156	153	1.49	2.80	[a] 228
September 1	E. C. Murphy	140	104	1.23	2.36	[a] 128
September 1	L. O. Murphy	150	118	1.11	2.35	[a] 131
November 2	E. C. Murphy	199	543	.93	3.36	[b] 507

[a] Made from coal tipple. [b] Made from new bridge.

Daily height, in feet, of Blacklick Creek at Blacklick, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.6	.....	.....	3.4	3.0	3.1	3.1	4.1	2.4	2.2	3.6	6.4
2	3.8	.....	.....	3.3	2.9	3.0	3.1	3.7	2.3	2.2	3.3	7.0
3	4.1	.....	.....	3.2	2.9	2.8	2.9	3.3	2.3	2.3	3.2	10.7
4	3.8	.....	.....	3.0	2.8	2.7	2.8	3.0	2.4	2.2	3.3	6.5
5	3.6	.....	.....	3.2	2.8	2.7	3.8	3.1	2.3	2.2	3.2	5.1
6	3.5	.....	.....	3.4	2.9	2.7	3.3	2.8	2.2	2.2	3.7	4.6
7	3.2	.....	.....	3.5	3.5	5.9	3.1	3.0	2.2	2.2	3.7	4.0
8	3.0	2.9	7.6	3.4	3.4	4.6	4.2	3.1	2.1	2.1	3.6	3.9
9	3.3	.....	7.4	3.5	3.1	3.9	3.5	3.0	2.1	2.1	3.5	3.7
10	3.2	.....	6.5	3.5	2.9	3.5	3.1	2.8	2,1	2.0	3.3	3.6
11	3.1	.....	5.5	6.1	3.0	4.2	3.0	2.7	a6.5	3.4	3.2	3.5
12	4.4	.....	5.1	5.3	4.1	4.4	2.9	2.8	4.7	4.0	3.1	3.4
13	5.4	.....	4.7	4.5	3.9	4.0	2.9	3.2	4.0	3.3	3.1	3.3
14	4.6	3.0	4.5	4.0	4.4	3.6	2.9	3.0	3.5	3.0	3.2	3.2
15	4.1	.....	4.4	4.0	4.6	3.3	2.8	3.9	3.2	2.9	3.1	3.2
16	3.8	3.0	4.5	3.6	4.0	3.1	2.6	3.6	3.2	2.9	3.2	3.2
17	3.6	.....	5.4	3.6	3.8	3.1	2.5	3.3	3.0	2.8	3.2	3.0
18	3.6	3.0	5.9	3.7	3.7	3.0	2.4	3.0	2.9	2.7	3.1	3.0
19	3.4	.....	8.4	3.5	3.5	3.7	2.5	2.8	2.8	3.7	3.0	3.0
20	3.5	.....	7.0	3.4	3.3	3.2	3.0	2.7	2.7	6.0	3.0	2.9
21	3.5	3.4	8.6	4.8	3.2	4.2	2.8	2.7	2.6	4.6	2.9	4.9
22	3.3	.....	7.0	5.3	3.0	5.8	2.9	2.6	2.5	4.1	2.8	4.5
23	3.2	.....	6.3	4.6	2.9	4.9	2.7	2.5	2.4	3.9	2.8	4.3
24	3.3	.....	5.0	4.2	2.9	4.4	3.1	2.4	2.4	3.7	2.8	4.1
25	3.0	.....	5.4	3.8	2.7	4.0	2.8	3.5	2.3	3.8	3.0	3.6
26	2.7	.....	5.5	3.6	2.7	3.7	2.6	3.0	2.3	4.0	2.9	3.7
27	3.0	.....	4.9	3.6	2.8	3.4	2.6	2.7	2.3	3.7	2.8	3.6
29	3.0	.....	4.5	3.4	2.6	3.2	2.5	2.6	2.3	3.5	2.9	3.7
29	3.0	.....	4.0	3.3	2.5	3.0	3.7	2.6	2.2	3.3	7.7	6.5
30	3.0	.....	4.0	3.2	2.6	2.9	4.3	2.5	2.2	3.1	7.0	5.1
31	.....	.....	3.6	....	3.1	.....	4.7	2.4	.....	3.1	.....	4.4

a Approximate.

NOTE.—River frozen entirely across for several miles up and down stream from January 31 to March 6. During this period the following comparative readings were made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 8	2.9	3.0	0.7
February 14	3.0	3.0	.8
February 16	3.0	3.0	.8
February 18	3.0	3.0	.8
February 21	3.4	3.4	.7

Station rating table for Blacklick Creek at Blacklick, Pa., from August 17, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	21	2.60	199	3.40	597	4.20	1,327
1.90	35	2.70	233	3.50	676	4.30	1,432
2.00	51	2.80	270	3.60	759	4.40	1,540
2.10	69	2.90	310	3.70	846	4.50	1,650
2.20	89	3.00	354	3.80	936	4.60	1,765
2.30	112	3.10	403	3.90	1,029	4.70	1,880
2.40	138	3.20	460	4.00	1,125	4.80	2,000
2.50	167	3.30	525	4.10	1,224	4.90	2,120

NOTE.—The above table is applicable only for open channel conditions. It is based on 10 discharge measurements made during 1904–5. It is not very well defined; above 5 feet the discharge is estimated.

Estimated monthly discharge of Blacklick Creek at Blacklick, Pa., for 1904–5.

[Drainage area, 403 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
August 17–31	167	35	88.3	0.219	0.122
September	100	32	52.2	.129	.144
October	216	28	92.8	.230	.265
November	112	35	63.1	.156	.174
December 1–6, 25–31	4,890	60	1,052	2.62	1.26
1905.					
January 1–30	2,765	233	757	1.88	2.10
March 8–31	7,310	759	3,245	8.05	7.18
April	3,730	354	1,042	2.58	2.88
May	1,765	167	547	1.36	1.57
June	3,450	233	938	2.33	2.60
July	1,880	138	466	1.16	1.34
August	1,224	138	393	.975	1.12
September	4,305	69	411	1.02	1.14
October	3,590	51	606	1.50	1.73
November	6,130	270	802	1.99	2.22
December	11,270	310	1,776	4.41	5.08

NOTE.—No estimates made during frozen period.

MONONGAHELA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Monongahela River is formed near Fairmont, Marion County, in the northern part of West Virginia, by the union of its West Fork with Tygarts Valley River. The headwaters of the latter stream lie on the slopes and in the valleys of the Appalachian Mountains near the eastern boundary of West Virginia, thence they flow northward, draining a hilly and mountainous country. West Fork has its headwaters west of those of Tygarts Valley River, in the central part of West Virginia, thence they flow northward, draining a hilly country.

The principal tributaries of Monongahela River below Fairmont are Cheat and Youghiogheny rivers, both entering from the east. Cheat River drains a rugged, mountainous district in northern West Virginia and flows into Monongahela River near Point Marion, Pa. Youghiogheny River drains a mountainous district of Maryland and Pennsylvania and enters the Monongahela about 15 miles above Pittsburg. The basins of all these tributary rivers have steep slopes and collect and discharge their waters quickly, with the result that the Monongahela is liable to the excessive freshets for which it is noted. The whole basin was once heavily timbered, but has been thoroughly cleared except about the upper waters of the principal streams. Little water power is used in the basin. Navigation extends to Fairmont.

MONONGAHELA RIVER AT LOCK NO. 4, PA.

This station was established in March, 1905, for the purpose of studying the flood discharge. It is located at the Government dam at Lock No. 4, Pa., and the bridge at Belle Vernon, Pa.

The channel is straight for 800 feet above and below the bridge. The velocity of the current is small, except at high stages. The right bank is high and does not overflow. The left bank is low, clean, and liable to overflow. The bed of the stream is composed of sand and gravel and is permanent. There are three channels at all stages, and no obstruction to the flow.

The discharge at high water is determined by computations of the flow over the crest of the dam, and that at low water by current-meter measurements from the bridge. The initial point for soundings at the bridge is the center of the hand-rail post over the left abutment on the downstream side.

There are two timber gages, graduated to feet and tenths, one at the head of the locks and the other below. The gages are the property of the army engineers, and daily gage readings are furnished by the United States Weather Bureau. The elevation of the zero of the upper gage is 726.112 feet above mean sea level; that of the lower gage is 717.816 feet, and that of the crest of the dam is 734.94 feet. The crest of the dam is at gage height 8.80 feet. Bench mark No. 1 is a cross cut on the lower horizontal piece of the hand rail of the bridge, upstream side, 162 feet from the initial point for soundings. Its elevation is 10.89 feet above bench mark No. 2, which is a quarter circle cut on the west corner of the left abutment, downstream side. These bench marks are not referred directly to the gage at Lock No. 4, 2 miles below. Bench mark No. 1 (which is referred to No. 2) is for the purpose of referring the water surface at the bridge, when measurement is made, to a permanent datum, in order that comparison may be made with other measurements at the bridge. In each case the gage height is taken from the lower gage at the lock.

Discharge measurements of Monongahela River at Lock No. 4, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 13	E. C. Murphy	866	12,210	1.76	13.6	21,520
March 18	do	843	10,780	.95	9.8	10,240
March 23	Grover and Morse	754	13,790	2.80	17.6	38,680

Station rating table for Monongahela River at Lock No. 4, Pa., from March 31, 1886, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
12.00	15,300	14.00	22,500	17.00	36,100	23.50	70,800
12.10	15,600	14.10	22,920	17.20	37,100	24.00	73,800
12.20	15,900	14.20	23,340	17.40	38,100	25.00	79,800
12.30	16,210	14.30	23,760	17.60	39,100	26.00	85,800
12.40	16,520	14.40	24,180	17.80	40,100	27.00	92,600
12.50	16,840	14.50	24,600	18.00	41,100	28.00	99,600
12.60	17,160	14.60	25,040	18.20	42,100	29.00	106,600
12.70	17,490	14.70	25,480	18.40	43,100	30.00	113,600
12.80	17,830	14.80	25,920	18.60	44,100	31.00	120,600
12.90	18,180	14.90	26,360	18.80	45,100	32.00	127,600
13.00	18,540	15.00	26,800	19.00	46,100	33.00	135,000
13.10	18,910	15.20	27,700	19.50	48,600	34.00	143,000
13.20	19,290	15.40	28,600	20.00	51,300	35.00	151,000
13.30	19,680	15.60	29,500	20.50	54,050	36.00	159,000
13.40	20,080	15.80	30,400	21.00	56,800	37.00	167,000
13.50	20,480	16.00	31,300	21.50	59,550	38.00	175,000
13.60	20,880	16.20	32,200	22.00	62,300	39.00	183,000
13.70	21,280	16.40	33,100	22.50	65,050	40.00	191,000
13.80	21,680	16.60	34,100	23.00	67,800	41.00	199,000
13.90	22,080	16.80	35,100				

The above table is applicable only for open-channel conditions. It is based on three discharge measurements, besides slope and weir measurements. It is well defined. These gage heights refer to the lower gage.

Flood flow of the Monongahela River at Lock No. 4, Pa., 1886–1905.

[Lowest stage (3.2 feet) November 21, 1887. Drainage area, 5,430 square miles.]

Date.	Gage[a] height.	Discharge.	Date.	Gage height.	Discharge.
1886.	*Feet.*	*Sec.-feet.*	1887.	*Feet.*	*Sec.-feet.*
March 31	16.5	33,600	February 3	14.0	22,500
April 1	27.0	92,600	February 4	31.0	120,600
April 2	23.5	70,800	February 5	24.0	73,800
April 2	13.5	20,480	February 6	16.3	32,650
April 3	18.5	43,600	February 26	11.7	14,500
April 5	25.0	79,800	February 27	28.0	99,600
April 6	26.0	85,800	February 28	24.0	73,800
April 7	19.5	48,600	March 1	16.3	32,650
May 8	6.5	.....	1888.		
May 9	22.0	62,300	January 8	19.5	48,600
May 10	16.5	33,600	January 9	20.7	55,150
May 10	11.5	.....	January 10	16.5	33,600
May 10	10.2	.....	July 9	6.4	.....
May 10	15.3	28,150	July 10	26.0	85,800
May 10	21.2	57,900	July 11	42.0	207,000
May 10	24.3	75,600	July 12	27.0	92,600
May 10	16.5	33,600	July 13	14.5	.....

[a] These gage heights refer to the lower gage.

Flood flow of the Monongahela River at Lock No. 4, Pa., 1886–1905—Continued.

Date.	Gage height.	Discharge.
1889.	*Feet.*	*Sec.-feet.*
February 17	12.7	17,490
February 18	27.0	92,600
February 19	25.5	82,800
February 20	19.5	48,600
April 13	13.0	18,540
April 14	21.0	56,800
April 15	17.7	39,600
May 31	8.7	.....
June 1	25.0	79,800
June 2	19.4	48,100
November 9	11.9	15,000
November 10	21.4	59,000
November 11	18.0	41,100
1890.		
January 7	10.0	.....
January 8	20.5	54,050
January 9	20.0	51,300
January 10	16.4	33,100
February 3	10.8	.....
February 4	21.1	57,350
February 5	21.1	57,350
February 6	16.2	32,200
February 20	11.0	.....
February 21	23.5	70,800
February 22	19.5	48,600
March 22	19.5	48,600
March 23	31.8	126,200
March 24	28.5	103,100
March 25	18.8	45,100
October 12	11.8	14,800
October 13	20.1	51,850
October 14	24.3	75,600
October 15	21.5	59,550
October 16	15.0	26,800
1891.		
January 1	9.0	.....
January 2	27.0	92,600
January 3	31.3	122,700
January 4	20.8	55,700
January 5	14.1	22,920
February 10	17.0	36,100
February 11	24.0	73,800
February 12	18.8	45,100
February 16	12.3	16,210
February 17	21.8	61,200
February 18	20.5	54,050
February 19	16.3	32,650
February 22	19.0	46,100
February 23	20.4	53,500
February 24	15.3	28,150
1892.		
January 13	11.0	.....
January 14	25.7	84,000
January 15	28.5	103,100
January 16	19.3	47,600
April 23	18.0	41,100
April 24	21.6	60,100
April 25	15.5	29,050
1893.		
January 29	16.5	33,600
January 30	23.5	70,800
January 31	18.2	42,100
1895.		
January 6	7.3	.....
January 7	24.5	76,800
January 8	30.0	113,600
January 9	22.0	62,300
January 10	15.3	30,400
January 11	21.9	61,750
January 12	19.0	46,100
March 15	14.5	24,600
March 16	21.0	56,800
March 17	21.7	60,650
March 18	16.4	33,100
1896.		
March 19	11.2	.....
March 20	20.5	54,050
March 21	18.6	44,100
July 30	14.2	23,340
July 31	25.3	81,600
August 1	24.0	73,800
August 2	15.6	29,500
1897.		
February 22	16.0	31,300
February 23	36.0	159,000
February 24	36.0	159,000
February 25	23.0	67,800
February 26	14.0	22,500
May 14	19.7	49,650
May 15	20.6	54,600
May 16	14.6	25,040
December 5	8.0	.....
December 6	20.6	54,600
December 7	15.6	29,500
1898.		
January 10	14.0	22,500
January 11	23.9	73,200
January 12	20.0	51,300
January 13	15.8	30,400
January 16	19.5	48,600

Flood flow of the Monongahela River at Lock No. 4, Pa., 1886–1905—Continued.

Date.	Gage height.	Discharge.
1898.	*Feet.*	*Sec.-feet.*
January 17	21.0	56,800
January 18	16.0	31,300
January 23	13.5	20,480
January 24	21.9	61,750
January 25	16.7	34,600
March 17	8.5	.....
March 18	20.0	51,300
March 19	16.7	34,600
March 20	.....	.....
March 21	13.8	21,680
March 22	22.5	65,050
March 23	20.7	55,150
March 24	20.2	52,400
March 25	24.7	78,000
March 26	23.8	72,600
March 27	16.0	31,300
March 28	.....	.....
March 29	12.0	15,300
March 30	23.9	73,200
March 31	20.7	55,150
April 1	14.5	24,600
August 10	17.3	37,600
August 11	23.3	69,600
August 12	21.0	56,800
August 13	17.8	40,100
October 22	14.0	22,500
October 23	21.6	60,100
October 24	15.8	30,400
1899.		
January 6	15.0	26,800
January 7	23.5	70,800
January 8	23.0	67,800
January 9	15.6	29,500
February 4	11.5	.....
February 5	22.0	62,300
February 6	17.5	38,600
March 5	14.0	22,500
March 6	26.9	91,900
March 7	20.0	51,300
March 28	9.5	.....
March 29	23.0	67,800
March 30	23.0	67,800
March 31	16.5	33,600
1900.		
March 1	10.2	.....
March 2	21.0	56,800
March 2	19.0	46,100
November 26	17.6	39,100
November 27	33.8	141,400
November 28	22.6	65,600
November 29	14.8	25,920
1901.		
April 4	18.8	45,100
April 5	21.6	60,100
April 6	20.6	54,600
April 7	23.1	68,400
April 8	21.6	60,100
April 9	17.0	36,100
April 19	12.0	15,300
April 20	23.3	69,600
April 21	25.5	82,800
April 22	21.5	59,550
April 23	17.2	37,100
May 27	19.4	48,100
May 28	21.3	58,450
May 29	20.0	51,300
May 30	17.1	36,600
December 15	18.5	43,600
December 16	28.5	103,100
December 17	18.5	43,600
December 29	16.5	33,600
December 30	25.0	79,800
December 31	22.0	62,300
1902.		
January 27	9.5	.....
January 28	28.9	85,200
January 29	19.5	48,600
February 26	16.4	33,100
February 27	21.5	59,550
February 28	18.8	45,100
March 1	29.5	110,100
March 2	25.1	80,400
March 3	20.0	51,300
March 4	15.6	29,500
March 9	11.3	.....
March 10	21.6	60,100
March 11	19.6	49,100
April 9	17.2	37.100
April 10	20.1	51,850
April 11	22.0	62,300
April 12	22.7	66,150
April 13	21.5	59,550
April 14	17.7	39,600
December 12	20.0	51,300
December 13	25.0	79,800
December 14	26.2	87,000
December 15	19.0	46,100
December 16	17.0	36,100
December 17	26.0	85,800
December 18	20.5	54,030
December 19	14.5	24,600
1903.		
January 3	10.9	.....
January 4	22.1	62,850
January 5	18.9	45,600
February 4	16.0	31,300
February 5	21.7	60,650
February 6	17.8	40,100
February 15	10.5	.....

Flood flow of the Monongahela River at Lock No. 4, Pa., 1886–1905—Continued.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1903.	*Feet.*	*Sec.-feet.*	1904.	*Feet.*	*Sec.-feet.*
February 16	22.5	65,600	March 23	14.2	23,340
February 17	28.4	102,400	March 24	20.2	52,400
February 18	19.2	47,100	March 25	16.8	35,100
February 28	14.6	25,040	1905.		
March 1	32.5	131,100	January 11	10.2	.....
March 2	24.6	77,400	January 12	24.3	75,600
March 3	15.7	29,950	January 13	19.5	48,600
March 23	13.0	18,540	March 8	12.0	15,300
March 24	23.2	69,000	March 9	21.0	56,800
March 25	21.0	56,800	March 10	28.3	101,700
March 26	14.6	25,040	March 11	29.3	108,700
1904.			March 12	18.5	43,600
January 22	13.8	21,680	March 21	16.5	33,600
January 23	21.2	57,900	March 22	27.2	94,000
January 24	20.0	51,300	March 23	20.5	54,050
January 25	16.8	24,600	March 24	13.4	20,080

CHEAT RIVER NEAR MORGANTOWN, W. VA.

A cable station was established July 8, 1899, by E. G. Paul, at Uneva, about 7 miles from Morgantown, W. Va. July 26, 1901, the cable was moved about 1 mile downstream in order to secure a more satisfactory cross section and better facilities for observing gage heights.

The channel is straight for about 800 feet above and 1,200 feet below the station. The right bank is low and liable to overflow; the left bank is high. The bed of the stream is of rocks and gravel and the current is sluggish.

A timber gage was established at the present station August 21, 1902. It is located 275 feet below the cable and is inclined up to 6.5 feet, above which point readings are taken on a vertical timber spiked to an ash tree. The bench mark is a mark on the face of a sandstone rock at the edge of the road 20 feet downstream and 30 feet back from the gage; elevation, 21.13 feet above gage datum. On September 28, 1904, a standard chain gage was installed on the new steel bridge, known as Ice's Ferry Bridge, near the site of the first cable, and both gages have been read since that time. They were set to read the same and their records have checked very closely. The published record is that for the inclined gage.

This station was discontinued December 31, 1905.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geolgical Survey:

Description: 36, pp 160–161; 48, p 177; 65, p 290; 83, p 184; 98, p 245; 128, p 52.
Discharge: 36, p 161; 48, p 177; 65, p 290; 83, p 184; 98, p 245; 128, p 53.
Discharge, monthly: 75, p 100.
Gage heights: 36, p 161; 48, p 177; 83, p 185; 98, p 246; 128, p 53.
Rating table: 65, p 323.

Discharge measurements of Cheat River near Morgantown, W. Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second feet.*
March 17[a]	Grover and Morse	388	2,754	2.08	4.80	5,717
March 17[b]	.....do	320	1,946	3.05	5.62	5,945

[a] Measurement made from bridge. Gage height referred to chain gage.
[b] Measurement made from cable. Gage height referred to inclined staff gage.

Daily gage height, in feet, of Cheat River near Morgantown, W. Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.8	2.95	5.35	4.1	4.4	5.9	3.7	4.05	2.7	2.0	3.55	5.2
2	3.6	2.85	4.55	4.0	4.05	5.25	4.15	3.8	2.65	2.0	3.35	4.7
3	3.6	2.9	4.1	3.85	3.85	4.4	3.8	3.45	2.5	2.0	3.15	8.25
4	3.65	2.85	3.75	3.8	3.7	3.75	3.65	3.05	2.5	2.1	3.1	8.0
5	3.45	2.9	3.7	3.8	3.8	3.55	4.75	2.9	2.45	2.05	3.0	6.15
6	3.4	2.9	4.7	4.2	4.35	3.4	4.15	3.4	2.4	2.1	3.05	5.1
7	3.45	3.1	5.55	4.9	3.95	3.5	3.8	3.2	2.4	2.1	3.4	4.55
8	3.35	3.4	8.2	5.05	3.8	3.65	3.8	3.35	2.35	2.1	3.6	4.2
9	3.2	3.85	11.25	4.85	3.8	3.45	4.05	3.05	2.3	2.1	3.5	4.0
10	3.2	5.95	12.65	4.8	3.55	3.3	3.7	3.15	2.3	2.0	3.45	3.9
11	3.3	4.8	8.75	5.8	3.45	3.15	3.65	3.15	2.85	2.0	3.35	3.6
12	6.45	4.35	7.05	5.75	7.3	3.65	3.6	3.15	4.15	2.3	3.1	3.55
13	9.85	7.4	6.2	4.75	7.45	4.55	3.75	3.0	4.1	3.4	3.0	3.45
14	7.05	6.25	5.8	4.6	5.9	4.25	4.45	3.3	3.6	3.2	3.0	3.4
15	5.45	8.5	5.4	4.4	8.5	3.6	3.85	5.2	3.05	2.9	2.9	3.3
16	4.85	8.3	5.2	4.2	6.75	3.25	3.65	5.6	2.9	2.8	3.0	3.2
17	3.95	8.35	5.75	4.05	6.2	3.0	3.45	5.45	2.7	2.55	3.4	3.15
18	3.85	7.65	6.05	3.8	5.25	3.0	3.1	4.3	2.65	2.4	3.55	3.1
29	3.8	6.7	6.85	3.7	4.8	3.0	2.9	4.0	2.5	2.45	3.4	3.2
20	3.8	6.55	8.2	3.7	4.45	3.0	3.8	3.5	2.45	6.6	3.35	3.2
21	3.8	6.55	10.85	4.6	4.1	3.05	4.3	3.45	2.4	6.0	3.05	5.1
22	3.6	7.0	9.35	5.65	3.85	5.3	3.7	3.05	2.3	5.2	2.8	5.85
23	3.5	8.0	7.25	5.35	3.55	5.25	3.8	2.9	2.3	4.65	2.65	5.95
24	3.4	7.9	6.1	4.65	3.5	4.85	5.5	2.75	2.25	3.25	2.45	6.05
25	3.2	7.5	6.65	4.35	3.3	5.9	4.35	4.35	2.2	3.1	3.3	4.95
26	2.8	7.85	6.55	4.05	3.2	5.0	3.7	5.25	2.1	4.15	3.3	4.15
27	2.95	7.25	6.05	4.35	3.1	6.9	3.55	4.25	2.1	5.25	3.3	4.2
28	2.9	6.3	5.6	5.9	3.0	5.45	3.25	3.75	2.1	4.55	3.3	4.0
29	2.95	.....	5.1	5.4	3.0	4.5	3.2	3.55	2.0	3.9	5.1	4.15
30	3.0	.....	4.85	4.95	2.95	3.9	5.15	2.9	2.0	3.8	7.3	4.25
31	3.15	.....	4.65	.....	3.2	.....	4.6	2.9	.....	3.65	.....	4.15

NOTE.—These gage heights are referred to the inclined staff gage.

YOUGHIOGHENY RIVER NEAR CONFLUENCE, PA.

This station was established September 15, 1904, by E. C. Murphy. It is located at the highway bridge about one-half mile from the railway station at Confluence, Pa.

The channel is straight for about 200 feet above and 500 feet below the station. The current is swift. The right bank is high and does not overflow; the left bank is low, clean, and overflows during high water. The bed of the stream is rocky. There are two channels at all stages. There is a small cobblestone dam about 4 to 6 inches high under the bridge.

Discharge measurements are made from the upstream side of the two-span steel bridge. The initial point for soundings is the center of the bridge pin over the right abutment on the upstream side of the bridge.

A standard chain gage, which is read once each day by L. L. Mountain, is fastened to the downstream hand rail of the bridge; length of chain, 23.26 feet. The gage is referred to bench marks as follows: (1) A cross on the head of a rivet in the bedplate at the right abutment on the downstream side; elevation, 20.53 feet. (2) A cross on the lower chord of the bridge under the gage box; elevation, 20.28 feet. Elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 56–57.

Discharge measurements of Youghiogheny River near Confluence, Pa., in 1905.

Date.	Hydrographer.	Width	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 11	E. C. Murphy	260	1,365	4.52	7.02	6,164
March 11	do	260	1,303	4.32	6.81	5,628
March 15	Grover and Morse	240	699	3.42	4.41	2,380
March 16	do	240	699	3.36	4.42	2,344
March 28	E. C. Murphy	231	553	3.39	3.78	1,872
April 17	A. H. Horton	203	295	2.27	2.61	670
April 22	do	231	550	2.85	3.79	1,567
June 5	R. H. Bolster	203	256	2.08	2.41	534
November 4	Hanna and Grieve	203	251	1.99	2.30	499

Daily gage height, in feet, of Youghiogheny River near Confluence, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.45	2.35	3.55	2.75	2.55	3.2	2.45	3.6	2.1	1.6	2.5	3.95
2	2.35	2.3	.....	2.6	2.4	2.8	3.65	3.0	2.05	1.6	2.4	3.5
3	2.6	2.35	.....	2.6	2.35	2.7	3.15	2.7	2.05	1.8	2.3	8.05
4	2.5	2.3	3.55	2.5	2.25	2.5	3.0	2.55	2.05	1.75	2.3	5.6
5	2.45	.....	.....	2.55	2.25	2.4	3.9	2.5	2.1	1.7	2.3	4.35
6	2.4	.....	.....	2.65	2.3	2.3	3.6	2.35	2.2	1.65	2.45	3.7
7	2.25	.....	5.4	2.75	2.3	3.0	4.5	2.2	2.25	1.65	2.4	3.35
8	2.2	2.55	5.45	2.9	2.35	2.9	4.8	2.1	2.55	1.6	2.35	3.1
9	2.1	.....	7.85	2.9	2.25	2.75	3.85	2.1	2.75	1.6	2.3	2.9
10	2.15	.....	8.7	3.05	2.25	2.6	3.3	2.05	2.9	1.55	2.3	2.8
11	2.2	2.65	6.75	3.95	2.4	4.7	3.15	2.3	3.5	1.7	2.2	2.75
12	2.45	.....	5.65	3.55	3.0	3.6	3.0	2.2	3.75	2.3	2.2	2.7
13	6.35	.....	5.05	3.3	2.85	3.5	3.1	2.1	3.1	2.2	2.15	2.6
14	4.7	.....	4.7	2.95	3.2	3.1	2.85	2.05	2.6	2.0	2.15	2.5
15	3.55	3.05	4.45	2.85	4.05	2.7	2.55	4.5	2.2	1.9	2.2	2.4
16	3.15	.....	4.45	2.75	3.85	2.45	2.35	4.1	2.15	1.8	2.2	2.35
17	2.9	.....	5.7	2.6	3.7	2.4	2.2	3.2	2.1	1.75	2.3	2.3
18	2.75	3.35	6.45	2.6	3.4	2.3	2.15	2.7	2.05	1.7	2.3	2.25
19	2.6	.....	8.7	2.5	3.0	2.2	2.1	2.4	2.0	1.9	2.35	2.25
20	2.55	.....	8.45	2.75	2.85	2.2	2.2	2.3	1.95	6.15	2.2	2.2
21	2.5	.....	10.25	3.05	2.75	2.1	2.7	2.2	1.9	4.1	2.1	3.8
22	2.4	3.45	8.05	3.8	2.6	3.35	2.4	2.1	1.8	3.25	2.05	4.6
23	2.45	.....	5.85	3.45	2.5	3.1	2.3	2.1	1.8	2.8	2.05	4.2
24	2.35	.....	4.9	3.1	2.35	3.4	2.7	2.0	1.8	2.6	2.0	4.0
25	2.4	3.55	5.2	3.0	2.3	3.0	2.5	2.5	1.8	2.5	2.1	3.5
26	2.4	.....	4.55	2.8	2.25	2.8	2.25	4.0	1.75	3.5	2.05	3.1
27	2.3	.....	4.15	2.9	2.2	3.45	2.1	2.95	1.7	3.3	2.05	2.95
28	2.35	.....	3.7	2.85	2.15	2.9	2.05	2.65	1.7	3.0	2.40	2.85
29	2.3	.....	3.3	2.85	2.0	2.6	2.4	2.3	1.65	2.8	5.40	3.1
30	2.35	.....	3.15	2.6	2.05	2.5	4.4	2.25	1.6	2.65	5.35	2.85
31	2.3	.....	2.9	.....	2.1	.....	4.0	2.2	.....	2.55	.....	2.75

NOTE.—From February 5 to March 6 river was frozen entirely across, except for narrow channel of open water under the gage. Thickness of ice, 0.7–1 foot.

Station rating table for Youghiogheny River near Confluence, Pa., from September 16, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	35	2.60	674	3.90	1,801	6.40	5,070
1.40	57	2.70	746	4.00	1,907	6.60	5,390
1.50	85	2.80	820	4.20	2,125	6.80	5,710
1.60	118	2.90	896	4.40	2,351	7.00	6,040
1.70	156	3.00	974	4.60	2,585	7.20	6,375
1.80	199	3.10	1,055	4.80	2,727	7.40	6,715
1.90	247	3.20	1,139	5.00	3,077	7.60	7,065
2.00	299	3.30	1,226	5.20	3,337	7.80	7,420
2.10	354	3.40	1,316	5.40	3,604	8.00	7,780
2.20	412	3.50	1,407	5.60	3,880	8.50	8,695
2.30	473	3.60	1,501	5.80	4,166	9.00	9,620
2.40	537	3.70	1,598	6.00	4,460	9.50	10,560
2.50	604	3.80	1,698	6.20	4,760	10.00	11,510

NOTE.—The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1904–5. It is well defined between gage heights 1.3 feet and 7 feet. The table has been extended above 7 feet.

Estimated monthly discharge of Youghiogheny River near Confluence, Pa., for 1904–5.

[Drainage area, 392 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
September 16–30	101	46	58.9	0.150	0.084
October	156	27	62.4	.159	.183
November	57	35	49.3	.126	.141
December (17 days)	2,851	57	836	2.13	1.35
1905.					
January	4,992	354	806	2.06	2.38
March 7–31	11,985	896	4,425	11.30	10.51
April	1,854	604	924	2.36	2.63
May	1,961	299	714	1.82	2.10
June	2,705	354	893	2.28	2.54
July	2,727	326	1,012	2.58	2.97
August	2,467	299	718	1.83	2.11
September	1,648	118	534	1.36	1.52
October	4,685	101	629	1.60	1.84
November	3,604	299	646	1.65	1.84
December	7,870	412	1,414	3.61	4.16

NOTE.—No estimate during frozen period.

CASSELMAN RIVER AT CONFLUENCE, PA.

This station was established September 15, 1904, by E. C. Murphy. It is located at the highway bridge in Confluence, Pa., about 500 yards from the railroad station.

The channel is straight for 200 feet above and 500 feet below the station. The current is swift. The right bank is high and is not subject to overflow. The left bank is low and overflows during extreme high water. The bed of the stream is covered with bowlders and there is some vegetation. There are two channels at all stages.

Discharge measurements are made from the upper side of the two-span steel bridge. The initial point for soundings is the center of the bridge pin over the right abutment on the upstream side.

A standard chain gage, which is read once each day by L. L. Mountain, is fastened to the upstream hand rail of the bridge; length of chain, 21.41 feet. The gage is referred to bench marks as follows: (1) A chisel draft marked with paint on the right abutment on the downstream side; elevation, 17.88 feet. (2) A cross on the top of the lower chord of the bridge near the gage; elevation, 18.61 feet. Elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 57–58.

Discharge measurements of Casselman River at Confluence, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet*	*Feet per second.*	*Feet.*	*Second-feet.*
March 11	E. C. Murphy	248	1,186	3.11	6.16	[a] 3,688
March 15	Grover and Morse	247	609	3.70	4.02	2,253
March 15	do	230	576	3.74	3.89	2,155
March 16	do	231	605	3.68	3.99	2,230
March 28	E. C. Murphy	229	516	3.63	3.59	1,870
April 17	A. H. Horton	214	344	2.25	2.63	772
April 22	do	228	559	3.54	3.73	1,980
June 6	R. H. Bolster	205	214	1.29	2.02	277
November 4	Hanna and Grieve	233	330	1.59	2.30	526

[a] Influenced by backwater from Youghiogheny River.

Daily gage height, in feet, of Casselman River at Confluence, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.15	.....	2.9	2.7	2.4	2.2	2.4	2.6	2.2	1.7	2.5	3.2
2	2.10	.....	.....	2.6	2.25	2.3	2.95	2.25	2.1	1.8	2.4	3.0
3	2.4	.....	.....	2.55	2.25	2.2	2.55	2.1	2.1	2.5	2.3	8.4
4	2.35	2.6	2.9	2.5	2.3	2.1	2.4	2.0	2.1	2.25	2.3	5.1
5	2.3	.....	.....	2.5	2.35	2.05	2.3	2.3	2.2	2.0	2.3	4.35
6	2.2	.....	.....	2.55	2.55	2.0	2.4	2.25	2.25	1.8	2.3	3.3
7	2.15	.....	3.5	2.65	2.5	2.5	3.25	2.1	2.35	1.75	2.3	3.0
8	2.1	2.7	4.6	2.7	2.45	2.75	3.6	2.0	2.65	1.7	2.3	2.9
9	2.1	.....	6.85	2.7	2.4	2.6	2.9	1.95	2.85	1.7	2.25	2.8
10	2.1	.....	7.3	2.75	2.3	2.5	2.6	1.9	2.95	1.65	2.2	2.7
11	2.15	2.7	5.6	3.5	2.25	5.7	3.1	3.2	4.85	1.95	2.15	2.6
12	2.35	.....	4.8	3.4	2.55	4.1	2.75	2.8	3.8	2.8	2.15	2.5
13	4.7	.....	4.5	3.05	2.4	3.35	2.8	2.4	2.9	2.35	2.1	2.4
14	3.8	.....	4.25	2.85	2.75	3.0	2.5	2.3	2.5	2.15	2.1	2.3
15	2.95	2.9	4.0	2.8	3.4	2.65	2.3	5.4	2.2	2.05	2.1	2.2
16	2.5	.....	4.0	2.7	3.2	2.45	2.2	4.25	2.2	2.0	2.2	2.15
17	2.45	.....	5.5	2.6	3.1	2.4	2.1	3.2	2.2	1.95	2.25	2.15
18	2.4	2.9	6.3	2.55	2.8	2.3	2.0	2.8	2.15	1.9	2.25	2.2
19	2.4	.....	9.0	2.5	2.65	2.2	2.0	2.5	2.1	2.15	2.15	2.15
20	2.35	.....	8.5	2.65	2.5	2.2	2.9	2.35	2.05	6.1	2.05	2.1
21	2.35	.....	10.4	2.95	2.4	2.1	2.35	2.2	2.0	3.7	2.0	4.0
22	2.25	2.9	7.5	3.7	2.35	3.35	2.2	2.2	1.95	3.0	2.0	4.3
23	2.25	.....	5.25	3.2	2.25	3.3	2.1	2.1	1.9	2.7	2.0	3.7
24	2.25	.....	4.4	2.9	2.2	3.7	2.5	2.0	1.9	2.6	2.0	3.4
25	2.2	2.9	4.9	2.8	2.15	3.2	2.25	3.2	1.85	2.5	1.95	3.0
26	2.2	.....	4.15	2.7	2.1	2.9	2.1	3.0	1.85	3.2	1.95	2.8
27	.....	.....	3.95	2.75	2.4	2.8	2.05	2.5	1.8	3.0	2.0	2.7
28	.....	.....	3.5	2.75	2.2	2.5	2.0	2.3	1.8	2.8	2.35	2.6
29	.....	.....	3.2	2.65	2.0	2.3	2.1	2.2	1.8	2.6	5.65	3.0
30	.....	.....	3.0	2.5	2.0	2.2	2.6	2.55	1.8	2.55	4.75	2.7
31	.....	.....	2.85	.....	2.15	.....	3.0	2.3	.....	2.5	.....	2.5

NOTE.—From January 27 to March 6 river frozen entirely across. Thickness of ice, 0.6–0.8 foot. During this time gage read to top of ice. February 15 water overflowed ice and froze under gage, increasing the reading 0.2 foot, approximately.

Station rating table for Casselman River at Confluence, Pa., from September 16, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	30	2.20	408	2.90	1,070	3.50	1,715
1.60	58	2.30	491	3.00	1,175	3.60	1,825
1.70	95	2.40	579	3.10	1,281	3.70	1,935
1.80	141	2.50	671	3.20	1,388	3.80	2,045
1.90	196	2.60	767	3.30	1,496	3.90	2,155
2.00	260	2.70	866	3.40	1,605	4.00	2,265
2.10	331	2.80	967				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1904–5. It is fairly defined between gage heights 1.5 feet and 4 feet. Owing to backwater from Youghiogheny River the discharge for higher gage heights is liable to be in considerable error and is therefore only approximate.

Estimated monthly discharge of Casselman River at Confluence, Pa., for 1904–5.

[Drainage area, 482 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
September 16–30	44	22	28.5	0.059	0.033
October	58	14	26.0	.054	.062
November	44	17	26.2	.054	.060
December 1–10, 24–31	2,368	44	467	.969	.649
1905.					
January 1–26	2,881	331	643	1.33	1.29
March 7–31	4,763	1,018	2,910	6.04	5.62
April	1,935	671	964	2.00	2.23
May	1,605	260	630	1.31	1.51
June	3,457	260	913	1.89	2.11
July	1,825	260	690	1.43	1.65
August	3,299	196	752	1.56	1.80
September	2,981	141	551	1.14	1.27
October	3,658	76	656	1.36	1.57
November	3,431	228	580	1.20	1.34
December	4,468	331	1,224	2.54	2.93

NOTE.—No estimates for ice period.

LAUREL HILL CREEK AT CONFLUENCE, PA.

This station was established September 15, 1904, by E. C. Murphy. It is located at the highway bridge near the tannery, about one-fourth of a mile from the railroad station at Confluence, Pa.

The channel is straight for 25 feet above and 300 feet below the station. The current is swift. The right bank is low, clean, and subject to overflow during high water. The left bank is high and not subject to overflow. The bed of the stream is composed of rough cobblestones and is permanent. There is one channel at all except freshet stages.

Discharge measurements are made from the lower side of the single-span steel bridge. The initial point for soundings is the center of the bridge pin over the left abutment on the left side of the bridge.

A standard chain gage, which is read once each day by L. L. Mountain, is fastened to the downstream hand rail of the bridge; length of chain, 17.52 feet. The gage is referred to bench marks as follows: (1) A cross on the top of a bolt in the bedplate of the bridge at the right abutment; elevation, 14.16 feet. (2) A cross on the lower chord of the bridge under the gage box; elevation, 14.74 feet. Elevations refer to datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 58–59.

Discharge measurements of Laurel Hill Creek at Confluence, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square Feet.*	*Feet per second.*	*Feet.*	*Second-Feet.*
March 11	E. C. Murphy	100	293	3.18	3.79	933
March 11	do	100	262	3.45	3.63	903
March 15	Grover and Morse	100	214	2.78	3.05	595
March 16	do	100	220	3.04	3.11	665
March 28	E. C. Murphy	98	196	2.89	2.98	568
April 17	A. H. Horton	90	167	1.45	2.45	242
April 22	do	100	228	3.00	3.21	684
June 6	R. H. Bolster	87	114	.52	1.98	59
November 4	Hanna and Grieve	90	167	1.02	2.30	171

Daily gage height, in feet, of Laurel Hill Creek at Confluence, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.3	.....	2.85	2.45	2.45	2.05	2.35	2.8	2.15	1.8	2.4	3.15
2	2.3	.....	.....	2.35	2.4	2.05	2.45	2.5	2.1	1.8	2.3	3.0
3	2.5	.....	.....	2.3	2.35	2.0	2.3	2.35	2.1	2.1	2.3	6.85
4	2.45	2.25	2.85	2.3	2.35	2.0	2.25	2.4	2.1	1.95	2.3	4.05
5	2.45	.....	.....	2.35	2.45	2.0	2.2	2.3	2.25	1.85	2.4	3.3
6	2.4	.....	.....	2.4	2.4	1.9	2.2	2.25	2.3	1.75	2.4	2.95
7	2.25	.....	.....	2.45	2.3	2.7	2.2	2.25	2.3	1.7	2.35	2.75
8	2.15	2.9	3.65	2.45	2.25	2.5	2.3	1.9	2.6	1.7	2.35	2.65
9	2.05	.....	4.85	2.4	2.15	2.4	2.15	1.9	2.8	1.7	2.3	2.55
10	2.0	.....	5.2	2.45	2.15	2.3	2.3	1.85	2.9	1.65	2.25	2.45
11	2.05	2.85	3.85	2.9	2.2	4.45	2.2	2.8	4.15	2.3	2.2	2.45
12	2.25	.....	3.2	2.9	2.55	3.7	2.2	2.55	3.1	2.4	2.2	2.4
13	3.7	.....	3.2	2.7	2.45	3.1	2.3	2.3	2.9	2.15	2.2	2.4
14	3.3	.....	3.15	2.6	2.95	2.75	2.2	2.3	2.55	2.05	2.2	2.35
15	3.0	2.9	3.05	2.5	3.0	2.5	2.15	4.0	2.4	1.95	2.15	2.35
16	2.65	.....	3.15	2.5	2.8	2.4	2.05	4.3	2.3	1.9	2.25	2.3
17	2.6	.....	4.0	2.4	2.6	2.3	2.0	3.35	2.2	1.85	2.25	2.25
18	2.5	2.85	4.5	2.4	2.5	2.2	2.0	2.9	2.15	1.8	2.2	2.25
19	2.35	.....	7.65	2.4	2.4	2.15	1.9	2.6	2.1	2.2	2.2	2.2
20	2.35	.....	6.55	2.5	2.4	2.15	2.45	2.35	2.05	4.1	2.15	2.15
21	2.3	.....	7.95	2.65	2.3	2.1	2.2	2.3	2.0	3.15	2.1	3.5
22	2.25	2.9	5.2	3.15	2.25	4.6	2.1	2.3	1.95	2.65	2.1	3.5
23	2.3	.....	3.75	2.8	2.2	3.8	2.0	2.2	1.9	2.5	2.05	3.2
24	2.3	.....	3.3	2.65	2.15	3.85	2.4	2.1	1.9	2.4	2.1	2.95
25	2.2	2.85	3.5	2.6	2.15	3.4	2.2	2.35	1.9	2.35	2.05	2.75
26	2.25	.....	3.2	2.5	2.1	3.2	2.15	2.2	1.85	2.65	2.05	2.65
27	.....	.....	3.1	2.6	2.15	2.85	2.1	2.1	1.8	2.5	2.0	2.55
28	.....	.....	2.95	2.9	2.15	2.6	2.05	2.05	1.8	2.45	2.5	2.5
29	.....	.....	2.7	2.65	2.1	2.45	2.3	2.0	1.8	2.35	4.75	3.1
30	.....	.....	2.6	2.55	2.15	2.35	2.4	2.3	1.8	2.35	3.9	2.75
31	.....	.....	2.5	.....	2.05	.....	3.25	2.2	.....	2.3	.....	2.6

NOTE.—Creek frozen over January 27 to March 7, inclusive. During this period gage was read to top of ice. Thickness of ice, 0.7–1 foot.

Station rating table for Laurel Hill Creek at Confluence, Pa., from September 16, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	7	2.10	93	2.50	266	2.90	503
1.70	13	2.20	128	2.60	321	3.00	568
1.80	24	2.30	169	2.70	379	3.10	634
1.90	41	2.40	215	2.80	440	3.20	701
2.00	64						

NOTE.—The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1904–5. It is well defined between gage heights 1.8 feet and 3.2 feet. Above 3.2 feet the discharge is estimated and may be considerably in error, as the creek is affected by backwater from Casselman and Youghiogheny rivers.

Estimated monthly discharge of Laurel Hill Creek at Confluence, Pa., for 1904–5.

[Drainage area, 126 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
September 16–30	24	10	13.7	0.109	0.061
October	24	7	10.8	.086	.099
November	13	7	10.8	.086	.096
December 1–11, 26–31	882	13	191	1.52	.961
1905.					
January 1–26	916	64	247	1.96	1.90
March 8–31	1,106	266	793	6.29	5.61
April	668	169	304	2.41	2.69
May	568	78	204	1.62	1.87
June	1,080	41	375	2.98	3.32
July	730	41	153	1.21	1.40
August	1,044	32	258	2.05	2.36
September	1,019	24	192	1.52	1.70
October	1,010	10	169	1.34	1.54
November	1,091	64	201	1.60	1.78
December	1,056	110	427	3.39	3.91

NOTE.—No estimates for ice period.

BEAVER RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Beaver river is formed by the junction of Mahoning and Shenango rivers just below Newcastle, Pa. Mahoning River flows through a hilly and important territory. There are numerous water-power developments on it, and it forms an important adjunct in the water supply and sewage disposal of many towns along its course.

MAHONING RIVER AT YOUNGSTOWN, OHIO.

This station was established May 23, 1903. It is located about 2 miles below the center of the city of Youngstown, Ohio, at the highway bridge near the plant of the Hazelton Steel Company.

The channel is straight for about 800 feet above and 200 feet below the bridge, and is 200 feet wide between abutments. The left bank is fairly high and is subject to overflow only at extremely high water. The right bank is low and overflows in floods. The section is fairly regular and the bed of the stream is composed of gravel and small bowlders, probably not subject to change. The current is sluggish at extremely low water.

Discharge measurements are made from the single-span highway bridge. The initial point for soundings is the face of the parapet wall of the east abutment on the upstream side.

The vertical gage, consisting of a 1 by 6 inch board nailed to stakes driven in the river bed 15 feet from the east abutment, was used up to September 23, 1903, when a standard chain gage was installed, having a length of 25.36 feet from the end of the weight to the marker. The gage was read during 1905 by John McVean. Bench marks were established as follows: (1) The top of the copper bolt on the face of the east abutment near the upstream corner; elevation, 9.37 feet. (2) The northwest corner of the bridge seat of the west abutment; elevation 17.12 feet. (3) A cut in the end stone of the second tier from the top of the north wing wall of the west abutment; elevation, 21.34 feet. (4) A cut in the top hand rail at a point 35 feet from the east abutment on the upstream side; elevation, 25.88 feet. The elevation of the center of the pulley on which the chain of the gage runs is 23.61 feet. Elevations refer to datum of gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 98, p 238; 128, p 60.
Discharge: Ann 20, iv, p 198; WS 98, p 239; 128, p 60.
Discharge, monthly: WS 128, p 62.
Gage heights: WS 98, p 239; 128, p 61.
Rating table: WS 128, p 61.

Discharge measurements of Mahoning River at Youngstown, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 18 [a]	R. Winthrop Pratt	75	119	0.96	1.41	422
May 23	M. S. Brennan	156	389	.71	1.09	276
June 22	Sidney K. Clapp	160	602	1.85	2.25	1,116
October 5	R. Winthrop Pratt	158	482	.96	1.51	465
November 3	do	158	443	.75	1.40	332

[a] Ice gorge below.

Daily gage height, in feet, of Mahoning River at Youngstown, Ohio, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.8	0.75	2.4	1.4	1.15	1.15	1.0	1.6	1.15	0.85	1.25	4.3
2	1.5	.72	1.95	1.45	1.15	.95	1.15	1.15	1.05	.9	1.3	3.9
3	1.15	.7	1.75	1.3	.95	.98	1.95	.95	.9	1.1	1.35	4.0
4	1.1	.65	1.7	1.22	.95	.....	1.5	.75	.8	1.2	1.3	5.0
5	1.15	.6	1.7	1.2	1.0	.....	1.6	.6	1.0	1.3	1.2	3.55
6	1.17	.72	2.15	1.15	.95	.....	1.55	.75	.92	1.25	1.5	2.6
7	1.1	.7	2.8	1.1	1.0	.....	1.4	.85	1.1	1.1	2.5	2.25
8	.9	.75	7.0	1.08	.95	.....	1.2	.9	.9	.95	2.4	2.2
9	.9	.8	7.0	1.15	.92	.....	1.0	1.0	.85	.85	2.05	2.15
10	.86	.78	7.0	1.1	.85	.....	.95	1.25	.7	.75	1.85	2.1
11	.9	.68	6.2	1.5	.92	.....	1.0	1.15	1.95	1.05	1.75	1.75
12	1.12	.72	3.9	1.58	4.6	.....	1.4	1.0	3.8	1.0	1.6	1.65
13	2.1	.85	3.0	1.6	5.5	2.3	6.4	3.9	3.2	1.55	1.55	1.55
14	2.8	.9	2.5	1.6	2.9	2.0	8.4	3.6	1.95	1.4	1.45	1.5
15	2.42	1.0	2.1	1.3	2.5	1.65	6.4	3.8	1.55	1.3	1.4	1.15
16	1.8	.92	1.9	1.25	2.5	1.4	2.5	2.7	1.65	1.25	1.45	1.2
17	1.5	.97	2.4	1.3	2.15	4.9	1.75	2.7	1.5	1.25	1.5	1.2
18	1.4	.84	4.0	1.5	2.3	4.8	1.55	2.6	2.4	1.25	1.7	1.1
19	1.2	.72	9.6	1.95	2.0	4.6	1.3	2.5	2.6	1.75	1.75	1.15
20	1.14	.76	11.5	2.2	1.85	2.25	5.2	2.0	3.7	2.7	1.5	1.15
21	1.1	.85	11.5	5.4	1.4	2.0	6.2	.....	4.8	3.05	1.35	3.45
22	1.2	1.05	9.0	4.2	1.3	4.9	2.6	.....	3.3	2.75	1.25	6.5
23	1.3	1.1	6.4	3.2	1.15	6.6	1.85	2.3	2.15	2.05	1.15	6.0
24	1.2	1.35	4.0	2.4	1.0	3.9	1.85	2.7	1.25	1.9	1.1	3.9
25	1.1	1.6	3.6	1.95	.85	3.0	1.35	3.6	1.45	1.75	1.1	2.8
26	1.02	2.4	3.1	1.5	.5	2.6	1.0	5.5	1.2	1.6	1.15	2.25
27	.9	2.5	2.5	1.45	3.0	1.25	.95	3.3	.95	1.4	1.3	2.05
28	.8	2.9	2.2	1.5	2.7	1.1	.75	1.9	.9	1.35	1.65	2.25
29	.76	.....	1.95	1.35	1.7	1.0	.8	1.45	.6	1.15	5.35	1.75
30	.8	.....	1.95	1.35	1.5	.9	2.25	1.25	.75	1.05	6.3	2.0
31	.76	.....	1.5	.....	1.3	.....	2.0	1.18	.....	1.1	.....	1.95

NOTE.—Practically no ice conditions at the station, owing to hot water from steel plant.

Station rating table for Mahoning River at Youngstown, Ohio, from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	51	2.10	938	3.70	2,310	6.60	5,650
.60	80	2.20	1,014	3.80	2,410	6.80	5,910
.70	113	2.30	1,091	3.90	2,510	7.00	6,180
.80	151	2.40	1,170	4.00	2,610	7.20	6,460
.90	195	2.50	1,250	4.20	2,810	7.40	6,740
1.00	244	2.60	1,330	4.40	3,030	7.60	7,020
1.10	296	2.70	1,410	4.60	3,250	7.80	7,300
1.20	350	2.80	1,490	4.80	3,470	8.00	7,580
1.30	406	2.90	1,575	5.00	3,690	8.50	8,330
1.40	464	3.00	1,660	5.20	3,910	9.00	9,080
1.50	524	3.10	1,745	5.40	4,150	9.50	9,830
1.60	586	3.20	1,830	5.60	4,390	10.00	10,600
1.70	651	3.30	1,920	5.80	4,630	10.50	11,400
1.80	719	3.40	2,010	6.00	4,870	11.00	12,200
1.90	790	3.50	2,110	6.20	5,130	11.50	13,050
2.00	863	3.60	2,210	6.40	5,390		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 20 discharge measurement made during 1903–1905. It is fairly well defined between gage heights 0.9 foot and 2.5 feet. The table has been extended beyond these limits, being based on 1 measurement at 7.8 and 1 at 10.8 feet, the latter being recomputed by the use of low-water soundings. Below 0.9 foot the curve is unsatisfactory, probably owing to the influence of the dam below, as at low stages the water may fall below the crest.

Estimated monthly discharge of Mahoning River at Youngstown, Ohio, for 1905.

[Drainage area, 958 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	1,490	136	406	0.424	0.489
February	1,575	80	310	.324	.337
March	13,050	524	3,310	3.46	3.99
April	4,150	286	754	.787	.878
May	4,270	51	780	.814	.938
June (21 days)	5,650	195	1,518	1.58	1.23
July	8,180	132	1,351	1.41	1.63
August[a]	4,270	80	1,009	1.05	1.21
September	3,470	80	759	.792	.884
October	1,702	132	506	.528	.609
November	5,260	296	822	.858	.957
December	5,520	296	1,464	1.53	1.76

[a] Discharge interpolated for missing gage heights.

MUSKINGUM RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Muskingum River is formed by the junction of Walhonding and Tuscarawas rivers in the east-central part of Ohio, flows southward and enters Ohio River at Marietta, Ohio.

MUSKINGUM RIVER AT ZANESVILLE, OHIO.

This station was established March 11, 1905. It is located at the Sixth Street Bridge, Zanesville, Ohio, 1,000 feet above the lowest lock which is maintained by the War Department which furnishes the gage heights. It is about 3,000 feet below a dam and about the same distance below the entrance of Licking River, which also has a dam near its mouth. The drainage area of Muskingum River at this station is 5,828 square miles.

The channel is straight for 1,000 feet above and below the station. The river broadens out on the right side just above the bridge. The right bank is thinly wooded, the water being confined within the abutments of the bridge. The left bank is clean, being formed by the artificial embankment of the canal. The bed of the stream is composed of gravel and silt and is not liable to change. There is but one channel at all stages, divided by three piers at low water and five piers at high water. The current is swift above the gage height of 10 feet. All of the flow except a small amount of leakage passes between the abutments of the bridge.

Discharge measurements are made from the upstream side of the Sixth Street Bridge. The bridge consists of six spans, having a total length of 800 feet. The easternmost span of the bridge is a drawspan over the canal. The initial point for soundings is the center of the iron post forming part of the hand rail over the west abutment, upstream side.

The gage is in two sections. The lower section is graduated to feet and tenths on the wooden crib adjacent to the extreme south end of the east lock wall. The upper section is a cast-iron plate, graduated to feet and tenths, set vertically in the masonry of the east lock wall at the extreme south end. Bench marks were established as follows: (1) On top of the west wall of the lock at upper gage; elevation, 699.92 feet. (2) A square cut in the masonry on the east wall of the lock at the upper gage opposite bench mark No. 1; elevation, 699.73 feet. (3) Gage reading of 29.00 feet, at an elevation of 694.86 feet above mean sea level. (4) Miter sill, equal to the zero of the gage, which is at an elevation of 665.86 feet above mean sea level.

Discharge measurements of Muskingum River at Zanesville, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 11	R. W. Pratt	531	6,269	4.11	16.85	25,800
March 16	do	510	2,841	2.25	9.75	6,409
March 16	E. C. Murphy	501	2,656	2.37	9.83	6,295
May 21	M. S. Brennan	472	2,923	2.88	10.50	8,416
June 13	Sidney K. Clapp	489	4,684	3.70	13.20	17,350
July 9	do	.....	2,474	2.27	9.20	5,628
August 28	R. W. Pratt	475	2,279	1.60	8.70	3,640
October 30	do	495	2,180	1.34	8.60	2,926
November 14	do	.....	2,275	1.54	8.75	3,501

Daily gage height, in feet, of Muskingum River at Zanesville, Ohio, for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	9	9.7	8.8	8.1	8.0	17	8.7	18	9.8	8.5	14.2	9.7
2	.....	8.8	9.5	8.8	8.1	7.9	18	8.5	15.2	12.2	8.3	12.6	10.7
3	.....	8.5	9.0	8.7	7.9	7.8	19	8.4	12.6	13.3	8.1	10.0	10.1
4	.....	8.4	8.6	8.9	7.8	7.9	20	8.4	11.7	11.7	8.3	10.2	10.4
5	.....	8.3	8.6	10.0	7.7	7.9	21	8.7	10.7	13.0	8.9	10.1	11.2
6	.....	8.2	9.9	10.0	7.7	7.8	22	11.4	10.1	13.6	9.0	9.9	11.7
7	.....	8.2	8.8	2.5	7.7	7.9	23	11.6	9.6	14.9	8.5	9.2	10.0
8	.....	8.2	8.6	9.3	7.7	7.8	24	11.1	9.2	15.2	8.3	8.7	9.5
9	8.6	8.3	10.3	9.3	7.7	7.8	25	11.2	9.0	15.1	8.1	8.5	9.0
10	8.5	8.2	9.8	8.9	7.7	7.7	26	9.4	8.8	13.6	8.2	8.6	8.8
11	8.7	8.3	9.3	8.5	7.7	7.9	27	9.2	10.2	11.6	8.1	9.0	8.6
12	9.4	12.4	9.4	8.4	8.1	9.8	28	9.2	10.0	10.3	8.0	9.0	8.3
13	9.7	18.5	10.6	8.4	9.4	10.5	29	9.2	10.0	9.7	8.0	8.5	8.3
14	9.6	15.6	10.3	9.0	9.1	9.5	30	9.1	9.8	9.2	8.0	8.2	8.2
15	9.2	18.2	9.8	9.8	8.9	8.8	31	.....	9.8	.....	8.0	8.0	.....
16	8.7	18.4	9.3	8.8	12.6	8.7							

LICKING RIVER AT PLEASANT VALLEY, OHIO.

This station was established November 14, 1902. It is located at the highway bridge 300 feet north of the railroad station at Pleasant Valley, Ohio, and 9 miles northwest of Zanesville, Ohio. The drainage area of Licking River at this station is 696 square miles.

The channel is straight for 200 feet above and 500 feet below the station. The banks are high and not liable to overflow, except in extreme floods. The bed of the stream is composed of gravel and clay. The current is sluggish.

Low-water measurements are made by wading and high-water measurements from the bridge to which the gage is attached. The initial point for soundings is a cross in the top stone of the downstream side of the south abutment of the bridge.

A standard chain gage is attached to the bridge. The length of the chain from the end of the weight to the marker is 20.93 feet. The gage was read during 1905 by A. B. Lebold. The gage is referred to bench marks as follows: (1) Nails driven into a telephone pole at elevations from 12.92 to 14.92 feet, respectively. (2) Three copper nails driven into a walnut tree about 400 feet to the right of the right end of the bridge, arranged vertically and having elevations, respectively, 14.92, 15.92, and 16.92 feet. (3) A nail driven into the outside guard timber near the gage box; elevation, 21.52 feet. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 83, pp 181–182; 98, p 229; 128, p 63.
Discharge: 83, p 182; 98, p 229; 128, p 63.
Discharge, monthly: 98, p 231; 128, p 65.
Gage heights: 83, p 182; 98, pp 229–230; 128, p 64.
Rating table: 98, p 230; 128, pp 64–65.

Discharge measurements of Licking River at Pleasant Valley, Ohio, in 1904–5.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.		*Feet.*	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
December 30	R. W. Pratt	78	353	1.48	3.14	524
1905.						
January 13	do	95	499	2.70	4.70	1,343
February 28	do	122	647	2.67	6.00	1,728
March 16	do	80	355	1.26	3.13	447
May 22	M. S. Brennan	79	337	1.49	2.86	502
June 19	Sidney K. Clapp	80	317	1.23	2.40	391
July 9	do	70	255	1.36	1.92	347
August 28	R. W. Pratt	65	242	.47	1.58	114
October 30	do	67	241	1.00	2.33	241
November 14	do	69	284	1.12	2.32	318

Daily gage height, in feet, of Licking River at Pleasant Valley, Ohio, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.7	.....	5.7	2.4	2.7	3.3	1.7	1.5	1.5	1.6	2.7	4.2
2	2.6	.....	4.7	2.3	2.4	2.7	3.4	1.5	1.5	1.7	2.6	3.9
3	2.45	2.2	4.9	2.2	2.2	2.4	2.2	1.4	1.4	4.4	2.5	10.2
4	2.3	.....	3.4	2.2	2.2	2.2	2.2	1.4	1.4	3.4	2.4	6.7
5	2.3	.....	3.3	2.2	2.1	6.2	2.2	1.4	1.4	2.6	2.4	5.0
6	2.3	.....	3.3	2.1	2.0	6.4	2.0	1.4	1.4	2.2	5.0	4.9
7	2.4	.....	3.2	2.1	2.0	4.0	1.9	1.4	1.4	2.0	4.7	4.8
8	2.25	.....	8.8	2.0	2.0	3.3	1.9	1.5	1.4	1.9	3.9	4.2
9	3.0	.....	10.5	2.0	2.1	2.7	2.0	1.7	1.4	1.8	3.4	3.8
10	3.25	3.55	6.6	2.0	2.0	2.5	1.8	1.5	1.4	1.7	3.0	3.4
11	3.3	.....	4.2	2.4	2.0	2.4	1.8	1.5	2.0	1.7	2.7	3.3
12	3.5	.....	4.1	3.6	10.7	2.3	1.8	6.9	1.9	1.7	2.6	3.2
13	4.8	.....	3.7	2.9	7.3	2.2	1.8	3.4	1.8	1.7	2.5	2.8
14	3.9	.....	3.4	2.6	5.0	2.1	1.8	2.8	1.7	1.7	2.4	2.5
15	.....	.....	3.2	2.4	7.9	2.0	1.8	3.3	1.6	1.7	2.4	2.4
16	.....	.....	3.2	2.3	5.5	2.1	1.7	3.1	1.7	1.6	2.3	2.3
17	.....	3.0	3.3	2.2	6.8	4.0	1.6	3.2	5.3	1.6	2.3	2.3
18	.....	.....	3.3	2.1	4.8	3.4	1.6	2.5	3.4	1.6	2.2	2.3
19	.....	3.0	3.8	2.0	4.1	2.7	1.5	2.2	2.8	8.2	2.2	2 3
20	3.15	3.2	5.3	2.0	3.6	2.2	1.6	2.7	3.8	7.4	2.1	2.4
21	.....	3.8	5.5	2.5	3.3	4.4	1.6	2.5	3.7	5.3	2.0	4.0
22	.....	4.4	5.3	5.5	2.9	3.4	1.5	2.1	3.0	4.2	2.0	5.8
23	.....	5.3	4.4	3.8	2.7	3.6	1.5	1.9	2.4	3.2	1.9	5.1
24	.....	5.0	3.9	3.1	2.5	2.8	1.5	1.8	2.1	3.0	1.9	4.4
25	.....	6.4	3.6	2.8	2.4	2.4	1.5	1.8	1.9	2.7	2.2	3.6
26	2.25	7.1	3.3	2.5	3.3	2.2	1.5	1.8	1.8	3.0	2.2	3.3
27	.....	6.9	3.1	2.5	3.8	2.0	1.4	1.7	1.7	2.9	2.1	3.0
28	.....	5.9	2.9	2.4	2.8	1.9	1.4	1.6	1.6	2.6	2.0	3.0
29	.....	.....	2.8	2.4	2.5	1.8	1.4	1.6	1.6	2.4	6.1	3.0
30	.....	.....	2.6	2.9	2.7	1.8	1.7	1.6	1.6	2.3	5.5	3.3
31	.....	.....	2.5	.....	4.1	.....	1.5	1.5	.....	2.2	.....	3.1

NOTE.—River partly frozen January 4–13 and entirely frozen January 15 to March 2, gage being read to top of ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 20	3.15	3.15	0.35
January 27	2.15	2.25	.9
February 10	3.55	3.55	1.4
February 17	2.8	3.0	.....

KANAWHA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Kanawha River, which rises in Watauga, Ashe, and Alleghany counties, N. C., flows northwestward through Virginia and West Virginia and joins Ohio River at Point Pleasant, W. Va. In its upper course it is known as New River. The headwaters lie in the Appalachian Mountains, among the high ridges which form the divides between the drainage basin of this river and Yadkin River on the east and Holston River on the west. The upper tributaries drain narrow valleys of the mountainous region of North Carolina, and their slopes are generally steep and their beds rough. The main river cuts the Allegheny Front just below Pearisburg, Va.; thence the river's course is through a narrow valley of West Virginia over a rough bed with many falls and rapids. The basin is as beautiful and picturesque as any in the eastern part of the United States. The country on its lower courses, through which the Chesapeake and Ohio Railway passes, is noted for its scenic beauty. Below the junction with the Gauley the river is known as the Kanawha.

The principal tributaries of New River are Little River, which empties near Radford, Va., and the Greenbriar, which rises in the eastern part of West Virginia and joins the New at Hinton, W. Va.

NEW RIVER AT RADFORD, VA.

This station was established August 1, 1898, by D. C. Humphreys. It is located at the highway bridge near the Norfolk and Western Railway station.

The channel is straight for several hundred feet above and below the station, and has a width of 580 feet at ordinary stages, broken by five piers. At high water its width is about 1,200 feet. The bottom is of solid rock and gravel, and is smooth and regular. On the left bank there is a steep, rocky bluff. The right bank is low and subject to overflow for about 100 yards, but all the water must pass under the bridge, which is about 85 feet above low water.

Discharge measurements are made from the upstream side of the bridge. The initial point for soundings is on the right bank of the river, 50 feet from the first pier.

The gage used at first was erected by the United States Weather Bureau. It consists of a vertical board graduated to feet and tenths and is attached to the iron framework connecting the pair of iron-concrete cylinders which form the first pier from the right bank. On account of the inaccessibility of the Weather Bureau gage a wire gage was put in place February 23, 1900, the datum being the same as that of the old gage. December 1, 1903, the wire gage was replaced by a standard chain gage. At this time the gage datum was lowered 3.41 feet. The length of the chain is 87.00 feet. The gage is read twice each day by C. L. Gillaspie. The gage is referred to bench marks as follows: (1) The bottom of the lowest horizontal brace connecting the two cylinders; elevation 7.28 feet. (2) The top of the lowest horizontal brace on the west side of the bridge 2.5 feet south of the northwest post of the bent nearest the river on the right bank; elevation, 22.66 feet. (3) The northwest corner of the top of the stone under the seventh post from the right bank; elevation, 18.58 feet. Elevations refer to the datum of the chain gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 27, p 59; 36, pp 161–162; 48, p 178; 65, p 293; 83, pp 190–191; 98, pp 250–251; 128, pp 66–67.
Discharge: 27, p 65; 36, p 162; 48, p 178; 65, p 293; 83, p 191; 98, p 251; 128, p 67.
Discharge, monthly: 75, pp 101–102; 128, p 68.
Gage heights: 27, p 61; 36, p 162; 48, p 178; 65, p 294; 83, p 191; 98, p 251; 128, p 67.
Rating table: 128, p. 68.

Discharge measurements of New River at Radford, Va., 1900–1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.[a]	Discharge.
1900.		*Feet.*	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 27	D. C. Humphreys		2,450	2.82	5.03	6,900
1901.						
August 8	do		3,570	4.77	7.42	17, 30
1904.						
June 18	F. H. Brundage	566	1,965	1.83	4.07	3,610
September 16	R. H. Bolster	556	1,520	1.08	3.40	1,635
September 29	do	556	1,432	.86	3.24	1,240
October 18	do	554	1,378	.73	3.14	1,005
1905.						
March 18	A. H. Horton	560	1,910	1.76	3.98	3,353
September 11	R. H. Bolster	566	1,810	1.44	3.88	2,615

[a] All gage heights refer to datum established December 1, 1903.

NOTE.—The five circular piers at this station are a few feet below the measuring section for low-water measurements, but are included in the measuring section for high-water measurements, owing to the fact that the meter is carried downstream by the swiftness of the current. The measurements for 1904 and 1905 as given above have been computed for one unbroken channel. Measurements June 27, 1900, and August 8, 1901, have been recomputed for a channel broken by five piers.

Daily gage height, in feet, of New River at Radford, Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	3.4	4.5	3.7	3.5	3.8	3.3	3.9	3.6	3.5	3.5	3.2
2	3.5	3.4	4.9	3.6	3.5	3.7	3.2	3.1	3.7	3.5	3.5	3.2
3	3.5	3.8	4.9	3.7	3.4	3.6	3.7	3.1	5.0	3.5	3.5	3.5
4	3.5	3.7	4.7	3.7	3.5	3.6	3.7	3.8	4.9	3.5	3.5	5.7
5	3.0	3.7	4.8	3.6	3.5	3.3	3.5	3.5	5.2	3.4	3.4	4.8
6	3.2	4.1	4.9	4.1	3.8	3.2	5.5	3.5	4.5	3.4	3.4	4.0
7	3.5	3.8	4.6	4.6	3.9	3.2	5.0	4.6	4.4	3.3	3.4	3.8
8	3.6	3.7	4.6	4.2	3.9	3.1	4.1	5.3	4.3	3.3	3.4	3.8
9	3.5	4.0	4.7	4.1	3.8	3.2	4.0	5.2	4.0	3.3	3.4	3.7
10	3.5	3.8	5.5	4.0	3.7	3.2	3.8	5.2	3.9	3.3	3.4	3.8
11	3.6	4.0	5.8	3.8	4.6	3.1	3.5	5.9	3.8	3.3	3.5	4.1
12	3.9	3.8	5.2	3.9	6.0	3.2	6.45	6.0	3.9	3.3	3.5	4.1
13	5.2	3.8	4.7	4.2	8.1	3.2	21.6	6.1	3.8	3.3	3.5	4.1
14	5.7	4.5	4.6	4.1	7.1	3.1	10.6	5.8	3.7	3.3	3.5	3.8
15	4.4	4.8	4.4	4.3	8.2	3.2	7.2	5.3	3.8	3.7	3.5	3.8
16	4.2	4.4	4.2	4.1	8.8	3.2	6.7	5.3	3.7	3.7	3.4	3.8
17	3.8	3.9	4.0	4.0	7.4	3.3	4.8	4.8	3.6	3.5	3.4	3.8
18	3.8	3.9	4.0	3.8	6.6	3.5	4.7	4.4	3.7	3.4	3.3	3.9
19	3.7	3.7	3.8	3.6	5.0	3.5	4.6	4.4	3.6	3.4	3.3	4.0
20	4.0	3.9	3.9	3.7	4.8	3.5	4.5	4.4	3.5	3.4	3.3	4.0
21	3.8	4.2	3.8	3.7	4.2	3.5	4.4	4.2	3.5	3.4	3.3	5.6
22	4.0	4.5	3.9	3.6	4.0	3.5	4.4	3.8	3.4	3.4	3.3	6.2
23	3.7	7.8	3.8	3.6	4.0	3.3	5.3	3.8	3.4	3.4	3.3	6.1
24	3.7	5.3	3.8	3.6	3.7	3.7	5.0	3.8	3.4	3.4	3.3	5.7
25	3.6	5.2	3.7	3.5	3.8	3.7	4.7	3.6	3.4	3.4	3.3	4.9
26	3.5	5.2	3.8	3.6	3.8	3.4	4.4	4.1	3.4	3.5	3.3	4.4
27	3.4	5.4	3.7	3.4	3.9	3.4	4.0	3.8	3.4	3.7	3.3	4.2
28	3.5	4.8	3.8	3.5	4.1	3.4	4.0	3.7	3.4	3.8	3.3	4.0
29	3.4	.....	3.6	3.5	4.0	3.3	4.9	3.7	3.4	3.8	3.3	4.0
30	3.9	.....	3.7	3.4	3.7	3.3	4.8	3.7	3.4	3.6	3.3	3.9
31	3.5	.....	3.6	.....	4.0	.....	4.1	3.7	.....	3.6	.....	3.9

NOTE.—January 5 and 6, water thrown from gage by ice; January 26–29, gage read to surface of ice.

Station rating table for New River at Radford, Va., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	700	4.40	4,550	5.80	9,950	7.40	16,950
3.10	920	4.50	4,900	5.90	10,360	7.60	17,900
3.20	1,150	4.60	5,260	6.00	10,770	7.80	18,890
3.30	1,390	4.70	5,630	6.10	11,190	8.00	19,920
3.40	1,640	4.80	6,000	6.20	11,610	8.20	20,990
3.50	1,900	4.90	6,380	6.30	12,040	8.40	22,100
3.60	2,160	5.00	6,770	6.40	12,470	8.60	23,250
3.70	2,430	5.10	7,160	6.50	12,900	8.80	24,440
3.80	2,710	5.20	7,550	6.60	13,340	9.00	25,650
3.90	3,000	5.30	7,940	6.70	13,780	9.20	26,870
4.00	3,290	5.40	8,340	6.80	14,230	9.40	28,100
4.10	3,590	5.50	8,740	6.90	14,680	9.60	29,340
4.20	3,900	5.60	9,140	7.00	15,130	9.80	30,580
4.30	4,220	5.70	9,540	7.20	16,030	10.00	31,820

NOTE.—The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made June 27, 1900, August 8, 1901, and in 1904–5. It is well defined between gage heights 3 feet and 7.5 feet. The table has been extended beyond these limits. Above gage height 7.5 feet the rating table is based on the extension of the area and velocity curves and is only approximate.

Estimated monthly discharge of New River at Radford, Va., for 1905.

[Drainage area, 2,725 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January[a]	9,540	1,640	2,777	1.02	1.18
February	18,890	1,640	4,509	1.65	1.72
March	9,950	2,160	4,435	1.63	1.88
April	5,260	1,640	2,763	1.01	1.13
May	24,440	1,640	6,344	2.33	2.69
June	2,710	920	1,588	.583	.650
July	123,800	1,150	10,210	3.75	4.32
August	11,190	920	4,766	1.75	2.02
September	7,550	1,640	2,885	1.06	1.18
October	2,710	1,390	1,805	.662	.763
November	1,900	1,390	1,610	.591	.659
December	11,610	1,150	4,312	1.58	1.82
The year	123,800	920	4,000	1.47	20.01

[a] Ice conditions January 5 and 6; estimates corrected. Ice January 26–29; estimates not corrected.

GREENBRIER RIVER AT ALDERSON, W. VA.

Greenbrier River rises on the western slope of the Allegheny Mountains, in Pocahontas County, W. Va., and flows in a southwesterly direction, emptying into New River near Hinton, Summers County, W. Va. It receives many short tributaries from the Allegheny Range, and flows for the most part through a broken, hilly, and mountainous country well covered with forests.

A gaging station was established August 1, 1895, by C. C. Babb. It is located at the highway bridge one-half mile above the mouth of Muddy Creek, in the village of Alderson, W. Va., 21 miles above Hinton.

The channel, which is straight for 500 feet above and below the station, is broken at the bridge by three piers. At low stages the water flows in two channels, between which is an island 600 feet long and 75 feet wide. The banks are high and not subject to overflow. The bed is of rock and gravel and is constant.

Discharge measurements are made from the bridge. The initial point for soundings is the center of the pin on the downstream side of the bridge, on the left bank.

The wire gage which was originally installed was located in the third panel of the second span, downstream side of the bridge. November 20, 1903, a standard chain gage was installed in the same position and at the same datum as the wire gage. The length of the chain is 27.81 feet. The gage is referred to bench marks as follows: (1) On the upper end of the coping of the first pier from the left bank; elevation, 21.74 feet. (2) On the upper end of the bridge seat of the left abutment; elevation, 21.61 feet. (3) The top of the water table at the northwest corner of the Merchants' Grocery Company building; elevation, 26.48 feet. (4) On the lower end of the third floor beam, in the second span from the left bank; elevation, 22.75 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, p 111; Bull 140, pp 77–78; WS 15, p 58; 27, p 59; 36, p 163; 48, p 178; 65, p 290; 83, p 188; 98, pp 248–249; 128, pp 70–71.

Discharge: Ann 18, iv, p 111; Bull 140, p 78; WS 15, p 58; 27, p 65; 36, p 163; 48, pp 178–179; 65, p 290; 83, p 188; 98, p 249; 128, p 71.

Discharge, monthly: Ann 18, iv, p 113; 19, iv, p 254; 20, iv, pp 202, 204; 21, iv, p 159; 22, iv, p 221; WS 75, p 100; 83, p 190; 128, p 73.

Discharge, yearly: Ann 20, iv, p 51.

Gage heights: Bull 140, p 78; WS 11, p 41; 15, p 58; 27, p 61; 36, p 164; 48, p 179; 65, p 291; 83, p 189; 98, pp 249–250; 128, p 72.

Hydrographs: Ann 19, iv. p 254; 20, iv, p 204; 21, iv, p 159; 22, iv, p 221.

Rainfall and run-off relation: Ann 20. iv, p 202.

Rating tables: Ann 18, iv, p 112; 19, iv, p 253; WS 39, p 445; 52, p 515; 65, p 323; 83, p 189; 128, p 72.

Discharge measurements of Greenbrier River at Alderson, W. Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 22	A. H. Horton	416	2,855	5.78	7.90	16,480
March 22	do	416	2,563	5.33	7.17	13,660
March 23	do	416	1,732	4.18	5.24	7,242
March 23	do	416	1,939	4.56	5.69	8,842
September 15	R. H. Bolster	326	367	.95	2.01	350

Daily gage height, in feet, of Greenbrier River at Alderson, W. Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.2	2.4	2.6	3.1	3.0	2.6	2.25	2.35	2.0	1.6	2.1	2.3
2	2.25	2.4	3.2	2.95	2.9	2.5	3.0	2.25	2.1	1.5	1.95	2.4
3	2.35	2.4	3.35	2.9	2.8	2.4	2.85	2.2	2.2	1.7	1.95	4.2
4	2.2	2.4	3.4	2.8	2.7	2.3	2.65	2.1	2.55	1.6	1.9	6.5
5	2.4	2.3	4.2	2.7	2.6	2.2	3.3	2.2	2.4	1.6	1.9	4.5
6	2.2	2.2	4.2	3.3	2.5	2.2	3.0	2.3	2.25	1.6	1.9	3.6
7	2.1	2.1	4.4	3.8	2.9	2.1	2.8	2.4	2.15	1.6	1.9	3.15
8	2.25	1.9	5.4	3.65	3.2	2.1	2.9	2.4	2.0	1.6	1.9	2.95
9	2.35	2.0	7.9	3.5	3.15	2.0	2.65	2.25	1.95	1.6	2.0	2.75
10	2.0	2.0	10.5	3.3	2.9	2.0	2.5	2.15	1.9	1.6	2.05	2.65
11	2.15	1.9	8.6	3.2	2.85	2.0	2.4	2.5	1.9	1.7	2.0	2.5
12	2.75	2.0	6.4	3.2	11.2	2.0	2.3	2.6	1.9	1.8	1.95	2.45
13	4.5	2.2	5.5	3.1	9.3	2.0	5.5	2.5	2.1	2.0	1.9	2.4
14	4.55	2.35	4.85	3.0	6.3	1.95	7.0	2.4	2.0	1.9	1.9	2.3
15	3.7	2.5	4.75	2.9	5.4	1.95	5.5	2.45	2.0	2.05	1.8	2.4
16	3.3	2.6	4.7	2.8	5.1	2.05	4.1	2.55	1.95	1.9	1.8	2.3
17	3.1	2.45	4.65	2.75	4.75	2.0	3.3	2.65	1.9	1.8	1.8	2.25
18	2.8	2.3	5.0	2.65	4.4	1.9	3.0	2.6	1.85	1.8	1.8	2.25
19	2.5	2.3	5.0	2.6	3.9	1.9	2.75	2.5	1.8	1.75	1.85	2.2
20	2.5	2.2	5.45	2.5	3.5	1.9	2.55	2.35	1.8	1.7	1.9	2.4
21	2.5	2.1	6.2	2.5	3.15	1.9	2.5	2.25	1.75	1.7	2.1	2.6
22	2.5	2.1	7.55	2.55	2.95	2.8	2.35	2.2	1.7	1.7	2.3	6.0
23	2.45	2.5	5.8	2.65	2.85	3.1	3.8	2.1	1.7	1.7	2.25	4.8
24	2.4	2.5	4.6	2.6	2.7	3.15	5.0	2.05	1.7	1.7	2.2	4.2
25	2.4	2.7	4.1	2.5	2.6	4.7	3.85	2.0	1.7	1.75	2.15	3.8
26	2.4	2.9	4.0	2.5	2.5	3.8	3.25	2.1	1.6	1.9	2.1	3.55
27	2.4	2.9	3.8	2.5	2.5	3.5	2.9	2.0	1.7	2.4	2.1	3.2
28	2.4	2.85	3.6	2.6	2.45	3.15	2.65	2.3	1.65	2.95	2.05	3.0
29	2.4	.....	3.4	3.2	2.4	2.8	2.6	2.2	1.6	2.45	2.05	2.9
30	2.4	.....	3.3	3.1	2.5	2.5	2.45	2.15	1.6	2.3	2.2	2.9
31	2.4	.....	3.2	.....	2.5	.....	2.45	2.1	.....	2.3	.....	2.9

Station rating table for Greenbrier River at Alderson, W. Va., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.40	43	3.20	2,261	4.90	6,403	6.60	11,725
1.50	69	3.30	2,468	5.00	6,680	6.70	12,075
1.60	103	3.40	2,680	5.10	6,960	6.80	12,425
1.70	146	3.50	2,897	5.20	7,243	6.90	12,780
1.80	199	3.60	3,119	5.30	7,529	7.00	13,140
1.90	263	3.70	3,346	5.40	7,818	7.20	13,860
2.00	340	3.80	3,579	5.50	8,112	7.40	14,600
2.10	431	3.90	3,818	5.60	8,412	7.60	15,350
2.20	537	4.00	4,062	5.70	8,718	7.80	16,120
2.30	659	4.10	4,310	5.80	9,031	8.00	16,910
2.40	798	4.20	4,561	5.90	9,350	8.20	17,710
2.50	954	4.30	4,815	6.00	9,675	8.40	18,510
2.60	1,124	4.40	5,072	6.10	10,005	8.60	19,330
2.70	1,301	4.50	5,332	6.20	10,340	8.80	20,170
2.80	1,483	4.60	5,595	6.30	10,680	9.00	21,030
2.90	1,670	4.70	5,861	6.40	11,025	9.50	23,250
3.00	1,862	4.80	6,130	6.50	11,375	10.00	25,560
3.10	2,059						

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1903–1905 between gage heights 1.4 feet and 8 feet. It is well defined between these limits.

Estimated monthly discharge of Greenbrier River at Alderson, W. Va., for 1905.

[Drainage area, 1,344 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	5,464	340	1,256	0.935	1.08
February	1,670	263	765	.569	.592
March	27,940	1,124	7,140	5.31	6.12
April	3,579	954	1,728	1.29	1.44
May	31,440	798	4,135	3.08	3.55
June	5,861	263	1,073	.798	.890
July	13,140	598	2,598	1.93	2.22
August	1,212	340	681	.507	.584
September	1,039	103	310	.231	.258
October	1,766	69	294	.219	.252
November	659	199	347	.258	.288
December	11,380	537	2,479	1.84	2.12
The year	31,440	69	1,900	1.41	19.39

SCIOTO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Scioto River rises in the eastern part of Auglaize County, Ohio, flows eastward for about 40 miles and then almost due south, entering the Ohio at Portsmouth. Below Columbus, where it is joined by the Olentangy, it is one of the largest and most important

streams in the State. The United States Geological Survey maintains stations on both Scioto and Olentangy rivers at Columbus for the purpose of studying the water supply and sewage disposal of that city. The river has considerable fall and flows through a hilly basin, forming numerous good locations for water-power developments.

SCIOTO RIVER NEAR COLUMBUS, OHIO.

This station was originally established for the Ohio State board of health on the Grand View Avenue Bridge, 3 miles northwest of Columbus post-office, and was reestablished on the same bridge for the United States Geological Survey on November 21, 1903.

The main channel is straight for 100 feet above and 200 feet below the station, and there is a small island above, which causes a side channel to enter the main channel at this point. The banks are high and overflow only in extreme floods. The bed of the stream is of clay and coarse gravel, and fairly permanent. At low water the current is sluggish.

The bridge from which the discharge measurements are made is a two-span iron highway bridge, 250 feet between abutments. The initial point for soundings is the face of the east abutment on the downstream side, and the bridge is marked every 10 feet with double nails. At low water this river can be waded with good results below the bridge.

The gage of the United States Geological Survey has its zero at the same elevation as the gage which was established for the Ohio State board of health. It is a standard chain gage, with a length of 30.40 feet from the end of the weight to the end of the last copper link, which is used as the marker. This gage was read during 1905 by O. M. Fisher. Bench marks were established as follows: (1) The upper side of the upper angle iron forming the lowest part of the hand rail above a point 1 foot east of the pulley; elevation 34.02 feet. (2) The extreme northeast corner of the north stone of the parapet wall of the east abutment; elevation, 34.32 feet. (3) A nail in a telegraph pole 10 feet east of the east abutment at the north side; elevation, 34.95 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey. (Ann=Annual Report; WS=Water-Supply Paper.)

Description: Ann 21, iv, p 169; WS 27, p 60; 36, p 176; 49, p 219; 65, p 295; 98, p 233; 128, p 74.
Discharge: WS 36, p 177; 49, p 219; 98, p 233; 128, p 75.
Discharge, flood: Ann 20, iv, p 214.
Discharge, low-water: Ann 20, iv, p 214.
Discharge, monthly: Ann 20, iv, p 213; 21, iv, p 170; 22, iv, p 237; 128, p 76.
Gage heights: WS 27, p 65; 36, p 177; 49, p 220; 65, p 296; 98, p 234; 128, p 75.
Hydrograph: Ann 22, iv, p 237.
Rating tables: WS 39, p 446; 52, p 515; 128, p 76.

Discharge measurements of Scioto River near Columbus, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 2	R. W. Pratt	206	442	0.65	9.95	287
February 25	do	231	1,038	1.74	12.65	1,808
May 12	do	247	2,370	4.04	18.48	9,576
May 21	M. S. Brennan	215	752	1.77	11.58	1,332
June 18	S. K. Clapp	212	592	1.08	10.65	637
July 10	do	202	376	.85	9.92	320
August 30	R. W. Pratt	173	312	.32	9.43	101
October 14	do	205	380	.53	9.82	200
November 20[a]	do	26	13	1.15	8.99	15

[a] Made at different section.

Daily gage height, in feet, of Scioto River near Columbus, Ohio, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10.15	.....	15.5	9.95	12.2	10.7	9.56	9.1	9.3	11.3	10.25	11.7
2	9.95	9.5	15.1	9.8	11.7	10.5	9.5	9.91	9.4	13.2	10.1	11.3
3	9.96	.....	14.2	9.7	11.2	10.1	9.5	10.02	9.62	12.2	9.9	12.8
4	9.7	.....	13.9	9.7	10.75	10.0	9.6	9.86	9.33	11.8	9.15	12.2
5	9.65	.....	11.9	9.7	10.4	12.3	9.6	9.7	9.4	11.3	9.15	11.4
6	9.6	.....	11.4	9.68	10.22	14.6	10.1	9.8	9.3	10.9	11.9	11.2
7	9.5	.....	11.4	9.65	10.2	14.3	9.94	9.34	9.28	10.7	11.7	11.1
8	.....	.....	14.2	9.55	10.2	13.6	10.0	9.28	9.15	10.3	11.6	11.1
9	.....	.....	14.4	9.54	10.15	12.6	10.5	9.2	9.2	10.15	11.5	10.65
10	.....	.....	13.2	9.5	11.1	11.35	10.3	9.29	9.15	10.05	11.0	10.6
11	.....	9.75	12.7	10.7	11.5	11.3	10.2	9.46	9.36	9.97	10.6	10.55
12	9.3	.....	12.2	10.7	19.3	10.85	9.9	11.7	12.5	9.7	10.35	10.5
13	.....	.....	11.5	10.5	18.3	10.65	9.7	12.3	12.1	9.73	10.25	10.5
14	.....	.....	11.2	10.3	16.6	10.5	9.5	10.95	11.7	9.7	10.15	10.45
15	.....	9.8	10.9	10.2	15.5	10.3	9.4	15.2	11.15	9.8	10.1	10.4
16	.....	.....	10.8	10.0	14.0	10.1	9.96	13.9	15.0	9.73	10.05	10.4
17	.....	9.7	10.75	9.7	13.2	10.3	9.62	11.7	14.9	9.7	10.3	10.4
18	.....	.....	11.7	9.63	13.0	10.55	9.6	10.8	12.6	9.7	9.4	10.15
19	10.06	.....	11.15	9.6	12.6	11.2	9.47	10.7	12.7	10.1	9.3	10.0
20	.....	.....	11.75	9.6	12.0	12.8	9.32	11.9	13.3	11.5	8.95	9.7
21	.....	11.5	11.55	11.45	11.45	12.5	9.25	11.3	13.1	10.8	8.9	9.8
22	.....	11.3	11.4	13.3	11.0	12.3	9.26	10.7	12.1	10.5	8.9	10.3
23	.....	12.3	11.15	12.7	10.7	11.6	9.55	10.6	11.9	10.3	8.9	13.2
24	.....	11.35	10.9	12.3	10.4	11.1	9.48	10.4	11.35	10.25	8.8	12.9
25	.....	12.2	10.7	11.7	10.25	11.0	9.36	10.1	10.8	10.2	8.95	12.9
26	.....	13.0	10.5	11.2	12.5	10.47	9.31	9.83	10.7	10.15	8.9	11.45
27	9.7	14.3	10.4	10.95	11.0	10.1	9.23	9.75	10.4	10.0	8.9	10.75
28	.....	14.5	10.3	10.7	10.5	9.91	9.2	9.69	10.15	9.99	8.85	10.0
29	.....	.....	10.2	11.7	10.2	9.74	9.16	9.6	10.0	9.85	8.9	10.7
30	.....	.....	10.1	12.9	10.7	9.63	9.1	9.43	9.9	9.82	9.8	10.15
31	.....	.....	10.0	.....	10.7	.....	9.11	9.43	.....	9.85	.....	10.75

NOTE.—River frozen over January 8 to February 20, approximately. Gage heights are to water surface in hole in ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 12	9.3	9.3	0.25
January 19	10.06	10.1	.3
January 27	9.7	9.75	.4
February 2	9.5	9.65	.4
February 11	9.75	9.9	1.1
February 15	9.8	9.95	1.3
February 18	9.7	9.85	1.3

Station rating table for Scioto River near Columbus, Ohio from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
8.90	12	11.00	830	13.00	2,510	17.00	7,640
9.00	27	11.10	895	13.20	2,715	17.20	7,950
9.10	43	11.20	965	13.40	2,925	17.40	8,260
9.20	61	11.30	1,035	13.60	3,145	17.60	8,570
9.30	81	11.40	1,110	13.80	3,365	17.80	8,880
9.40	103	11.50	1,185	14.00	3,395	18.00	9,200
9.50	128	11.60	1,260	14.20	3,825	18.20	9,520
9 60	156	11.70	1,340	14.40	4,065	18.40	9,840
9.70	186	11.80	1,420	14.60	4,305	18.60	10,170
9.80	218	11.90	1,500	14.80	4,555	18.80	10,510
9.90	253	12.00	1,585	15.00	4,805	19.00	10,850
10.00	291	12.10	1,670	15.20	5,065	19.50	11,700
10.10	332	12.20	1,755	15.40	5,330	20.00	12,600
10.20	376	12.30	1,845	15.60	5,600	20.50	13,500
10.30	424	12.40	1,935	15.80	5,880	21.00	14,450
10.40	475	12.50	2,025	16.00	6,160	21.50	15,410
10.50	530	12.60	2,120	16.20	6,450	22.00	16,410
10.60	585	12.70	2,215	16.40	6,740	22.50	17,440
10.70	645	12.80	2,310	16.60	7,040	23.00	18,400
10.80	705	12.90	2,410	16.80	7,340	24.00	20,680
10.90	765						

NOTE.—The above table is applicable only for open channel conditions. It is based on 17 discharge measurements made during 1904–5. It is well defined between gage heights 9 feet and 12 feet. The table has been extended above 12 feet, being based on four measurements from 18 to 23 feet gage height

Estimated monthly discharge of Scioto River near Columbus, Ohio, for 1904–5.

[Drainage area, 1,051 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
March	19,470	1,072	5,334	5.08	5.86
April	21,340	272	3,392	3.23	3.60
May	1,628	186	412	.392	.452
June	675	116	287	.273	.305
July	8,570	79	1,528	1.45	1.67
August	142	7	47.9	.046	.053
September	47	15	27.8	.026	.029
October	123	1	41.7	.040	.046
November	85	12	46.0	.044	.049
December	895	27	130	.124	.143
1905.					
January 1–7	354	128	220	.209	.054
February 21–28	4,185	1,035	2,192	2.09	.622
March	5,465	291	1,647	1.57	1.81
April	2,820	128	697	.663	.740
May	11,360	354	2,045	1.95	2.25
June	4,305	165	1,149	1.09	1.22
July	530	43	170	.162	.187
August	5,065	43	724	.689	.794
September	4,805	52	1,104	1.05	1.17
October	2,715	186	570	.542	.625
November	1,500	0	353	.336	.375
December	2,715	186	898	.854	.985

NOTE.—The estimates for 1904 are a revision of those published in the 1904 report, being based on additional data.
No estimate for frozen period.

OLENTANGY RIVER NEAR COLUMBUS, OHIO.

This station was established October 7, 1903, in connection with the water-supply and sewage-disposal investigations of the city of Columbus, Ohio. It is located 4 miles north of the Columbus post-office and one-fourth mile west of North High street, at the Dodridge street bridge.

The channel is straight for 300 feet above and 500 feet below the station. Both banks are high and overflow only at high stages. The bed of the stream is composed of sand and clay. The current is sluggish.

Discharge measurements are made from the two-span highway bridge 200 feet long and by wading below the bridge. The initial point for soundings is the east face of the west parapet wall.

A standard chain gage is bolted to the hand rail of the bridge on the upstream side; length of the chain from the end of the weight to the marker, 36.15 feet. The gage was read during 1905 by A. D. Winegardner. The gage is referred to bench marks as follows: (1) The northwest corner of the topstone of the north wing of the west abutment; elevation, 34.99 feet. (2) A cut in the top of the hand rail over the gage 31 feet from the initial point for soundings; elevation, 39.89 feet. (3) The center pin of the west end of the north truss; elevation, 38.60 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 27, p 60; 36, p 175; 49, p 218; 65, p 295; 98, pp 234-235; 128, p 77.
Discharge: WS 27, p 65; 36, p 175; 49, pp 218-219; 98, p 235; 128, p 77.
Discharge, low water: Ann 20, iv, p 215.
Discharge, monthly: Ann 20, iv, p 216; 21, iv, p 169; 22, iv, p 238; 128, p 79.
Gage heights: WS 27, p 65; 36, p 176; 49, p 219; 65, p 295; 98, p 235; 128, p 78.
Hydrograph: Ann 22, iv, p 238.
Rainfall and run-off relation: Ann 20, iv, p 216.
Rating tables: WS 39, p 446; 52, p 515; 128, pp 78-79.

Discharge measurements of Olentangy River near Columbus, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 2	R. W. Pratt	140	571	0.30	7.15	169
May 13	do	170	1,308	2.88	11.98	3,865
May 20	M. S. Brennan	150	699	1.18	8.24	823
June 19	S. K. Clapp	150	763	1.25	8.50	951
August 23	R. W. Pratt	138	561	.43	7.32	244
October 26	do	138	527	.35	7.10	180
November 7	do	141	676	1.04	8.10	704

Daily gage height, in feet, of Olentangy River near Columbus, Ohio, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.2	.....	9.2	7.0	7.6	8.8	6.7	6.6	6.7	6.8	7.1	8.7
2	7.2	.....	8.6	6.9	7.2	7.7	6.8	7.0	6.7	7.5	7.1	8.7
3	7.0	.....	8.4	6.9	7.2	7.4	6.7	6.8	6.8	7.9	7.1	8.9
4	6.9	.....	8.2	6.9	7.2	7.2	6.7	6.7	6.8	7.4	7.0	8.7
5	6.9	6.4	7.8	6.9	7.0	9.1	8.2	6.6	6.8	7.2	6.9	8.7
6	6.9	.....	7.9	6.9	7.0	9.5	7.9	6.6	6.6	7.1	8.2	7.3
7	6.9	.....	8.0	6.9	7.0	8.1	7.3	6.6	6.6	6.9	8.1	7.3
8	6.8	.....	11.0	6.8	7.0	7.9	7.0	6.6	6.6	6.8	7.9	7.2
9	.....	.....	10.7	6.8	7.0	7.5	7.2	6.55	6.6	6.7	7.6	7.1
10	.....	.....	8.9	6.8	6.9	7.3	7.0	6.6	6.6	6.3	7.5	7.0
11	.....	.....	8.0	7.9	8.2	.....	7.1	6.5	8.1	6.7	7.2	7.0
12	6.9	6.8	8.2	7.5	14.6	.....	6.9	8.5	10.0	6.7	7.1	7.0
13	7.2	6.9	7.8	7.5	13.6	.....	6.8	8.6	8.5	6.8	7.0	6.9
14	8.2	.....	7.6	7.2	12.5	.....	6.8	7.6	7.8	6.8	7.0	6.9
15	7.6	.....	7.5	7.1	10.9	7.1	6.8	11.3	7.4	6.8	6.9	6.8
16	7.4	.....	7.4	6.9	9.7	7.1	7.0	10.6	10.6	6.8	6.9	6.9
17	7.3	6.8	7.6	6.9	9.6	8.6	6.8	10.6	11.0	6.8	6.9	6.9
18	.....	.....	7.9	6.9	9.0	8.6	6.7	10.2	10.4	6.7	6.9	6.9
19	.....	.....	8.3	6.9	8.8	8.0	6.7	8.9	9.6	6.9	6.9	6.9
20	.....	.....	10.0	6.9	8.4	7.4	6.6	9.0	10.4	8.2	6.9	6.8
21	7.2	7.0	9.7	9.6	7.9	7.7	6.6	8.4	9.1	8.0	6.9	8.4
22	6.9	7.75	8.8	10.0	7.6	10.5	6.6	7.7	8.6	7.5	6.9	9.6
23	6.8	7.8	8.2	9.1	7.4	9.0	6.6	7.3	7.4	7.2	6.8	9.7
24	6.8	7.6	7.9	8.1	7.2	8.1	6.6	7.1	7.4	7.1	6.8	8.8
25	6.8	8.4	7.6	7.6	7.1	7.6	6.6	7.0	7.3	7.1	6.9	7.8
26	.....	9.0	7.5	7.5	9.4	7.3	6.6	7.0	7.1	7.0	6.9	7.6
27	.....	9.35	7.4	7.6	10.2	7.0	6.6	6.9	7.0	7.0	6.9	7.4
28	.....	9.6	7.3	7.3	8.8	6.9	6.6	6.9	7.0	6.9	6.9	7.3
29	.....	.....	7.2	7.9	7.9	6.8	6.6	6.7	6.9	6.9	7.7	7.2
30	6.4	.....	7.1	8.0	8.1	6.8	6.6	6.7	6.9	6.9	8.1	7.8
31	.....	.....	7.0	.....	9.2	.....	6.6	6.7	.....	6.8	.....	8.0

NOTE.—Ice conditions January 1 to March 7 approximately.

Station rating table for Olentangy River near Columbus, Ohio, from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.30	1	8.00	600	9.70	1,790	11.80	3,740
6.40	3	8.10	660	9.80	1,870	12.00	3,950
6.50	5	8.20	720	9.90	1,950	12.20	4,170
6.60	13	8.30	780	10.00	2,030	12.40	4,390
6.70	28	8.40	840	10.10	2,120	12.60	4,620
6.80	53	8.50	910	10.20	2,210	12.80	4,860
6.90	83	8.60	980	10.30	2,300	13.00	5,100
7.00	115	8.70	1,050	10.40	2,390	13.20	5,340
7.10	152	8.80	1,120	10.50	2,480	13.40	5,580
7.20	192	8.90	1,190	10.60	2,570	13.60	5,820
7.30	235	9.00	1,260	10.70	2,660	13.80	6,060
7.40	280	9.10	1,330	10.80	2,750	14.00	6,300
7.50	327	9.20	1,400	10.90	2,840	14.20	6,560
7.60	375	9.30	1,470	11.00	2,940	14.40	6,820
7.70	425	9.40	1,550	11.20	3,140	14.60	7,080
7.80	480	9.50	1,630	11.40	3,340	14.80	7,340
7.90	540	9.60	1,710	11.60	3,540	15.00	7,600

NOTE.—The above table is applicable only for open-channel conditions. It is based on 22 discharge measurements made during 1904–5. It is well defined between gage heights 6.5 feet and 8 feet. The table has been extended above 8 feet, being based on one measurement at 19.4 feet. Above 7.7 feet the table is the same as for 1904.

Estimated monthly discharge of Olentangy River near Columbus, Ohio, for 1905.

[Drainage area, 520 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 8–31	2,940	115	798	1.53	1.36
April	2,030	53	364	.700	.781
May	7,080	83	1,236	2.38	2.74
June 1–10, 15–30	2,480	53	601	1.16	1.12
July	720	13	91.2	.175	.202
August	3,240	5	572	1.10	1.27
September	2,940	13	675	1.30	1.45
October	720	1	155	.298	.344
November	720	53	201	.387	.432
December	1,790	53	492	.946	1.09

NOTE.—No estimate for frozen period.

LITTLE MIAMI RIVER BASIN.

DESCRIPTION OF BASIN.

Little Miami River rises in the southeastern part of Clark County, flows southwest through Greene and Warren counties, and enters Ohio River just above Cincinnati. The greater part of the drainage area lies to the east, as there is only a narrow piece of country between this and Miami River. The Little Miami is the best power river in the State of Ohio.

MAD RIVER NEAR SPRINGFIELD, OHIO.

This station was established December 31, 1903. It is located at the highway bridge 4 miles west of Springfield, Ohio, about 500 feet below the old Red Mill dam. The drainage area of Mad River at this station is 290 square miles.

The channel is practically straight for 1,000 feet above and below the station, there being a slight curve just above. The right bank is high, clean, and seldom overflows. The left bank is rather low and is subject to overflow. The bed of the stream is composed of a mixture of clay and gravel and is fairly permanent. The current is swift.

Discharge measurements are made from the downstream side of the single-span bridge to which the gage is fastened. The bridge has a length between abutments of 128 feet. The initial point for soundings is a cut in the guard timber directly over the face of the south abutment, downstream side.

A standard chain gage is spiked to the bridge; length of the chain, from the end of the weight to the marker, 16.05 feet. The gage was read during 1905 by Charles W. Smith and Samuel Taylor. The gage is referred to bench marks as follows: (1) On the extreme west corner of the second step-stone on the upstream side of the north side of the bridge; elevation, 15.88 feet. (2) The inside surface of the bottom of the gage box; elevation, 19.67 feet. (3) A nail in the top of the lower chord 87 feet from the initial point; elevation, 18.69 feet. Elevations refer to datum of the gage.

Description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 80–81.

Discharge measurements of Mad River near Springfield, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 12[a]	R. W. Pratt	165	926	0.57	6.63	527
February 27[a]	do	125	935	.80	6.97	750
March 23[a]	do	108	830	.39	6.13	326
May 20	M. S. Brennan	117	430	1.90	6.64	818
June 18	Sidney K. Clapp	113	350	.97	6.00	341
July 11	do	111	330	.85	5.92	279
August 24[a]	R. W. Pratt	103	099	.34	5.86	234
August 24	do	111	321	.81	5.87	259
October 11[a]	do	105	744	.47	6.18	351
November 11[a]	do	105	702	.43	6.15	300

[a] Made at different sections.

Daily gage height, in feet, of Mad River near Springfield, Ohio, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	5.8	5.7	7.75	5.95	6.3	6.6	6.1	5.7	5.7
2	5.75	5.75	7.8	5.9	6.1	6.3	6.1	5.7	7.3
3	5.75	5.8	6.74	5.9	6.1	6.1	6.1	5.7	6.2
4	5.8	5.75	6.5	5.8	6.3	6.0	6.4	5.7	6.0
5	5.8	.....	6.2	5.8	6.2	11.6	6.1	5.6	5.8
6	5.85	.....	6.25	5.8	6.1	9.9	6.0	5.7	5.8
7	5.8	.....	6.5	5.8	6.1	8.7	6.1	5.7	5.8
8	5.6	.....	8.6	5.9	6.05	7.1	6.1	5.7	5.8
9	5.65	.....	7.4	5.8	6.0	6.8	6.0	5.7	5.7
10	5.65	.....	6.9	5.75	5.9	6.4	6.0	5.6	6.0
11	5.5	5.75	6.6	7.6	6.5	6.4	5.9	5.8	6.6
12	6.5	.....	6.4	6.5	6.8	6.3	6.3	6.2	6.3
13	6.3	.....	6.3	6.5	10.9	6.2	6.0	6.0	6.0
14	6.1	.....	6.25	6.35	8.9	6.1	6.0	6.1	5.9
15	6.5	.....	6.25	6.15	8.6	6.1	5.9	6.7	5.8
16	6.5	.....	6.2	6.1	8.9	6.2	5.9	6.9	9.3
17	6.2	.....	6.2	6.0	7.6	6.1	5.8	6.2	7.4
18	5.8	5.8	6.15	5.9	7.2	6.0	5.8	6.4	7.0
19	5.8	7.5	6.3	6.0	7.0	6.0	5.8	6.9	7.8
20	5.8	.....	6.45	6.7	6.7	6.2	5.9	6.9	7.5
21	5.75	.....	6.3	6.9	6.5	6.9	5.8	6.2	6.7
22	5.75	6.35	6.25	6.9	6.2	6.5	5.8	6.0	6.4
23	5.75	6.35	6.2	6.7	6.2	6.2	5.8	5.9	6.2
24	5.4	6.1	6.2	6.5	6.1	6.1	5.8	5.9	.....
25	6.0	6.8	6.15	6.4	6.1	6.0	5.7	5.9	.....
26	5.8	8.2	6.1	6.1	6.5	6.3	5.7	5.8	.....
27	5.7	7.3	6.05	6.15	6.2	6.1	5.7	5.8	.....
28	5.7	7.85	6.5	6.1	6.1	6.0	5.7	5.7	.....
29	5.75	.....	6.0	7.8	6.2	5.9	5.7	5.7	.....
30	5.8	.....	5.95	6.8	7.8	5.9	.....	5.7	.....
31	5.75	.....	5.9	.....	7.0	.....	.....	5.7	.....

MIAMI RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Miami furnishes the main drainage system of southwestern Ohio. Exclusive of the Whitewater, it has a drainage area of nearly 4,000 square miles, or about one-tenth of the State of Ohio. Its headwaters are at the continental water-shed, and it drains the greater part of the Cincinnati arch from that watershed south to Ohio River. One of the eastern tributaries, Mad River, heads in the elevated tract near Bellefontaine, at an elevation of fully 1,200 feet above tide. The other headwaters, except the Whitewater, have their sources at an elevation of about 1,000 feet. The Whitewater, as noted above, rises in the higher part of eastern Indiana, at an elevation of nearly 1,200 feet.

The valleys of the headwaters as far down as the vicinity of Dayton are narrow and comparatively shallow post-Glacial channels, with courses independent of pre-Glacial drainage lines. Mad River, it is true, occupies a broad trough-like valley, but on its borders are moraines which cause most of the relief, the bluffs being generally but 20 or 30 feet high. Below Dayton the Miami and some of its tributaries occupy pre-Glacial lines which are only partially filled with glacial deposits. The work of the present streams has been in the main a reexcavation of the valleys. In this work they have fallen far short of reaching the old rock floors which lie 100 to 200 feet below their beds. The depth of this reexcavation is but 50 to 100 feet, and the width is but a small fraction of that of

the old valley, seldom so much as one-fourth as great. The contrast between the southern and the northern portion of this drainage basin, therefore, is not found in the work of the present streams, but is due to the less complete concealment of pre-Glacial drainage lines.

The fall of the Miami is rapid throughout its entire length, being seldom less than 3 feet and usually over 4 feet per mile. The streams in this drainage system seldom reach a very low stage in seasons of drought for the valleys are usually filled with gravelly or sandy deposits which furnish strong springs. Even in the small tributaries water-bearing beds outcrop along the banks or bluffs.

This stream and several of its tributaries afford valuable water power, the utilization of which is discussed by Prof. Dwight Porter in the Tenth Census Report.[a] From this report it appears that a total of 9,431 horsepower was used in 1880 by 290 mills, manufactories, etc., on the Miami and its tributaries, including Whitewater River.

The following pages contain the results of stream-measurement data collected by the United States Geological Survey in the drainage basin of Miami River.

MIAMI RIVER AT DAYTON, OHIO.

This station was established March 18, 1905. It is located at the Miami Street Bridge, Dayton, Ohio, about one-half mile below the mouth of Mad River. There is a dam 1 mile above the station which may divert water through a canal and discharge it 1,000 feet below the gaging section. There is also a dam on Mad River 2½ miles above the station, where water is diverted into the Miami canal.

The channel is straight for 1,000 feet above and nearly so for 1,000 feet below the station. Both banks are high, diked, and are not subject to overflow. The bed of the stream is composed of gravel and silt. All the water passes between the abutments of the bridge, except as diverted through the canals as noted above. The former canal is rarely used. The current is sluggish at low water.

Discharge measurements are made from the upstream side of the steel-concrete bridge to which the gage is attached. The bridge consists of seven spans of about 76 to 100 feet each, having a total length of 592 feet. The initial point for soundings is a standard bench-mark tablet of the topographic branch of the United States Geological Survey marked "755," embedded in the concrete masonry forming the extreme south end of the guard rail, upstream side.

The gage consists of a vertical staff graduated to feet and tenths, spiked to the downstream end of the first pier from the left bank. The gage is referred to bench marks as follows: (1) The top of the rail at the Union Station; elevation, 13.00 feet. (2) The top of the southwest corner of the lower masonry course of the soldiers' monument directly south of the bridge; elevation, 24.86 feet. (3) The United States Geological Survey standard bench mark, described as initial point for soundings; elevation, 30.80 feet. Elevations refer to the datum of gage. During 1905 the gage was read by D. D. Rist, the United States Weather Bureau observer.

Discharge measurements of Miami River at Dayton, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 18	R. W. Pratt	406	1,600	0.96	2.15	1,534
May 19	M. S. Brennan	443	1,878	2.37	3.53	4,455
June 17	Sidney K. Clapp	373	1,093	.88	1.60	967
July 11	do	359	897	.69	1.10	618
August 25	R. W. Pratt	382	1,630	1.06	2.45	1,712
October 12	do	377	1,257	.57	1.55	713
November 18	do	385	1,198	.56	1.48	665

[a] Tenth Census of United States, 1880, Vol. XVII, pp. 478–487.

Daily gage height, in feet, of Miami River at Dayton, Ohio, for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	3.3	2.6	1.2	0.7	1.1	17	1.4	4.4	1.6	0.8	3.8	4.6
2	.....	2.8	2.3	1.6	.6	1.0	18	1.3	4.0	1.5	.9	3.0	5.0
3	.....	2.4	2.0	1.7	.6	1.8	19	1.2	3.6	1.5	.9	2.5	5.1
4	.....	2.1	1.9	1.7	.6	1.5	20	1.2	3.2	1.6	1.0	2.7	5.0
5	.....	2.0	1.8	1.5	.6	1.4	21	1.8	2.9	2.2	1.0	3.0	4.1
6	.....	1.8	3.9	1.4	.5	1.1	22	4.7	2.5	2.4	.9	2.8	3.3
7	.....	2.0	3.8	1.2	.5	1.0	23	3.5	2.2	2.0	.9	2.4	2.9
8	.....	1.8	3.0	.9	.7	1.0	24	3.0	2.0	1.8	.8	2.1	2.5
9	.....	1.6	2.5	1.0	.6	1.0	25	2.5	1.9	1.7	.8	2.4	2.2
10	.....	1.5	2.2	1.0	.6	.9	26	2.3	1.9	1.4	.8	2.0	1.9
11	.....	1.2	2.1	.9	.9	1.1	27	2.2	1.9	1.6	.8	1.8	1.8
12	.....	9.3	2.0	1.0	1.1	3.7	28	2.2	1.8	1.4	.8	1 6	1.6
13	.....	9.0	1.8	1.2	1.0	4.8	29	3.8	1.7	1.3	.8	1.4	1.5
14	.....	6.2	1.7	1.1	1.5	3.4	30	3.5	3.8	1.2	.7	1.2	1.4
15	.....	5.8	1.6	1.0	1.5	3.0	31	.....	3.2	.....	.7	1.1	.....
16	1.6	5.0	1.6	.9	4.0	2.8							

KENTUCKY RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Kentucky River drains into the Ohio from the south about halfway between Cincinnati, Ohio, and Louisville, Ky. The following pages contain the results of stream-measurement data collected in the Kentucky River drainage by the United States Geological Survey during 1905.

KENTUCKY RIVER AT FRANKFORT, KY.

This station was established March 18, 1905. It is located at the Government dam on the Kentucky River in the lower part of Frankfort, Ky., about 1 mile below the city highway bridge.

The channel is straight for 1,000 feet above and below the bridge. Both banks are high, rocky, covered with buildings, and do not overflow. The bed of the stream consists of rock, gravel, and sand and is free from vegetation and permanent. The water is approximately 15 feet deep and flows in one channel at all stages. The current is swift at high and very sluggish at low stages.

The discharge is determined by computations of the flow over the crest of the dam at low and moderate stages, the flood discharge being obtained by current-meter measurements from the single span city highway bridge. Good results should be obtained for gage heights above 8 feet. The initial point for soundings is the outside face of the first hand-rail post on the upstream side of the bridge at the right bank.

The lower portion of the gage is painted on the masonry walls of the locks at the left end of the dam, and the upper portion consists of staffs set firmly into the riprap on the left bank. During 1905 the gage was read by Mrs. C. H. McCrackin. The zero of the gage is 5.80 feet below the crest of the dam. No bench marks were established for the gage at the dam, which is maintained by the United States Army engineers. A bench mark is placed on the top of their hand rail at 40 feet from the initial point for soundings, marked with a cross in paint; elevation, 46.93 feet above the water surface when the gage at the locks read 7.40 feet.

Daily gage height, in feet, of Kentucky River at Frankfort, Ky., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	7.3	8.3	6.5	7.5	6.2	6.2	5.5	6.9	9.6
2	.....	7.1	7.9	6.4	7.0	6.0	6.4	5.5	6.7	9.7
3	.....	7.0	7.5	6.4	6.9	6.0	6.8	5.55	6.6	10.3
4	.....	6.9	7.2	6.3	7.1	6.0	6.7	5.6	6.5	11.0
5	.....	6.9	7.1	6.2	7.2	6.0	7.2	5.55	6.4	10.7
6	.....	7.0	6.9	6.1	6.8	6.0	7.0	5.4	6.3	10.3
7	.....	7.3	6.8	6.0	6.5	6.0	6.6	5.3	6.3	9.0
8	.....	7.4	6.7	6.0	6.5	6.0	6.4	5.2	6.2	8.0
9	.....	7.4	6.6	5.9	6.7	5.95	6.2	5.2	6.2	7.4
10	.....	7.3	7.4	5.8	7.3	5.9	6.2	5.2	6.15	7.3
11	.....	7.5	7.2	5.8	6.9	6.7	6.2	5.2	6.1	7.2
12	.....	7.4	7.4	6.4	7.3	6.6	6.4	5.25	6.1	7.0
13	.....	7.3	8.3	6.1	6.8	6.8	6.5	5.9	6.0	6.9
14	.....	7.1	9.0	6.1	6.5	7.0	6.4	7.0	5.9	6.8
15	.....	7.0	10.7	6.4	6.3	6.9	6.3	7.3	5.9	6.8
16	.....	6.9	10.4	6.5	6.6	6.8	6.3	6.9	5.9	8.3
17	.....	6.9	9.4	6.4	6.6	7.0	6.3	6.5	5.9	9.3
18	7.4	6.8	8.9	6.2	6.4	6.7	6.3	5.9	5.9	9.2
19	7.2	6.7	9.1	6.1	6.2	6.5	6.2	6.3	6.0	8.6
20	7.1	6.6	8.7	6.1	6.2	6.3	6.1	6.3	6.0	8.1
21	8.8	6.5	8.0	6.4	6.0	6.1	6.0	6.2	5.9	8.9
22	11.3	6.6	7.5	6.5	8.7	6.2	5.9	6.9	5.9	10.0
23	10.5	6.7	7.1	6.4	8.1	9.0	5.85	7.4	5.9	9.4
24	9.6	6.8	6.8	7.2	8.0	8.0	5.8	7.0	5.9	9.1
25	8.9	6.8	6.7	8.3	8.8	7.2	5.7	6.8	6.1	8.7
26	8.6	6.7	6.5	8.35	8.2	7.2	5.55	8.2	6.1	8.3
27	8.3	6.7	6.5	8.3	7.4	7.2	5.5	8.8	6.0	8.0
28	7.8	6.7	6.5	8.1	6.8	6.8	5.45	8 3	6.0	7.7
29	7.5	7.5	6.4	8.8	6.6	6.5	5.4	7.8	10.6	7.5
30	7.4	8.4	6.6	8.3	6.4	6.3	5.4	7.5	10.3	7.3
31	7.4	.....	6.9	.....	6.3	6.2	.....	7.2	.....	7.2

DICKS RIVER NEAR DANVILLE, KY.

This station was established March 18, 1905. It is located at the Danville city waterworks dam, about 5 miles east of the city of Danville.

Discharge measurements are computed by formula from the depth of water on the crest of the dam. Length of crest, 150 feet up to gage height 1.0 foot. Above 1.0 foot the crest is 200 feet long. The initial point for soundings is the crest of the dam.

The gage consists of a 2 by 4 inch pine stick nailed to a small sycamore tree about 100 feet above the above-mentioned dam on the left bank of the stream. Its zero is referred to the crest of the dam, which is said to be perfectly level. The gage was read during 1905 by Anton Rehm, the engineer of the waterworks.

Daily gage height, in feet, of Dicks River near Danville, Ky., for 1905.

Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.
1	0.41	0.10	0.19	0.06	12	0.4	0.5	0.16	0.4	22	0.23	0.25	2.0	0.05
2	.36	.08	.18	.05	13	.35	.24	.13	.7	23	.20	.9	.7	.09
3	.3	.06	.48	.04	14	.35	.18	.1	.42	24	.18	.75	.5	1.98
4	.25	.04	.45	.03	15	.45	.22	.09	.31	25	.15	.8	.47	.88
5	.24	.03	.29	.02	16	.46	.19	.11	.5	26	.14	.55	.32	1.21
6	.23	.02	.22	.02	17	.48	.17	.1	.32	27	.13	.42	.22	.....
7	.23	.02	.2	.01	18	.45	.15	.8	.2	28	.45	.32	.15	.....
8	.26	.01	.25	.21	19	.4	.14	.7	.14	29	.26	.25	.11	.....
9	.25	.01	.21	.26	20	.35	.15	.6	.11	30	.21	.22	.09	.....
10	.25	.01	.2	.22	21	.26	.14	.5	.06	31	.15	.....	.07	.....
11	.55	.02	.21	.22										

SALT RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Salt River drains into the Ohio from the south about 20 to 30 miles below Louisville, Ky. The following pages contain the results of data collected by the United States Geological Survey in Salt River drainage basin during 1905:

ROLLING FORK OF SALT RIVER AT NEW HAVEN, KY.

This station was established June 16, 1905. It is located on the only two-span steel railroad bridge in New Haven, Ky., about one-fourth mile from the business section of the city.

The channel is straight for 500 feet above and 800 feet below the station. The right bank is arable above the station and is low, with a small growth of trees. Below the station it is high and steep. This bank is liable to overflow above the station. The left bank is high at the bridge, but just below the bridge it is low and subject to overflow. The bed of the stream is composed of solid rock and will not shift. There is generally one channel, except at very high stages, when there will be two. The current is swift.

At low water, measurements are made by wading just below the bridge; at medium water a boat will be used at the ford way 300 feet below the bridge. At extreme high water the steel highway bridge about 1 mile above will be used. The initial point for soundings will vary as the position of the measurements may vary according to the stage of the river.

A standard chain gage is located on the ties of the downstream side of the downstream guard rail near the middle of the left span of the bridge; length of the chain, 30.09 feet.

Discharge measurements of Rolling Fork of Salt River at New Haven, Ky., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 16	S. K. Clapp	75	77	1.78	1.41	137
October 17	M. S. Brennan	43	38	.33	1.26	12.5

Daily gage height, in feet, of Rolling Fork of Salt River at New Haven, Ky., for 1905.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.4	1.2	1.0			7.0
2		1.2	1.2	1.0			4.8
3		1.25	1.1	1.0			6.7
4		1.2	1.1	1.0			8.1
5		1.1	1.1	1.0			3.9
6		1.4	1.0	1.0			2.6
7		1.6	1.3	1.0			2.3
8		1.4	1.1	1.0			2.0
9		1.8	1.1	1.1			1.9
10		4.5	1.1	1.1	0.8		
11		5.2	1.3	1.0			1.7
12		3.7	1.2	1.0			1.6
13		2.3	1.5				1.6
14		2.2	1.5				1.4
15		1.8	1.4				2.4
16			1.4				4.95
17	1.0	1.5	1.4				
18	.9	1.3	1.5				3.3
19	.8	1.3	1.2				2.95
20		1.2	1.3				2.3
21	2.05	4.1	1.2				6.0
22	3.0	3.8	1.2				9.8
23	1.9	2.4	1.2				8.8
24	1.8	3.0	1.2				
25		2.2	1.1	1.0	.6		
26	1.6	1.9	1.1				3.1
27	1.6	1.7	1.1				2.3
28	1.3	1.6	1.0	.9			
29	1.3	1.5	1.0			7.2	
30	1.3	1.4	1.0			9.8	
31		1.3	1.0				

WABASH RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The drainage basin of the Wabash embraces an area of about 33,000 square miles, distributed as follows: In Ohio, 400 square miles; in Indiana, 24,350 square miles; in Illinois, 8,250 square miles. It drains, therefore, slightly more than two-thirds of Indiana, the area of the State being 35,910 square miles. Of the portion in Indiana, about one-half is embraced in the drainage areas of East and West White rivers. By including these drainage areas with the Wabash, the entire basin has nearly symmetrical, broadly ovate form. Not including the White River system, the Wabash basin is an unsymmetrical, elongated tract, curving around White River.

The length of the valley occupied by the Wabash is about 450 miles, but the length of the stream is fully 500 miles, for the river in its lower course makes several oxbow curves within the valley. The source of the river is about 1,000 feet above tide, while its mouth at low water is but 311 feet. The average fall, if we estimate the stream to have a length of 500 miles, is therefore about 16.5 inches per mile. The rate of descent is far from uniform, being much more rapid in the upper portion than in the lower. There are also many rapids, separated by pools or sluggish portions of the stream. The elevation of the stream is accurately determined at many points, but in the absence of a careful measurement of the length of the stream the rate of fall is only approximately known. The section above the point where the river enters the old lake outlet, estimated to have a length of 100

miles, has a fall of about 300 feet, or 3 feet per mile. Railway levels and canal surveys, at the point where the river joins the old lake outlet, show its elevation to be nearly 700 feet above sea level, the altitudes reported varying between 696 and 699 feet.

The following table gives the elevation and fall at various points:

Table of altitudes and distances along Wabash River.

Location.	Estimated distance.	Altitude.	Fall per mile.
	Miles.	*Feet.*	*Inches.*
Source	0.0	1,000.0	0.0
Huntington	100.0	699.0	36.0
Mouth of Salamonie River	15.0	667.0	25.6
Mouth of Mississinewa River	20.0	633.0	20.4
Logansport	20.0	583.0	30.0
Lafayette	50.0	506.0	18.5
Attica	25.0	487.0	9.1
Covington	20.0	470.0	10.2
Terre Haute	55.0	447.7	4.9
State Line	14.6	440.6	5.8
Hutsonville, Ill	29.0	424.6	6.6
Vincennes	46.4	398.8	6.7
Mouth of White River	32.5	376.5	8.2
Grayville, Ill	28.0	365.0	4.9
Mouth of Little Wabash River	46.0	323.0	11.0
Mouth of Wabash River	16.0	311.0	9.0

WABASH RIVER AT LOGANSPORT, IND.

This station was established April 27, 1903. It is located at the Cicott Street Bridge, about 1 mile from the center of the city of Logansport, Ind., $1\frac{3}{4}$ miles from the Wabash Railroad station, $1\frac{1}{2}$ miles from the Pennsylvania station, four blocks from the street-car line, and 1,000 feet below the mouth of Eel River. The drainage area of Wabash River is 3,163 square miles at Logansport, below the mouth of Eel River.

The channel is nearly straight for 1,000 feet above and 1,500 feet below the station. The distance between abutments is 550 feet and the channel is broken by three bridge piers. The right bank is high and is not subject to overflow at the bridge. The left bank is submerged only at extreme high water. The bed of the stream consists of solid rock covered with small bowlders, and is rough and permanent. The stream is shallow and is never very sluggish.

Discharge measurements are made from the upstream side of the bridge, to which the gage is attached. The initial point for soundings is the face of the left abutment.

A standard chain gage is placed on the second span of the bridge, at the third panel from the second pier, between the lower chord bars, and is supported by the bridge pins. It is reached through a trap door in the floor planks of the bridge. The length of the chain is 20.78 feet. The gage was read during 1905 by W. R. Allison. The gage is referred to bench marks as follows: (1) The top of the north abutment, under the fourth board of the downstream sidewalk; elevation above gage datum, 18.81 feet. From Pennsylvania Railroad levels its elevation above sea level has been found to be 591 feet. (2) The top of the third course of masonry from the top of the north abutment; elevation above the zero of the gage, 15.31 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, p 225; 128, pp 83–84.
Discharge: 98, p 225; 128, p 84.
Discharge, monthly: 98, p 227; 128, p 86.
Gage heights: 98, p 226; 128, p 85.
Rating table: 98, p 226; 128, p 85.

Discharge measurements of Wabash River at Logansport, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 21	S. K. Clapp	509	1,908	2.86	3.75	5,450
May 27	M. S. Brennan	496	1,072	1.59	2.22	1,700
June 14	S. K. Clapp	513	1,961	2.80	3.79	5,480
July 14	do	487	1,275	1.93	2.75	2,436
August 23	M. S. Brennan	494	925	1.25	1.95	1,160
September 4	do	488	767	.98	1.74	748

Daily gage height, in feet, of Wabash River at Logansport, Ind., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.95	.....	6.12	4.82	4.25	3.14	1.67	1.4	1.63	1.48	1.6	4.5
2	2.42	.....	5.88	4.25	3.7	2.88	1.7	1.4	1.72	1.55	1.63	4.05
3	2.2	2.15	5.55	3.45	3.2	2.7	1.7	1.36	1.75	1.6	1.58	3.68
4	2.0	.....	5.2	2.93	2.68	2.52	1.62	1.25	1.75	1.65	1.55	3.6
5	1.9	.....	4.6	2.6	2.55	2.4	1.62	1.35	1.6	1.89	1.6	3.5
6	1.85	.....	4.35	2.4	2.8	5.1	1.63	1.58	1.55	1.87	2.0	3.1
7	1.9	.....	3.95	2.28	3.4	4.0	1.63	2.45	1.5	1.8	2.35	2.84
8	.....	.....	3.7	2.2	3.39	3.55	1.63	2.17	1.45	1.75	2.5	2.58
9	.....	2.1	3.85	2.15	2.95	3.22	1.63	1.8	1.42	1.65	2.39	2.48
10	.....	.....	4.0	2.1	2.73	3.23	1.7	1.7	1.42	1.6	2.33	2.4
11	.....	.....	3.86	2.05	3.8	3.78	2.25	1.53	1.5	1.6	2.2	2.3
12	2.7	.....	3.6	2.05	10.5	3.78	3.17	1.45	1.49	1.54	2.05	2.25
13	.....	.....	3.1	2.05	10.05	3.8	2.95	1.4	3.33	1.5	1.85	2.22
14	.....	.....	2.85	2.0	8.45	3.72	2.63	1.49	3.48	1.5	1.81	2.15
15	.....	.....	2.7	2.0	7.1	3.33	2.4	1.77	2.9	1.45	1.8	2.1
16	.....	2.2	2.5	1.95	6.12	3.0	2.3	1.9	2.83	1.42	1.78	1.99
17	.....	.....	2.85	1.9	5.1	2.85	2.1	1.7	3.58	1.4	1.75	2.1
18	3.0	.....	3.4	1.86	4.5	2.68	1.92	2.3	4.42	2.13	1.7	2.05
19	.....	.....	3.6	1.86	3.88	2.65	1.91	2.56	3.78	2.45	1.7	2.0
20	.....	.....	3.6	1.88	3.5	2.6	1.75	2.7	3.28	2.3	1.65	1.9
21	.....	.....	3.71	5.65	3.23	2.4	1.99	2.43	3.0	2.2	1.58	2.8
22	.....	.....	3.47	6.45	2.85	2.72	1.73	2.21	2.8	2.05	1.55	4.65
23	.....	2.23	3.1	5.98	2.6	2.6	1.68	1.99	2.0	2.0	1.63	4.58
24	.....	.....	3.0	5.15	2.45	2.3	1.5	2.0	2.2	1.85	1.62	4.1
25	2.25	.....	3.58	4.48	2.3	2.19	1.5	2.57	2.0	1.8	1.59	3.6
26	.....	.....	3.45	3.75	2.25	2.19	1.43	2.6	1.8	1.78	1.6	3.2
27	.....	7.9	2.95	4.65	2.2	2.15	1.4	2.3	1.8	1.7	1.58	2.9
28	.....	6.45	2.65	4.12	2.15	2.0	1.37	1.98	1.7	1.65	1.93	2.63
29	.....	.....	2.45	5.55	2.1	1.88	1.4	1.82	1.55	1.6	5.8	2.6
30	.....	.....	2.5	4.95	2.25	1.78	1.4	1.72	1.5	1.53	6.1	2.75
31	.....	.....	5.32	.....	2.61	.....	1.43	1.55	.....	1.6	.....	3.0

NOTE.—Gage heights interpolated March 2, 9, November 16, and December 7. Ice conditions January 1 to February 27. From January 12 to February 27 river was frozen entirely across. Gage was read to the surface of the water in a hole in the ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 12	2.7	2.65	0.4
January 18	3.0	(a)	.7
January 25	2.25	2.3	.8
February 3	2.15	2.25	.95
February 9	2.1	2.15	1.0
February 16	2.2	2.3	1.0
February 23	2.23	2.25	1.1

[a] Water overflows ice.

Station rating table for Wabash River at Logansport, Ind., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	330	2.30	1,805	3.40	4,440	4.50	7,700
1.30	360	2.40	2,010	3.50	4,715	4.60	8,020
1.40	420	2.50	2,225	3.60	4,995	4.70	8,340
1.50	510	2.60	2,445	3.70	5,280	4.80	8,670
1.60	630	2.70	2,675	3.80	5,570	4.90	9,000
1.70	770	2.80	2,910	3.90	5,865	5.00	9,340
1.80	920	2.90	3,150	4.00	6,160	5.20	10,020
1.90	1,080	3.00	3,395	4.10	6,460	5.40	10,720
2.00	1,250	3.10	3,645	4.20	6,760	5.60	11,430
2.10	1,425	3.20	3,905	4.30	7,070	5.80	12,160
2.20	1,610	3.30	4,170	4.40	7,380	6.00	12,910

NOTE.—The above table is applicable only for open channel conditions. It is based on discharge measurements made during 1903–1905. It is well defined between gage heights 1.2 feet and 4 feet. The table has been extended beyond these limits. Above 6 feet the discharge is estimated, being based on three high-water measurements of 1904.

Estimated monthly discharge of Wabash River at Logansport, Ind., for 1905.

[Drainage area, 3,163 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March	13,370	2,118	5,561	1.76	2.03
April	14,670	1,014	4,774	1.51	1.68
May	33,750	1,518	6,961	2.20	2.54
June	9,680	890	3,318	1.05	1.17
July	3,829	402	1,065	.337	.388
August	2,675	345	1,154	.365	.421
September	7,444	438	1,946	.615	.686
October	2,118	420	865	.273	.315
November	13,290	570	1,769	.559	.624
December	8,180	1,080	3,398	1.07	1.23

NOTE.—No estimate for frozen period.

WABASH RIVER AT TERRE HAUTE, IND.

This station was established February 25, 1905. It is located at the Vandalia Line railway bridge near the city waterworks. There are no tributaries nor any islands, falls, or dams in the river near the station.

The channel is practically straight for 700 feet above and below the station. There is a considerable angle of approach on the right bank, but practically none at the left bank. The right bank is comparatively low and alluvial, but is protected by a levee that does not overflow. The left bank is high, covered with buildings, and does not overflow. All of the water passes between the abutments of the bridge. The bed of the stream is composed of hard, permanent material, is clean of vegetation, and always consists of but one channel. The current has a medium-swift velocity at low stages.

Discharge measurements are made from the downstream lower chord of the bridge. The initial point for soundings is the center of the truss pin through the left end of the downstream lower chord of the left span of the bridge.

A standard chain gage is fastened to the downstream side of the bridge, on the first span from the left bank; length of chain, 42.97 feet. During 1905 the gage was read by Albert Shewmaker. The gage is referred to bench marks as follows: (1) The Terre Haute city bench mark at the northeast corner of First and Chestnut streets; elevation 0.33 foot. (2) The southeast corner of the left abutment of the Vandalia Line railway bridge; elevation, 36.40 feet. (3) The base of the railroad rail immediately opposite the pulley at the gage box; elevation, 42.51 feet. Elevations refer to the datum of the gage. This is 0.33 foot below the city datum, which is 438.72 feet above mean sea level.

Information in regard to a former gaging station maintained in the city of Terre Haute is contained in the following publications of the United States Geological Survey (Ann= Annual Report; WS=Water-Supply Paper):

Description: WS 98, p 220.
Discharge: Ann 21, iv, p 171.
Gage heights: WS 83, p 177; 98, p 220.

Discharge measurements of Wabash River at Terre Haute, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 12	M. S. Brennan	557	5,584	2.82	6.90	15,750
June 25	do	521	3,839	1.91	3.74	7,367
July 29	do	480	2,652	1.00	1.42	2,648
August 25	do	502	2,963	1.25	2.00	3,700
September 11	do	495	2,773	1.19	1.81	3,311
October 15	do	455	2,525	.82	1.00	2,066

Daily gage height, in feet, of Wabash River at Terre Haute, Ind., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	13.7	5.1	8.6	6.4	2.2	1.72	1.5	1.42	1.9	9.55
2	.....	14.3	7.0	8.0	6.2	2.02	1.58	1.75	1.4	1.82	9.85
3	.....	14.4	7.2	6.7	6.6	2.88	1.38	1.75	1.3	1.85	8.62
4	.....	14.7	6.2	5.8	5.2	3.8	1.28	1.6	1.22	1.8	7.05
5	.....	15.0	5.2	5.3	4.6	2.78	1.22	1.85	1.18	1.88	6.02
6	.....	13.3	4.4	4.9	4.05	2.48	1.15	1.95	1.18	2.85	5.88
7	.....	10.6	3.9	4.7	4.7	2.28	1.3	1.88	1.18	3.4	5.3
8	.....	9.0	3.6	4.5	6.0	1.98	1.22	1.7	1.32	3.9	4.88
9	.....	8.2	3.3	4.9	5.6	2.35	1.48	1.5	1.3	3.98	4.4
10	.....	7.3	3.1	5.6	4.9	2.58	1.82	1.4	1.28	3.88	4.05
11	.....	6.6	3.0	5.3	4.6	4.0	1.68	1.92	1.18	3.62	3.8
12	.....	6.5	3.05	6.8	4.7	4.75	1.45	3.0	1.1	3.32	3.62
13	.....	6.2	3.1	12.7	5.2	4.25	1.28	3.1	1.02	3.05	3.42
14	.....	5.6	2.95	14.1	5.4	4.4	1.52	2.72	1.0	3.75	3.18
15	.....	5.0	2.72	15.1	5.1	4.4	2.62	2.4	1.0	2.52	2.85
16	.....	4.6	2.55	16.3	5.0	3.85	2.8	3.32	.95	2.38	2.65
17	.....	4.3	2.4	17.0	4.6	3.4	2.62	3.95	.9	2.22	2.48
18	.....	4.0	2.32	16.8	4.2	3.0	2.55	4.6	2.0	2.12	2.52
19	.....	4.35	2.15	15.7	4.8	2.68	2.25	5.0	3.4	2.02	2.55
20	.....	5.1	2.02	12.8	5.4	2.75	2.1	5.1	4.15	1.92	2.48
21	.....	5.6	2.82	9.5	7.3	4.6	2.38	4.8	4.92	1.82	2.62
22	.....	5.6	5.9	7.8	4.8	3.4	2.58	4.2	4.68	1.75	3.2
23	.....	5.5	9.2	6.6	4.1	2.65	[a]2.15	3.6	4.12	1.65	4.9
24	.....	5.3	10.9	5.7	3.9	2.28	1.72	3.2	3.68	1.65	7.08
25	.....	4.8	10.6	5.0	3.7	1.98	1.68	2.72	3.3	1.6	7.4
26	9.7	4.8	9.4	4.6	3.3	1.78	1.78	2.32	2.95	1.65	6.7
27	12.3	5.0	8.4	4.3	2.9	1.6	2.1	2.05	2.7	1.58	6.0
28	11.3	5.0	7.5	4.1	2.65	1.5	2.38	1.8	2.45	1.42	5.3
29	.....	4.5	8.0	3.9	2.5	1.42	2.3	1.68	2.2	2.1	4.9
30	.....	4.1	8.2	6.7	2.4	1.78	2.02	1.5	2.12	8.0	4.5
31	.....	4.5	.....	7.1	.....	1.68	1.75	.....	1.95	.....	4.48

[a] Gage height interpolated.

Station rating table for Wabash River at Terre Haute, Ind., from February 25 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	1,945	2.50	4,670	4.20	8,430	7.40	17,200
1.00	2,065	2.60	4,870	4.40	8,910	7.60	17,800
1.10	2,195	2.70	5,080	4.60	9,390	7.80	18,400
1.20	2,335	2.80	5,290	4.80	9,890	8.00	19,000
1.30	2,485	2.90	5,505	5.00	10,400	8.20	19,600
1.40	2,643	3.00	5,720	5.20	10,920	8.40	20,300
1.50	2,808	3.10	5,940	5.40	11,450	8.60	21,000
1.60	2,978	3.20	6,160	5.60	11,990	8.80	21,700
1.70	3,152	3.30	6,380	5.80	12,540	9.00	22,400
1.80	3,330	3.40	6,605	6.00	13,100	9.50	24,150
1.90	3,513	3.50	6,830	6.20	13,660	10.00	25,900
2.00	3,700	3.60	7,055	6.40	14,240	10.50	27,800
2.10	3,890	3.70	7,280	6.60	14,820	11.00	29,800
2.20	4,080	3.80	7,510	6.80	15,400	11.50	31,800
2.30	4,275	3.90	7,740	7.00	16,000	12.00	33,800
2.40	4,470	4.00	7,970	7.20	16,600		

NOTE.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905. It is well defined between gage heights 1 foot and 4 feet. The table has been extended beyond these limits, being based on one measurement at 6.9 feet and also on well-defined area and mean-velocity curves to 12 feet. Above this point the curve is more uncertain as the river overflows.

Estimated monthly discharge of Wabash River at Terre Haute, Ind., for 1905.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
March	48,800	7,970	18,690
April	29,400	3,738	11,750
May	60,800	7,740	22,560
June	16,900	4,470	9,787
July	9,765	2,676	5,454
August	5,290	2,265	3,495
September	10,660	2,643	5,164
October	10,190	1,945	4,077
November	19,000	2,676	5,033
December	25,380	4,630	10,650

TIPPECANOE RIVER NEAR DELPHI, IND.

This station was established March 14, 1903. It is located at the highway bridge at Springboro, Ind. The nearest railroad station is Delphi, 5 miles east of Springboro. The drainage area of Tippecanoe River at this station is 1,890 square miles.

The channel is straight for about 1,600 feet above and about 2,000 feet below the station. Its width at ordinary stages is 350 feet, broken by two piers, and at high water is 510 feet, broken by three piers. Both banks are high and can not overflow to any considerable extent. The bed of the stream is rocky and rough. The current is swift.

Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is the face of the east abutment.

A standard chain gage is located on the second span from the east bank, one panel length beyond the center of the span; length of the chain, 25.66 feet. The gage was read during 1905 by Lois Imler. The bench mark is the head of an anchor bolt in the east abutment; it is the outside anchor of the downstream truss; elevation above the zero of the gage, 22.25 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 222–223; 128, p 86.
Discharge: 98, p 223; 128, p 87.
Discharge, monthly: 98, p 224; 128, p 88.
Gage heights: 98, p 223; 128, p 87.
Rating table: 98, p 224; 128, p 88.

Discharge measurements of Tippecanoe River near Delphi, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 21	S. K. Clapp	319	713	3.9	4.25	2,782
May 27	M. S. Brennan	325	682	3.23	4.29	2,203
June 13	S. K. Clapp	285	672	3.66	4.30	2,459
July 14	do	272	617	3.44	4.10	2,120
August 24	M. S. Brennan	256	294	1.89	2.98	556
October 5	do	251	276	1.76	2.98	486

Daily gage height, in feet, of Tippecanoe River near Delphi, Ind., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.04	.....	7.8	4.1	7.9	4.4	3.4	3.35	3.9	3.02	3.25	4.4
2	3.08	.....	6.9	4.0	7.8	4.2	3.35	3.3	3.5	3.09	3.25	4.4
3	3.09	.....	6.1	3.95	7.8	4.0	3.3	3.3	3.6	3.08	3.2	4.25
4	3.08	3.06	5.9	3.7	7.6	3.95	3.25	3.25	3.75	3.04	3.2	4.2
5	3.06	.....	5.7	3.65	7.4	3.9	3.15	3.15	3.7	3.02	3.15	4.0
6	3.03	.....	5.6	3.6	7.3	3.85	3.15	3.06	3.55	3.0	3.8	3 85
7	3.0	.....	5.5	3.5	7.2	3.75	3.25	3.0	3.45	2.98	4.1	3.8
8	3.0	.....	5.4	3.55	6.8	3.75	3.25	3.0	3.35	2.98	4.0	3.7
9	.....	.....	5.1	3.55	6.8	3.9	3.2	2.98	3.15	2.97	3.95	3.65
10	.....	.....	4.7	3.55	6.5	4.0	3.3	2.98	3.1	2.96	3.95	3.55
11	.....	3.1	4.1	3.5	5.6	4.5	3.7	2.97	3.09	2.96	3.9	3.5
12	.....	.....	4.1	3.5	10.1	4.3	4.3	2.99	3.06	2.95	3.9	3.45
13	.....	.....	4.05	3.7	9.4	4.4	4.1	3.0	3.1	2.94	3.8	3.45
14	3.0	.....	4.05	3.9	10.2	4.4	4.0	3.09	3.3	2.93	3.7	3.65
15	.....	.....	4.2	3.85	10.0	4.4	3.9	3.2	3.25	2.91	3.6	3.6
16	.....	.....	4.2	3.85	9.8	4.3	3.7	3.45	3.15	2.9	3.5	3.5
17	.....	.....	4.2	3.8	8.9	5.0	3.6	3.3	3.15	2.9	3.35	3.45
18	.....	3.12	4.2	3.75	7.6	5.6	3.45	3.15	3.15	3.15	3.35	3.4
19	.....	.....	4.1	5.2	6.5	5.0	3.45	3.15	3.1	4.4	3.3	3.4
20	.....	3.1	4.1	7.0	4.8	4.3	3.35	3.45	3.1	4.4	3.3	3.25
21	3.03	.....	4.05	6.1	4.8	4.2	3.25	3.4	3.09	4.3	3.3	2.3
22	.....	.....	4.1	6.0	4.7	4.3	3.2	3.35	3.08	4.1	3,3	3.4
23	.....	.....	4.3	6.0	4.7	4.05	3.2	3.3	3.1	4.0	3.25	4.8
24	.....	.....	4.3	6.59	4.6	3.85	3.15	3.25	3.1	3.95	3.25	4.65
25	.....	3.15	4.2	5.8	4.6	3.7	3.1	3.25	3.09	3.85	3.2	4.2
26	.....	.....	4.2	5.5	4.4	3.6	3.07	3.2	3.08	3.8	3.15	3.9
27	.....	.....	4.2	5.4	4.4	3.65	3.05	3.15	3.06	3.6	3.1	3.9
28	3.1	.....	4.1	7.8	4.4	3.7	3.02	3.08	3.05	3.35	3.1	3.85
29	.....	.....	4.1	8.0	4.5	3.5	3.35	3.01	3.04	3.3	4.3	3.35
30	.....	.....	4.2	7.9	4.5	3.45	3.65	2.95	3.03	3.3	4.4	3.8
31	.....	4.90	4.1	.....	4.7	.....	3.4	2.98	.....	3.25	.....	3.75

NOTE.—There were ice conditions during January and February. From January 9 to February 11 the river was frozen over except for a narrow channel near the west bank. February 12–28, river frozen entirely across. Gage heights are to surface of water in hole in ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 14	3.0	2.9	0.3
January 21	3.03	3.03	.35
January 28	3.1	3.12	.5
February 4	3.06	.....	.5
February 11	3.1	3.12	1.0
February 18	3.12	3.12	1.0
February 25	3.15	3.19	1.0

Station rating table for Tippecanoe River near Delphi, Ind., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.70	280	4.20	2,410	5.70	5,280	8.40	11,290
2.80	390	4.30	2,580	5.80	5,490	8.60	11,750
2.90	510	4.40	2,750	5.90	5,700	8.80	12,210
3.00	630	4.50	2,920	6.00	5,910	9.00	12,670
3.10	760	4.60	3,090	6.20	6,350	9.20	13,130
3.20	890	4.70	3,270	6.40	6,790	9.40	13,590
3.30	1,030	4.80	3,450	6.60	7,230	9.60	14,050
3.40	1,170	4.90	3,640	6.80	7,670	9.80	14,510
3.50	1,320	5.00	3,830	7.00	8,110	10.00	14,970
3.60	1,470	5.10	4,030	7.20	8,550	10.50	16,120
3.70	1,620	5.20	4,230	7.40	8,990	11.00	17,270
3.80	1,770	5.30	4,440	7.60	9,450	11.50	18,420
3.90	1,930	5.40	4,650	7.80	9,910	12.00	19,570
4.00	2,090	5.50	4,860	8.00	10,370	12.50	20,720
4.10	2,250	5.60	5,070	8.20	10,830	13.00	21,870

NOTE.—The above table is applicable only for open-channel conditions. It is based on 23 discharge measurements made during 1903–1905. It is not very well defined.

Estimated monthly discharge of Tippecanoe River near Delphi, Ind., for 1905.

[Drainage area, 1,890 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March	9,910	2,170	3,411	1.80	2.08
April	10,370	1,320	3,708	1.96	2.19
May	15,430	2,750	7,507	3.97	4.58
June	5,070	1,245	2,331	1.23	1.37
July	2,580	656	1,197	.633	.730
August	1,245	570	847	.448	.516
September	1,930	669	960	.508	.567
October	2,750	510	1,121	.593	.684
November	2,750	760	1,383	.732	.817
December	3,450	1,030	1,799	.962	1.10

NOTE.—No estimate for frozen period.

WEST BRANCH OF WHITE RIVER AT INDIANAPOLIS, IND.

This station was established May 6, 1904. It is located in the central portion of the city, on the bridge of the Cleveland, Cincinnati, Chicago and St. Louis Railway.

The channel is straight for about 500 feet above and 1,000 feet below the station. The right bank is high and seldom overflows. The left bank is high, covered with buildings, and never overflows. All the water passes between the abutments of the bridge. The bed of the stream is composed of gravel and sand, and is fairly permanent. There is one channel at all stages. At low water the current is too sluggish to permit of very accurate measurements.

Discharge measurements are made from the downstream side of the bridge of three spans, to which the gage is attached. The initial point for soundings is the downstream inner face of the right abutment.

A standard chain gage is attached to the downstream side of the bridge, its length from the end of the weight to the marker, which is the outside of the ring, being 37.10 feet. The gage was read during 1905 by J. D. Burk. The chain and weight are kept at the water-softening plant of the Kingan Packing Company, 100 feet downstream from the right abutment of the bridge. The gage is referred to bench marks as follows: (1) The south capstone of the ballast wall of the right abutment; elevation, 36.51 feet. (2) The downstream top edge of the fifth cross girder from the right abutment of the bridge; elevation, 36.54 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 128, p 89.
Discharge: 98, p 227; 128, p 89.
Discharge, monthly: 128, p 91.
Gage heights: 128, p 90.
Rating table: 128, p 90.

Discharge measurements of West Branch of White River at Indianapolis, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 15	S. K. Clapp	250	1,415	1.00	8.80	1,408
May 13	M. S. Brennan	328	2,836	3.04	13.30	8,626
June 14	S. K. Clapp	243	1,277	.57	8.05	730
September 11	M. S. Brennan	272	1,452	.98	8.98	1,427
October 18	do	239	1,234	.50	7.94	621

Daily gage height, in feet, of West Branch of White River at Indianapolis, Ind., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.5	7.3	11.8	10.6	10.4	11.0	7.6	7.3	7.8	7.7	7.75	8.3
2	8.3	7.2	12.1	9.8	9.4	9.8	7.6	7.3	7.7	8.35	7.7	8.4
3	8.15	7.1	11.2	9.3	9.0	9.3	7.65	7.35	7.6	10.3	7.7	8.8
4	7.65	7.1	10.8	8.9	8.75	8.8	7.65	7.3	7.7	10.7	7.65	9.9
5	7.85	7.15	10.1	8.75	8.6	8.5	7.6	7.3	7.8	9.6	7.9	8.2
6	7.85	7.15	9.6	8.5	8.65	8.7	7.6	7.3	7.75	9.0	8.4	8.4
7	7.8	7.1	9.4	8.4	9.0	8.8	7.6	7.75	7.65	8.6	9.7	8.6
8	7.55	7.1	9.6	8.2	9.2	8.9	7.6	7.65	7.6	8.3	9.35	8.3
9	7.4	7.2	10.2	8.15	8.95	8.5	7.8	7.6	7.5	8.2	8.9	8.15
10	7.35	7.15	10.7	8.1	8.7	8.3	8.0	7.6	7.6	8.15	8.5	8.1
11	7.5	7.15	9.8	10.3	8.9	8.2	7.85	7.5	7.85	8.0	8.3	8.0
12	8.1	7.15	9.5	10.2	13.2	8.2	7.8	7.5	11.1	7.95	8.15	7.95
13	8.8	7.1	9.1	10.0	13.3	8.2	8.2	7.65	11.5	8.0	8.1	7.9
14	8.9	6.95	8.9	9.3	12.5	7.95	8.2	7.85	9.8	7.9	8.0	7.85
15	8.7	7.0	8.75	8.85	11.1	8.0	8.0	8.2	9.0	7.85	7.95	7.7
16	8.25	7.0	8.9	8.6	10.4	7.9	7.85	8.65	9.1	7.8	7.85	7.65
17	8.2	7.1	8.6	8.4	10.0	7.95	7.7	8.8	11.7	7.7	7.8	7.65
18	8.2	7.1	8.75	8.3	9.8	7.9	7.7	8.6	12.0	7.9	7.8	7.6
19	8.1	7.2	8.8	8.2	9.5	7.9	7.6	8.5	10.8	8.25	7.75	7.6
20	8.0	7.2	8.9	8.3	9.2	7.95	7.55	8.3	9.6	9.15	7.7	7.65
21	7.95	7.25	8.95	10.1	9.0	8.2	7.55	8.3	9.3	9.1	7.6	7.75
22	7.9	7.35	8.8	11.9	8.7	8.4	7.5	8.9	8.8	8.85	7.6	9.9
23	7.75	7.55	8.65	11.8	8.5	8.3	7.55	8.5	8.5	8.6	7.55	10.5
24	7.7	8.0	8.6	10.4	8.35	8.1	7.55	8.2	8.3	8.3	7.5	10.1
25	7.3	9.7	9.1	9.6	8.2	8.0	7.5	8.6	8.2	8.15	7.5	9.5
26	7.2	10.9	9.1	9.3	8.15	7.9	7.5	9.9	8.0	8.0	7.5	8.95
27	7.4	11.7	8.8	9.2	8.1	7.65	7.45	9.6	7.9	8.0	7.5	8.6
28	7.5	11.4	8.55	9.2	8.0	7.6	7.35	8.9	7.85	7.9	7.65	8.4
29	7.35	.....	8.5	9.4	8.3	7.6	7.3	8.5	7.85	7.8	7.7	8.35
30	7.3	.....	9.5	10.4	12.4	7.6	7.3	8.15	7.75	7.75	7.9	8.5
31	7.35	.....	11.0	.....	12.2	.....	7.3	7.9	.....	7.8	.....	8.6

NOTE.—Ice conditions unknown; discharge applied as for open channel.

Station rating table for West Branch of White River at Indianapolis, Ind., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.90	125	8.20	800	9.50	2,005	11.40	4,655
7.00	150	8.30	880	9.60	2,115	11.60	5,005
7.10	180	8.40	960	9.70	2,225	11.80	5,375
7.20	215	8.50	1,045	9.80	2,345	12.00	5,765
7.30	255	8.60	1,130	9.90	2,465	12.20	6,165
7.40	300	8.70	1,215	10.00	2,585	12.40	6,585
7.50	350	8.80	1,305	10.20	2,845	12.60	7,015
7.60	400	8.90	1,395	10.40	3,125	12.80	7,455
7.70	455	9.00	1,490	10.60	3,405	13.00	7,905
7.80	515	9.10	1,585	10.80	3,695	13.50	9,055
7.90	580	9.20	1,685	11.00	3,995	14.00	10,210
8.00	650	9.30	1,785	11.20	4,315		
8.10	725	9.40	1,895				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1904–5. It is well defined between gage heights 7.2 feet and 9 feet. The table has been extended beyond these limits, being based on one measurement at 13.3 feet.

Estimated monthly discharge of West Branch of White River at Indianapolis, Ind., for 1905.

[Drainage area, 1,520 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	1,395	215	598	0.393	0.453
February	5,185	138	759	.499	.520
March	5,965	1,045	2,171	1.43	1.65
April	5,565	725	1,992	1.31	1.46
May	8,595	650	2,522	1.66	1.91
June	3,995	400	971	.639	.713
July	800	255	436	.287	.331
August	2,465	255	803	.528	.609
September	5,765	350	1,491	.981	1.09
October	3,545	455	1,008	.663	.764
November	2,225	350	669	.440	.491
December	3,265	400	1,076	.708	.816
The year	8,595	138	1,208	.786	10.81

See gage height footnote.

EEL RIVER AT CATARACT, IND.

This station was established August 6, 1903. It is located 6 miles from Cloverdale, Ind., and one-half mile northeast of Cataract, Ind. It is 300 feet above a dam, below which there is a fall of 35 feet. The drainage area of Eel River at this station is 255 square miles.

The channel is straight for about 500 feet above and 300 feet below the bridge. Both banks are high and rocky and will not overflow. The bed of the stream is a smooth rock ledge, nearly level between the bridge abutments. The current varies from swift to rather sluggish.

Discharge measurements are made from the upstream side of the single-span covered highway bridge, which has a length between abutments of 128 feet. The initial point for soundings is the face of the left abutment at the top of the coping on the upstream side of the bridge.

The gage is a 3 by 6 inch oak timber, securely fastened to the west abutment on the downstream face. The gage was read during 1905 by Joseph Steiner. Bench marks were established as follows: (1) A wire nail in the root of a small elm tree in a stone wall on the north side of the road approaching the bridge on the west side of the river and about 50 feet from the bridge; elevation, 12.60 feet. (2) A wire nail in the root of a large oak tree in the pasture on the west side of the river, 300 feet from the bridge and 20 feet from the fence which bounds the south side of the road approaching the bridge; elevation, 27.20 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 218–219; 128, pp 91–92.
Discharge: 98, p 219.
Gage heights: 98, p 219; 128, p 92.

Daily gage height, in feet, of Eel River at Cataract, Ind., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.3	2.1	3.3	2.4	3.9	2.0	2.0	1.1	1.6	1.6	1.8	2.4
2	3.2	2.1	3.4	2.3	3.8	2.0	1.9	1.1	1.5	1.4	1.8	2.5
3	3.1	2.1	3.5	2.2	3.8	2.0	1.8	1.0	1.6	1.3	1.9	2.4
4	3.0	2.0	3.6	2.1	3.7	2.0	1.7	1.0	1.8	1.2	1.9	2.3
5	2.9	2.0	3.6	2.1	3.5	2.1	1.6	1.0	1.9	1.2	2.0	2.2
6	2.8	1.6	3.5	2.0	3.4	2.1	1.7	1.0	1.9	1.1	2.0	2.2
7	2.7	1.6	3.4	2.0	3.3	2.0	1.8	1.1	1.8	1.1	2.1	2.3
8	2.8	1.6	3.2	2.0	3.2	2.0	2.0	1.1	1.8	1.2	2.0	2.3
9	2.8	1.6	3.0	1.9	3.5	2.1	2.0	1.2	1.8	1.2	2.0	2.4
10	2.9	1.6	2.9	1.8	3.6	2.0	2.0	1.2	1.7	1.3	1.9	2.4
11	2.9	1.6	2.8	1.8	3.6	2.1	1.9	1.3	1.7	1.3	1.9	2.4
12	3.0	1.6	2.8	1.7	3.5	2.1	1.9	1.2	1.6	1.4	2.0	2.3
13	3.0	1.6	2.7	1.6	3.5	2.0	1.8	1.3	1.5	1.5	2.0	2.3
14	3.0	1.6	2.7	1.6	3.4	2.1	1.9	1.4	1.4	1.6	2.1	2.2
15	2.9	1.7	2.7	1.6	3.2	2.2	2.0	1.6	1.3	1.6	2.1	2.1
16	2.9	1.8	2.6	1.6	3.1	2.3	2.0	1.7	1.2	1.7	2.0	2.0
17	2.8	1.8	2.5	1.6	3.0	2.4	1.9	1.9	1.2	1.8	1.9	2.0
18	2.8	1.8	2.5	1.7	2.9	2.5	1.8	2.0	1.1	1.9	1.9	2.1
19	2.7	2.0	2.4	1.7	2.8	2.6	1.7	2.5	1.1	2.0	1.8	2.2
20	2.6	2.2	2.4	1.9	2.7	2.7	1.6	2.4	1.0	2.1	1.7	2.3
21	2.6	2.3	2.3	1.9	2.6	2.8	1.5	2.4	1.0	2.3	1.6	2.4
22	2.6	2.5	2.2	2.0	2.6	2.9	1.4	2.3	1.0	2.3	1.5	2.4
23	2.6	2.8	2.2	2.0	2.5	2.8	1.3	2.2	1.0	2.3	1.5	2.3
24	2.6	3.0	2.1	2.0	2.4	2.7	1.2	2.1	1.1	2.2	1.4	2.4
25	2.6	3.0	2.0	2.2	2.3	2.6	1.2	2.0	1.2	2.1	1.5	2.5
26	2.6	3.0	2.0	2.3	2.3	2.5	1.3	2.0	1.4	2.1	1.6	2.6
27	2.6	3.1	2.0	2.5	2.2	2.4	1.3	2.0	1.5	2.0	1.7	2.6
28	2.6	3.2	2.1	2.7	2.2	2.3	1.4	1.9	1.6	2.0	1.9	2.7
29	2.5	.....	2.2	4.0	2.1	2.2	1.4	1.9	1.6	2.0	2.0	2.8
30	2.4	.....	2.3	4.0	2.1	2.1	1.3	1.8	1.7	1.9	2.0	2.8
31	2.3	.....	2.3	.....	2.1	.....	1.2	1.7	.....	1.8	.....	2.7

NOTE.—Ice conditions unknown.

EAST BRANCH OF WHITE RIVER AT SHOALS, IND.

This station was established June 25, 1903. It is located at the highway bridge in the village of Shoals, Ind., 400 feet above the Baltimore and Ohio Southwestern Railroad bridge. There are rapids just below this station, also about 5½ miles below.

The channel is straight above and below the station. The right bank is a high, rocky road embankment and never overflows; the left bank is a steep, rocky bluff and does not overflow. The bed of the stream is rocky, and the channel is divided into three parts by the bridge piers. The current is swift.

Discharge measurements are made from the three-span highway bridge, to which the gage is attached. The initial point for soundings is the face of the left abutment.

A standard chain gage is fastened to the railing and metal posts of the downstream side of the first span on the left end of the highway bridge; length of the chain, 46.41 feet. The gage was read during 1905 by O. H. Griest. The bench mark is the stone cap on the downstream end of the first pier from the left bank. Its elevation is 100.00 feet above the gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 216–217; 128, p 93.
Discharge: 98, p 217; 128, p 93.
Discharge, monthly: 98, p 218; 128, p 95.
Gage heights: 98, p 217; 128, p 94.
Rating table: 98, p 218; 128, p 95.

Discharge measurements of East Branch of White River at Shoals, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 16	S. K. Clapp	355	1,421	4.28	66.00	6,090
May 15	M. S. Brennan	406	4,248	4.26	73.58	18,120
June 15	S. K. Clapp	330	744	2.47	64.40	1,838
October 16	M. S. Brennan	313	564	1.74	63.80	982

Daily gage height, in feet, of East Branch of White River at Shoals, Ind., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	65.5	63.9	66.4	66.0	67.0	66.4	64.3	63.8	65.1	63.9	65.6	66.3
2	65.0	64.0	68.4	66.0	67.2	66.8	64.2	63.8	65.6	64.0	65.4	69.0
3	64.7	63.8	67.9	65.9	67.5	66.4	64.1	63.8	65.0	64.0	65.3	70.0
4	64.5	63.8	68.0	65.6	67.0	65.8	64.1	63.7	64.7	64.1	65.2	71.0
5	64.3	63.7	68.1	65.3	65.8	65.4	64.0	63.6	64.3	64.1	66.0	70.8
6	64.3	63.7	67.1	65.0	66.1	65.2	64.0	63.6	64.2	64.3	66.5	69.3
7	64.1	63.7	66.7	64.9	67.0	65.9	64.0	63.5	64.2	64.5	66.5	68.4
8	63.9	63.7	67.1	64.8	67.3	64.9	64.0	63.6	64.0	64.6	66.8	67.0
9	63.7	63.7	70.6	64.7	67.5	64.9	63.9	63.7	64.0	64.6	67.0	66.5
10	63.6	63.8	71.5	64.5	68.0	65.0	63.9	63.7	64.0	64.4	66.7	65.6
11	63.6	63.9	71.7	65.1	68.8	64.9	64.0	63.8	64.2	64.2	66.2	65.4
12	65.5	64.0	70.0	65.3	69.6	64.8	64.2	64.0	64.2	64.1	65.8	65.2
13	65.5	64.2	68.9	65.4	71.6	64.6	64.3	64.1	64.1	64.0	65.5	65.2
14	66.4	64.4	67.2	65.4	72.8	64.5	64.3	64.8	64.1	63.9	65.2	65.1
15	66.0	64.5	66.4	65.2	74.0	64.4	64.2	66.2	64.2	63.8	65.2	65.0
16	65.7	64.6	66.0	65.0	75.2	64.3	64.2	65.7	64.2	63.8	65.0	64.9
17	66.8	64.4	65.8	64.8	76.2	64.3	64.2	66.1	64.2	64.0	64.9	64.8
18	67.2	64.2	65.5	64.6	75.3	64.5	64.1	66.1	64.1	65.3	64.8	64.7
19	65.8	64.0	65.4	64.5	72.3	64.3	64.0	66.0	64.0	69.1	64.8	64.8
20	65.2	63.9	65.2	64.4	69.7	64.8	64.0	66.7	64.0	71.1	64.8	65.0
21	64.7	64.2	65.2	64.6	67.4	65.0	63.9	66.1	64.2	69.4	64.9	65.8
22	64.5	65.0	65.1	66.6	66.4	65.4	63.9	65.9	64.3	69.8	65.0	67.0
23	64.4	65.2	65.0	67.7	66.0	65.6	64.0	65.8	64.3	68.7	64.9	68.2
24	63.8	66.0	65.0	68.7	65.6	65.8	64.4	66.0	64.1	67.3	64.8	68.4
25	63.8	67.1	65.0	67.5	65.4	65.4	64.4	66.0	64.0	67.0	64.7	68.5
26	63.8	70.3	65.0	67.0	65.2	65.1	64.3	65.9	63.9	68.0	64.7	67.9
27	63.9	71.6	65.0	66.9	65.1	64.9	64.3	65.7	63.8	67.9	64.7	66.9
28	64.0	68.2	65.7	66.4	65.0	64.7	64.2	65.4	63.8	68.0	64.9	66.5
29	64.0	.....	65.2	66.2	64.9	64.6	64.0	65.3	63.8	67 3	65.1	66.0
30	64.0	.....	65.6	66.4	65.0	64.4	63.9	65.2	63.8	66.6	65.8	65.9
31	63.9	.....	66.0	.....	65.0	.....	63.8	64.9	.....	66.0	.....	65.8

Station rating table for East Branch of White River at Shoals, Ind., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
63.50	570	65.40	4,041	67.30	8,390	70.40	15,520
63.60	670	65.50	4,266	67.40	8,620	70.60	15,980
63.70	790	65.60	4,492	67.50	8,850	70.80	16,440
63.80	918	65.70	4,718	67.60	9,080	71.00	16,900
63.90	1,050	65.80	4,945	67.70	9,310	71.20	17,360
64.00	1,190	65.90	5,172	67.80	9,540	71.40	17,820
64.10	1,338	66.00	5,400	67.90	9,770	71.60	18,280
64.20	1,500	66.10	5,630	68.00	10,000	71.80	18,740
64.30	1,673	66.20	5,860	68.20	10,460	72.00	19,200
64.40	1,856	66.30	6,090	68.40	10,920	72.50	20,350
64.50	2,051	66.40	6,320	68.60	11,380	73.00	21,500
64.60	2,259	66.50	6,550	68.80	11,840	73.50	22,700
64.70	2,479	66.60	6,780	69.00	12,300	74.00	23,900
64.80	2,700	66.70	7,010	69.20	12,760	74.50	25,100
64.90	2,922	66.80	7,240	69.40	13,220	75.00	26,300
65.00	3,145	66.90	7,470	69.60	13,680	75.50	27,500
65.10	3,365	67.00	7,700	69.80	14,140	76.00	28,700
65.20	3,592	67.10	7,930	70.00	14,600	76.50	29,900
65.30	3,816	67.20	8,160	70.20	15,060		

NOTE.—The above table is applicable only for open channel conditions. It is based on 14 discharge measurements made during 1903–1905. It is fairly well defined between gage heights 63.2 feet and 69 feet. The table has been extended beyond these limits, being based on one measurement at 95.2 feet. This measurement may be considerably in error owing to backwater.

Estimated monthly discharge of East Branch of White River at Shoals, Ind., for 1905.

[Drainage area, 4,900 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	8,160	670	2,694	0.550	0.634
February	18,280	790	3,216	.656	.683
March	18,510	3,145	7,320	1.50	1.73
April	11,610	1,856	4,801	.980	1.09
May	29,180	2,922	10,698	2.18	2.51
June	7,240	1,673	3,363	.686	.765
July	1,856	918	1,315	.268	.309
August	7,010	570	3,191	.651	.750
September	4,492	918	1,591	.325	.363
October	17,130	918	5,264	1.07	1.23
November	7,700	2,479	4,106	.838	.935
December	16,900	2,479	7,263	1.48	1.71
The year	29,180	570	4,568	.932	12.71

NOTE.—Practically no ice conditions; discharge applied as for open channel.

TENNESSEE RIVER BASIN.

DESCRIPTION OF BASIN.

Tennessee River is formed by the junction of the French Broad and the Holston, about 4 miles above Knoxville, Tenn. It flows southwestward, crossing into Alabama about 40 miles below Chattanooga, Tenn., and, after crossing the northern part of Alabama, again enters Tennessee in Harding County. It then flows northward, crossing Tennessee and Kentucky, and enters Ohio River at Paducah, about 40 miles above Cairo. Its principal tributary on the north is Clinch River, which enters it near Kingston, Roan County, Tenn. The principal tributaries on the south are Hiwassee and Little Tennessee rivers. The Hiwassee rises in the northern part of Georgia and flows into the Tennessee about 30 miles above Chattanooga. Its principal tributaries are the Ocoee and Nottely. Little Tennessee River rises in the northeast corner of Georgia, flows across the southwestern part of North Carolina, and enters the Tennessee near Loudon, Tenn. Its principal tributary is the Tuckasegee. French Broad River rises in the western part of North Carolina. Its principal tributaries are the Pigeon and the Nolichucky. Holston River rises in the western part of Virginia. Its principal tributary is Watauga River.

FRENCH BROAD RIVER AT HORSESHOE, N. C.

This station was established October 4, 1904, by B. S. Drane. It is located at the steel highway bridge at Horseshoe, N. C.

The channel is straight for about 2,000 feet above and 1,500 feet below the station. The current is of fair velocity at all stages except the lowest, when it becomes sluggish along the right bank. The right bank is of earth, wooded, and about 15 feet high. The left bank is similar, but is cleared. The earth embankments which form the bridge approaches on either side are of such a height that all the water passes beneath the bridge and through a flood channel 81 feet wide, which is opened through the embankment 140 feet from the left end of the bridge.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is on the downstream hand rail over the inner edge of the capstone of the left abutment.

A plain staff gage, graduated to feet and tenths, is attached vertically to a 1½ by 4 inch oak timber, which is driven into the bed of the stream to a firm foundation and nailed to an overhanging birch on the right bank, 25 feet below the bridge. It is read once each day by Charles Duncan. The gage is referred to bench marks as follows: (1) The upper surface of the downstream end of the first floor beam from the left bank, 15 feet from the initial point for soundings; elevation, 20.48 feet. (2) The center of the head of a wire nail driven into the downstream face of a large birch tree on the right bank, about 20 feet above the bridge; elevation, 12.40 feet. Elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey, No. 128, pages 98–99.

Discharge measurements of French Broad River at Horseshoe, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 12	B. S. Drane	81	439	2.02	3.10	888
June 22	do	81	522	2.22	3.84	1,159
August 29	do	81	488	2.27	3.60	1,109
November 11	W. E. Hall	81	259	1.60	1.37	415

Daily gage height, in feet, of French Broad River at Horseshoe, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.6	1.7	4.0	2.4	2.6	3.3	6.8	3.1	3.2	1.8	1.65	1.3
2	1.45	1.65	3.9	2.35	2.4	3.0	7.2	2.8	4.0	1.8	1.6	1.3
3	1.45	1.6	3.8	2.3	2.4	2.8	4.8	2.8	3.8	1.85	1.55	9.4
4	1.4	1.5	3.5	2.25	4.0	2.7	3.7	2.9	3.4	2.4	1.5	6.3
5	1.15	1.5	3.4	2.4	4.7	2.7	3.4	3.2	3.2	2.0	1.5	3.5
6	1.25	1.9	3.3	3.2	8.4	2.6	3.8	2.9	2.95	1.8	1.45	2.7
7	4.7	1.8	3.3	2.7	6.3	2.4	3.8	2.85	2.8	1.75	1.45	2.3
8	2.7	2.35	3.3	2.4	5.7	2.35	4.8	2.8	2.75	1.65	1.45	3.6
9	2.0	3.4	3.2	2.4	4.8	2.2	3.7	6.5	2.7	1.6	1.4	9.0
10	.95	5.0	5.2	2.8	4.6	2.1	3.2	5.5	2.65	1.6	1.4	9.3
11	.65	3.8	4.8	2.5	4.0	2.1	6.6	10.2	2.55	6.9	1.4	5.4
12	8.4	3.1	4.0	2.6	3.6	2.0	12.5	10.8	2.55	4.4	1.4	4.4
13	10.2	6.3	4.2	3.8	3.3	2.0	13.8	10.5	2.5	2.7	1.4	3.6
14	7.0	5.3	3.8	3.4	3.2	1.85	15.2	7.5	2.4	2.3	1.35	3.2
15	4.5	4.0	3.5	2.9	2.9	2.4	15.0	6.3	2.4	2.1	1.35	3.6
16	3.7	3.0	3.3	3.0	5.9	10.2	7.8	5.4	2.35	2.0	1.3	4.6
17	3.2	3.0	3.1	2.7	4.8	8.9	6.7	5.3	2.3	2.0	1.25	3.8
18	2.7	2.85	3.0	2.5	3.8	6.3	6.0	4.5	2.25	1.9	1.2	3.4
19	2.55	2.6	2.9	2.35	3.4	4.2	5.7	4.4	2.35	1.85	1.2	3.1
20	2.5	2.8	2.8	2.3	3.2	4.4	5.3	4.4	2.3	1.8	1.45	3.2
21	2.35	8.9	3.3	2.25	3.0	4.9	5.0	4.3	2.3	1.8	1.7	7.3
22	2.2	6.7	3.7	2.2	3.3	3.9	5.3	4.6	2.15	1.8	1.45	5.3
23	2.1	6.7	3.2	2.15	3.2	3.8	4.6	5.6	2.0	1.75	1.35	4.6
24	2.0	6.0	3.0	2.1	4.0	3.3	4.2	6.6	2.0	1.7	1.3	4.7
25	1.8	5.4	3.1	2.1	3.3	2.75	4.0	6.0	1.95	1.65	1.3	4.4
26	2.5	5.0	2.9	2.9	3.5	2.7	3.2	5.4	1.9	1.85	1.3	3.8
27	3.4	4.6	2.75	2.6	5.8	2.75	3.4	4.5	1.85	1.95	1.3	3.5
28	3.6	4.4	2.5	2.4	6.3	2.7	4.1	4.0	1.85	1.8	1.25	3.2
29	2.4	.....	2.5	2.3	4.5	2.4	3.8	3.6	1.8	1.75	1.25	5.1
30	2.2	.....	2.5	3.2	4.2	3.2	3.4	3.4	1.8	1.7	1.3	4.4
31	1.8	.....	2.6	.....	3.6	.....	3.4	3.3	.....	1.7	.....	4.5

FRENCH BROAD RIVER AT SMITH BRIDGE, NEAR ASHEVILLE, N. C.

This station is located at the steel highway bridge known as Smith Bridge, about 1 mile below the Southern Railway depot at Asheville, N. C., and near the end of the Patton avenue line of the Asheville Street Railway Company. The United States Weather Bureau maintains a station at this place, and during 1904 a number of discharge measurements were made by the United States Geological Survey. During 1905 the discharge measurements have been continued and the gage heights have been furnished by the Weather Bureau.

The channel is straight for about 1,500 feet above and 800 feet below the station. There is but one channel at all stages, broken by three piers at ordinary and four at high-water stages. The banks are not high, but all water will probably be confined between the abutments, as the road has been raised by embankments. The current is fairly swift and somewhat irregular. The bed is of sand and bowlders and is irregular.

Discharge measurements are made from the walkway on the upstream side of the bridge, the initial point for soundings being the end of the hand rail at the left bank. The bridge has five spans of 100 feet each, supported by four stone piers and two stone abutments.

A new boxed chain gage has been installed by the Weather Bureau to take the place of the vertical gage which is attached to the southwest corner of the second stone pier from the left bank. It is located on the downstream side of the bridge in the second panel to the left of the pier to which the vertical gage is attached. The length of the chain is 26.45 feet. The bench mark is the top of the downstream end of the second floor beam to the left of the second pier from the left bank; elevation, 20.08 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Bull.=Bulletin; Ann.=Annual Report; WS=Water-Supply Paper):

Description: Bull 140, pp 80–81; WS 15, p 60; 27, p 59; 36, pp 165–166; 48, p 186; 65, p 301; Ann 18, iv, p 116; 128, pp 99–100, 100–101.

Discharge: Ann 18, iv, p 116; Bull 140, p 80; WS 15, p 60; 27, p 65; 36, p 166; 48, p 186; 65, p 301; 128, pp 100–101.

Discharge, monthly: Ann 19, iv, p 257–258; 20, iv, p 205; 21, iv, p 160; 22, iv, p 223; WS 75, p 103.

Discharge, yearly: Ann 20, iv, p 52.

Gage heights: Bull 140, p 81; WS 11, p 42; 15, p 60; 27, p 62; 36, p 166; 48, p 186; 65, p 301.

Hydrographs: Ann 19, iv, pp 258–259; 20, iv, p 205; 21, iv, p 161.

Rating tables: Ann 19, iv, p 257; WS 27, p 66; 39, p 446; 52, p 515; 65, p 323.

Discharge measurements of French Broad River at Smith Bridge, near Asheville, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 17	B. S. Drane	318	930	1.70	−0.07	1,577
June 28	do	320	964	1.74	0.00	1,674
August 26	do	331	1,339	2.48	1.18	3,326
November 10	W. E. Hall	300	679	1.37	− .52	931

Daily gage height, in feet, of French Broad River at Smith Bridge, near Asheville, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	−0.5	−0.4	0.5	−0.3	−0.1	0.4	0.5	0.1	0.1	−0.5	−0.5	−0.6
2	− .5	− .4	.5	− .3	− .2	.2	2.0	.1	.4	− .5	− .5	−0.6
3	− .6	− .6	.4	− .3	− .3	.1	1.5	.1	.8	− .5	− .5	2.8
4	− .8	−.6	.2	− .4	.2	.0	.5	.1	.5	− .2	− .5	2.3
5	− .8	− .6	.2	− .3	.7	.0	.4	.3	.1	− .3	− .5	.6
6	− .6	− .6	.1	.3	1.7	.2	.8	.2	.0	− .4	− .5	.2
7	1.9	.0	.1	.1	1.2	− .3	.6	.0	.0	− .5	− .5	− .2
8	.0	.1	.1	− .1	1.3	− .4	.6	.0	− .2	− .5	− .6	1.9
9	− .5	− .1	− .1	− .1	.8	− .4	.5	1.5	− .1	− .5	− .6	2.8
10	− .5	.9	.5	.1	1.0	− .4	1.1	2.3	− .1	− .6	− .6	2.8
11	− .6	.5	1.0	.0	.8	− .4	2.4	3.3	− .2	.0	− .6	1.5
12	.0	.1	.5	.4	.4	− .4	5.7	3.9	− .2	1.3	− .6	.8
13	3.4	1.0	.6	.6	.4	− .4	6.0	3.5	− .2	.0	− .6	.7
14	2.9	1.6	.6	.4	.2	− .4	5.1	2.7	− .2	− .3	− .6	.5
15	.9	1.0	.3	.2	.2	− .4	4.4	1.7	− .2	− .4	− .6	.4
16	.4	.5	.2	.2	1.8	.5	3.0	1.7	− .2	− .4	− .6	.8
17	.0	.1	.1	.1	1.5	3.0	3.0	1.1	− .3	− .4	− .6	.5
18	.0	.2	.1	.0	.8	2.5	1.6	.9	− .3	− .4	− .6	.4
19	− .2	− .5	.0	− .1	.4	3.0	1.5	.7	− .3	− .4	− .6	.2
20	− .2	− .4	.0	− .2	.2	1.3	1.2	.7	− .3	− .5	− .6	.1
21	− .3	2.5	.1	− .2	.2	1.0	1.0	.6	− .3	− .5	− .6	2.0
22	− .3	2.0	.5	− .2	.2	.8	1.1	.5	− .3	− .5	− .5	1.8
23	− .3	2.1	.1	− .3	.5	.7	.9	1.0	− .3	− .5	− .6	1.2
24	− .3	− .3	1.6	.0	.6	.4	.7	1.4	− .4	− .5	− .6	1.0
25	− .3	1.1	.3	− .4	.3	.2	1.0	1.6	− .4	− .5	− .6	.8
26	− .3	1.0	.1	− .3	.3	.1	.5	1.4	− .4	− .5	− .6	.5
27	− .2	.8	.0	− .1	.3	.3	.3	.9	− .5	− .5	− .6	.3
28	.0	.5	− .1	− .2	3.0	.1	.5	.5	− .5	− .4	− .6	.2
29	− .2	.....	− .2	− .2	1.5	− .1	1.0	1.0	− .5	− .4	− .6	.8
30	− .2	.....	− .1	.1	.9	.1	.8	.8	− .5	− .5	− .6	.7
31	− .1	.....	− .2	.....	.6	.....	.2	.2	.....	− .5	.....	.5

Station rating table for French Broad River at Smith Bridge, near Asheville, N. C., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−1.00	420	0.40	2,190	1.70	4,150	3.00	6,310
−0.90	510	0.50	2,330	1.80	4,310	3.20	6,670
−0.80	610	0.60	2,470	1.90	4,470	3.40	7,030
−0.70	720	0.70	2,620	2.00	4,630	3.60	7,390
−0.60	840	0.80	2,770	2.10	4,790	3.80	7,750
−0.50	960	0.90	2,920	2.20	4,950	4.00	8,110
−0.40	1,090	1.00	3,070	2.30	5,120	4.20	8,490
−0.30	1,220	1.10	3,220	2.40	5,290	4.40	8,870
−0.20	1,350	1.20	3,370	2.50	5,460	4.60	9,250
−0.10	1,490	1.30	3,520	2.60	5,630	4.80	9,630
0.00	1,630	1.40	3,670	2.70	5,800	5.00	10,010
0.10	1,770	1.50	3,830	2.80	5,970	5.50	11,010
0.20	1,910	1.60	3,990	2.90	6,140	6.00	12,010
0.30	2,050						

NOTE.—The above table is based on nine discharge measurements made during 1904–5. It is well defined between gage heights −0.9 foot and 1.2 feet. The table has been extended beyond these limits.

Estimated monthly discharge of French Broad River at Smith Bridge, near Asheville, for 1905.

[Drainage area, 987 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	7,030	610	1,743	1.77	2.04
February	5,460	840	2,255	2.28	2.37
March	3,990	1,350	1,996	2.02	2.33
April	2,470	1,090	1,536	1.56	1.74
May	6,310	1,220	2,637	2.67	3.08
June	6,310	1,090	2,211	2.24	2.50
July	12,010	1,910	4,178	4.23	4.88
August	7,930	1,630	3,320	3.36	3.87
September	2,770	960	1,406	1.42	1.58
October	3,520	840	1,145	1.16	1.34
November	960	840	872	.883	.985
December	5,970	840	2,961	3.00	3.46
The year	12,010	840	2,188	2.22	30.18

FRENCH BROAD RIVER AT OLDTOWN, TENN.

This was originally one of the temporary stations established in connection with the general hydrographic study of the southern Appalachian region.

The channel is straight for about 600 feet above and below the station. The velocity is moderately swift, and is considerably obstructed by old piling and logs. Both banks are high and wooded, and all water passes beneath the bridge at all stages. The bed is of gravel and sand.

Discharge measurements are made from the downstream side of the steel highway bridge of four spans. The initial point for soundings is the end of the guard rail at the left end of the bridge, on the downstream side.

The original gage put in at this station was carried away with the old bridge by flood early in the spring of 1902. A wire gage was established on the new bridge October 27, 1902, by B. S. Drane. The wire gage was replaced April 29, 1903, by a standard chain gage at the same datum. The length of the chain is 28.00 feet. The gage is referred to bench marks as follows: (1) A point marked in white paint on the sharp rectangular corner of the angle-iron connection between the floor beam and the first post on the downstream side in the second span from the left end of the bridge; elevation, 25.84 feet. (2) The top of a copper bolt set in a bowlder projecting from the hillside on the left bank 175 feet downstream from the center line of the bridge, 8 feet from the center of the road, and about 4 feet above ground. This rock is the first smooth-faced ledge of limestone outcropping close to the road. The face next the road is nearly vertical for a length of 4 feet. Elevation of bench mark, 29.52 feet. Elevations refer to the datum of the gage. The station was abandoned December 31, 1905.

Information in regard to this station is contained in the following water-supply papers of the United States Geological Survey:

Description: 48, p 187; 65, p 302; 83, p 223; 98, pp 279–280; 128, pp 101–102.
Discharge: 48, p 187; 65, p 302; 83, p 223; 98, p 280; 128, p 102.
Discharge, monthly: 98, p 282; 128, p 103.
Gage heights: 48, p 187; 65, p 302; 83, p 223; 98, pp 280–281; 128, p 102.
Rating tables: 65, p 323; 98, p 281; 128, p 103.

Discharge measurements of French Broad River at Oldtown, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 9	B. S. Drane	395	2,028	2.25	2.50	4,564
May 11	W. E. Hall	379	2,059	2.05	2.54	4,208
June 20	B. S. Drane	396	2,125	2.14	2.70	4,547
August 21	W. E. Hall	361	1,964	1.53	2.13	3,007
December 19	F. A. Murray	375	1,894	1.38	1.95	2,627
December 26	do	377	2,002	1.70	2.19	3,399

Daily gage height, in feet, of French Broad River at Oldtown, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.55	2.0	2.25	1.65	1.9	2.05	2.15	1.95	1.8	1.35	1.4	1.35
2	1.5	1.65	2.15	1.65	1.8	1.95	3.0	1.9	1.9	1.35	1.35	1.35
3	1.6	1.6	2.1	1.6	1.7	1.85	2.75	1.8	2.2	1.4	1.3	4.1
4	1.6	1.55	2.05	1.6	1.7	1.75	2.25	1.8	2.0	1.5	1.3	3.3
5	1.4	1.5	2.0	1.7	2.6	1.75	2.2	1.95	1.9	1.6	1.3	2.4
6	1.75	1.55	1.95	2.1	2.55	1.8	2.65	1.9	1.8	1.5	1.35	1.9
7	2.2	1.65	1.9	2.2	3.2	1.7	2.4	1.95	1.75	1.5	1.4	1.8
8	2.25	1.9	1.95	2.0	3.8	1.7	2.05	2.25	1.7	1.4	1.35	1.7
9	1.8	2.5	2.0	1.95	2.9	1.7	2.1	3.0	1.65	1.35	1.3	2.7
10	1.8	2.9	2.25	2.25	2.45	1.6	2.4	2.75	1.65	1.4	1.3	3.8
11	1.7	2.55	2.65	2.1	2.5	1.6	2.5	3.6	1.65	1.5	1.35	3.0
12	2.4	2.2	2.4	2.85	2.2	1.65	9.3	4.6	1.6	2.55	1.3	2.35
13	4.8	2.5	2.3	2.6	2.75	1.9	7.6	4.2	1.6	1.95	1.25	2.1
14	4.1	3.0	2.2	2.4	2.55	1.65	6.0	3.7	1.6	1.65	1.3	1.95
15	2.65	2.5	2.1	2.2	2.4	1.55	5.1	3.1	1.55	1.5	1.3	1.9
16	2.15	2.1	2.0	2.0	4.0	1.6	4.1	2.7	1.55	1.5	1.3	2.25
17	2.0	2.05	1.95	1.95	3.8	3.6	3.1	2.6	1.55	1.5	1.25	2.1
18	1.95	2.0	1.85	1.9	2.85	3.4	2.8	2.4	1.5	1.45	1.25	2.0
19	1.9	1.9	1.8	1.8	2.4	3.2	2.4	2.3	1.5	1.4	1.3	1.9
20	1.8	2.1	1.85	1.75	2.2	2.75	2.8	2.4	1.6	1.55	1.25	1.9
21	1.7	4.4	1.9	1.75	2.05	2.5	2.55	2.1	1.6	1.5	1.3	2.3
22	1.7	4.3	2.1	1.75	2.15	2.5	2.7	2.1	1.6	1.5	1.35	2.9
23	1.65	3.8	1.95	1.7	2.7	2.35	2.65	2.2	1.5	1.4	1.3	2.6
24	1.6	3.2	1.9	1.6	2.5	2.2	2.4	2.3	1.5	1.4	1.3	2.6
25	1.6	2.85	1.85	1.6	2.35	2.0	2.3	2.6	1.45	1.4	1.3	2.35
26	1.5	2.65	1.85	1.65	2.15	1.9	2.2	2.45	1.4	1.5	1.25	2.15
27	1.4	2.5	1.8	1.75	2.25	2.4	2.1	2.3	1.4	1.55	1.25	2.0
28	1.3	2.4	1.75	1.8	3.1	2.1	2.2	2.1	1.35	1.55	1.3	1.95
29	1.2	.....	1.7	1.85	3.0	1.9	2.4	2.0	1.4	1.5	1.35	2.0
30	1.15	.....	1.7	1.95	2.4	1.95	2.7	1.9	1.35	1.45	1.4	2.2
31	1.5	.....	1.7	.....	2.25	.....	2.2	1.9	.....	1.4	.....	2.0

Station rating table for French Broad River at Oldtown, Tenn., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	400	1.90	2,410	2.80	5,140	3.70	8,805
1.00	535	2.00	2,680	2.90	5,500	3.80	9,245
1.10	685	2.10	2,955	3.00	5,875	3.90	9,690
1.20	850	2.20	3,235	3.10	6,260	4.00	10,140
1.30	1,030	2.30	3,525	3.20	6,660	4.20	11,050
1.40	1,225	2.40	3,825	3.30	7,075	4.40	11,980
1.50	1,435	2.50	4,135	3.40	7,500	4.60	12,920
1.60	1,660	2.60	4,455	3.50	7,930	4.80	13,860
1.70	1,900	2.70	4,790	3.60	8,365	5.00	14,800
1.80	2,150						

NOTE.—The above table is based on 13 discharge measurements made during 1904–5 and 1 measurement made in 1903 to determine the upper part of the curve. It is well defined between gage heights 1 foot and 3 feet.

Estimated monthly discharge of French Broad River at Oldtown, Tenn., for 1905.

[Drainage area, 1,737 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	13,860	768	2,703	1.56	1.80
February	11,980	1,435	4,188	2.41	2.51
March	4,622	1,900	2,688	1.55	1.79
April	5,320	1,660	2,508	1.44	1.61
May	10,140	2,025	4,493	2.59	2.99
June	8,365	1,548	3,051	1.76	1.96
July	36,300	2,818	6,942	4.00	4.61
August	12,920	2,150	4,319	2.49	2.87
September	3,235	1,128	1,730	.996	1.11
October	4,295	1,128	1,502	.865	.997
November	1,225	940	1,051	.605	.675
December	10,590	1,128	3,679	2.12	2.44
The year	36,300	768	3,238	1.86	25.36

SWANNANOA RIVER AT BILTMORE, N. C.

This station was established May 21, 1904, for the purpose of making miscellaneous measurements. It is located at the Biltmore, N. C., terminal of the Asheville-Biltmore electric railway line, about three-fourths of a mile above the mouth of Swannanoa River.

The channel is straight for about 1,000 feet above and curved for 300 feet below the station. The current is sluggish above and somewhat swifter below the bridge. Both banks are high and not subject to overflow. The bed of the stream is composed of sand. There is but one channel at all stages.

Discharge measurements are made from the upstream side of a single-span highway bridge. The initial point for soundings is the right end of the upstream hand rail of the bridge.

Bench marks were established as follows: (1) The center of the center-pin bearing at the upstream end of the second floor beam from the right bank; elevation, 16.00 feet. (2) The center of the head of a small wire nail driven into a triangular-shaped blaze in the downstream side of a birch tree on the right bank, about 25 feet above the bridge; elevation, 5.74 feet. Elevations refer to the datum of the assumed gage.

A description of this station and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, page 104.

Discharge measurements of Swannanoa River at Biltmore, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 17	B. S. Drane	74	140	1.19	1.24	167
June 28	do	75	140	1.24	1.22	175
August 26	do	75	158	1.28	1.29	204

TENNESSEE RIVER NEAR KNOXVILLE, TENN.

This station was originally established by the United States Weather Bureau at the old Gay street or county highway bridge, which has been torn down and replaced by a new bridge.

The channel is straight for one-half mile above and 1,000 feet below the station. The right bank will overflow for about 400 feet and the left bank for 200 feet, beyond which points steep high bluffs begin on both sides of the river. The bed is of rocks and gravel, and is rough and probably permanent. The current is swift and somewhat broken by the rough bed and by the remains of old piers.

Until recently discharge measurements have been made from the Cherokee Bridge, about 2½ miles downstream from the Gay Street Bridge, at which measurements are now made, and which is one-half mile above the Knoxville and Augusta Railroad bridge. The Gay Street Bridge has 7 spans, with a total length of 1,570 feet. The floor of the bridge is about 100 feet above low water. The initial point for soundings is the end of the bridge on the right bank, downstream side.

When the old bridge was removed it was decided to move the gage down the river in order to get below some shoals and wing dams which have been put in for boating. A temporary gage was put in at the Knoxville and Augusta Railroad bridge, half a mile below the Gay Street Bridge, and was used during the greater part of the year 1899. In the latter part of that year a new permanent gage was established, and readings from it began November 1, 1899. The new gage is on the right bank of the river, just below the mouth of West Knoxville Bayou and about 1,000 feet below the temporary gage at the Knoxville and Augusta Railroad bridge. The gage is in two sections—the first, a sloping section made of a 2 by 4 inch pine timber spiked on top of an 8 by 8 inch oak sill well bolted to piles and imbedded in crushed stone, reading from −2 to +12 feet; the second, a vertical section, attached to one of the bents of the railroad trestle across West Knoxville Bayou, about 50 feet from the bank of the river, reading from 12 to 36.5 feet. The gage is fastened to the upstream post of the bent, facing away from the river. The gage was located for the United States Weather Bureau by the United States Engineer Corps. Daily records are kept by the United States Weather Bureau and are furnished to the Geological Survey. The zero of the gage is 804.3 feet above sea level. The bench mark is a cross in the stone on the east corner of the base of right-bank pier of the Knoxville and Augusta Railroad bridge. Elevation, 2.40 feet above the zero of the gage and 806.7 feet above sea level.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 36, pp 172–173; 48, pp 193–194; 65, p 303; 83, pp 220–221; 98, p 276; 128, pp 104–105.
Discharge: 36, p 173; 48, p 194; 65, p 303; 83, p 221; 98, p 277; 128, p 105.
Discharge, monthly: 75, pp 103–104; 83, p 222; 98, p 279; 128, p 107.
Gage heights: 36, p 173; 48, p 194; 65, p 304; 83, p 221, 98, p 277; 128, p 106.
Rating tables: 65, p 324; 83, p 222; 98, p 278; 128, p 106.

Discharge measurements of Tennessee River near Knoxville, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 15	B. S. Drane	894	8,013	3.50	7.00	28,040
April 14	O. P. Hall	883	6,178	3.49	5.32	21,580
May 10	W. E. Hall	856	6,383	3.39	5.26	21,630
August 26	do	876	5,255	3.03	3.33	15,920
October 11	O. P. Hall	630	2,977	1.51	.72	4,484
December 27	F. A. Murray	856	5,126	2.52	3.09	12,900

Daily gage height, in feet, of Tennessee River near Knoxville, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.8	1.3	4.3	2.0	3.0	2.4	2.1	4.0	1.6	0.4	0.6	0.4
2	1.5	1.4	4.0	2.0	2.8	2.2	1.8	2.4	1.5	.4	.5	.4
3	1.8	1.2	3.6	1.8	2.4	2.1	2.3	2.1	2.4	.5	.5	1.9
4	2.3	1.1	3.4	1.7	2.1	1.9	2.2	1.8	2.3	.5	.4	6.8
5	2.2	1.1	3.4	1.7	1.9	1.7	1.8	1.6	1.9	.5	.4	6.8
6	2.2	2.1	3.2	2.2	2.4	1.6	1.8	1.6	1.8	.6	.4	4.4
7	2.2	2.3	3.1	3.7	3.0	1.5	2.5	1.6	2.2	.6	.4	2.7
8	3.7	2.8	3.2	4.5	4.7	1.4	2.5	1.9	1.6	.6	.4	2.0
9	3.3	8.5	4.7	4.2	6.2	1.3	2.1	3.1	1.4	.5	.5	2.5
10	2.5	10.8	9.7	4.4	5.4	1.2	1.9	4.3	1.2	.4	.4	4.5
11	2.0	8.7	9.2	4.7	4.0	1.2	2.1	4.0	1.1	.7	.4	5.4
12	3.7	6.6	8.6	4.3	3.6	1.1	2.7	6.3	1.1	1.0	.4	4.1
13	8.5	5.5	6.4	5.4	3.9	1.4	12.0	8.0	1.1	1.7	.3	3.0
14	10.8	6.6	5.2	5.4	4.9	1.6	11.7	7.5	1.2	1.5	.3	2.4
15	8.4	7.4	4.5	4.5	6.6	1.3	9.3	6.0	1.2	1.1	.3	2.0
16	5.1	5.1	3.9	3.8	8.1	1.3	6.7	5.0	1.0	.8	.3	2.0
17	3.7	4.6	3.5	3.3	10.1	1.2	5.0	4.7	.9	.7	.3	2.2
18	3.0	3.9	3.2	3.0	9.1	3.7	3.8	4.2	.9	.6	.3	2.2
19	2.6	3.6	2.9	2.6	6.7	3.7	3.3	4.0	.8	.5	.3	2.0
20	2.5	3.8	2.8	2.3	5.0	3.3	4.3	3.1	.8	.6	.4	1.8
21	2.4	10.1	2.8	2.2	4.0	3.0	3.6	2.8	.8	.7	.4	1.8
22	2.1	11.0	2.9	2.4	3.6	2.9	3.0	2.4	.8	.7	.4	2.0
23	2.0	10.0	2.9	2.2	3.9	2.8	3.1	2.3	.9	.6	.5	4.0
24	1.8	8.5	2.8	2.1	4.4	2.6	3.7	2.7	.8	.5	.5	5.1
25	1.6	7.3	2.5	2.1	3.9	2.4	4.0	3.5	.7	.5	.4	4.6
26	1.2	6.0	2.4	1.9	3.3	2.1	3.2	3.2	.6	.7	.4	4.0
27	.7	5.2	2.4	2.5	2.8	2.7	2.6	3.2	.6	.7	.3	3.2
28	.5	4.7	2.3	2.2	2.9	3.3	2.2	2.8	.5	.9	.3	2.8
29	.6	.....	2.2	2.3	3.0	2.4	2.1	2.3	.5	1.0	.3	2.5
30	1.0	.....	2.1	3.4	3.4	1.9	2.4	1.9	.4	.9	.4	2.3
31	1.3	.....	2.1	.....	2.8	.....	2.8	1.7	.....	.7	.....	2.4

Station rating table for Tennessee River near Knoxville, Tenn., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−0.40	1,750	1.30	6,150	3.00	12,190	6.40	26,100
−0.30	1,930	1.40	6,480	3.20	12,950	6.60	26,990
−0.20	2,120	1.50	6,820	3.40	13,710	6.80	27,890
−0.10	2,320	1.60	7,160	3.60	14,480	7.00	28,790
0.00	2,530	1.70	7,500	3.80	15,260	7.20	29,710
0.10	2,750	1.80	7,850	4.00	16,040	7.40	30,630
0.20	2,980	1.90	8,200	4.20	16,840	7.60	31,560
0.30	3,220	2.00	8,550	4.40	17,640	7.80	32,500
0.40	3,470	2.10	8,900	4.60	18,450	8.00	33,440
0.50	3,730	2.20	9,260	4.80	19,270	8.50	35,840
0.60	4,000	2.30	9,620	5.00	20,090	9.00	38,290
0.70	4,280	2.40	9,980	5.20	20,930	9.50	40,790
0.80	4,570	2.50	10,340	5.40	21,770	10.00	43,340
0.90	4,870	2.60	10,710	5.60	22,620	10.50	45,940
1.00	5,180	2.70	11,080	5.80	23,480	11.00	48,590
1.10	5,500	2.80	11,450	6.00	24,340	11.50	51,290
1.20	5,820	2.90	11,820	6.20	25,220	12.00	54,040

The above table is based on discharge measurements made during 1900–1905 and is well defined.

Estimated monthly discharge of Tennessee River near Knoxville, Tenn., for 1905.

[Drainage area, 8,990 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	47,530	3,730	12,280	1.37	1.58
February	48,590	5,500	22,740	2.53	2.64
March	41,810	8,900	15,950	1.77	2.04
April	21,770	7,500	12,430	1.38	1.54
May	43,860	8,200	17,710	1.97	2.27
June	14,870	5,500	9,002	1.00	1.12
July	54,040	7,850	15,550	1.73	1.99
August	33,440	7,160	14,050	1.56	1.80
September	9,980	3,470	5,745	.637	.713
October	7,500	3,470	4,354	.484	.558
November	4,000	3,220	3,448	.384	.428
December	27,890	3,470	12,600	1.40	1.61
The year	54,040	3,220	12,150	1.35	18.29

TENNESSEE RIVER AT CHATTANOOGA, TENN.

This station was established in 1879, at the foot of Lookout street, just below Chattanooga Island, by the Signal Corps of the United States Army; but since July 1, 1891, it has been in charge of the Weather Bureau.

The channel is curved for 3,000 feet above and 2,000 feet below the station. The right bank is high and overflows at flood stages, but all water passes under the bridge or its approach. The left bank is a high, rocky bluff and will not overflow. The bed is composed of loose rock, sand, and gravel and is fairly constant.

Discharge measurements are made from the steel highway bridge of six spans and an approach about 1,000 feet long on the right bank. The floor of the bridge is about 125 feet above low water. The initial point for soundings is the outside corner of the iron post of the downstream hand rail on the left bank.

The gage consists of a sloping section made of railroad rails bolted to solid rock and a vertical section of heavy timber bolted to the vertical face of the rock cliff. During the year 1900 a new gage was established. It is a vertical metal scale bolted to the south side of the third stone pier from the south end of the Hamilton County highway bridge. The original sloping gage, however, is still considered standard, as the later gage is not properly adjusted at its lower end on account of the projecting base of the pier. The self-registering gage invented by Professor Fulton, of Tennessee University, is also in use at this station. The gage is connected by wire with the Weather Bureau office, and a continuous electrical record of river height is made in the same manner as the record of wind, sunshine, etc. Gage heights are furnished to the Geological Survey through L. M. Pindell. The bench mark is the top of the water table on the southeast corner of the post-office on Eleventh street. Its elevation is 74.40 feet above the zero of the gage and 705 feet above sea level.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, p 119; WS 15, p 64; 27, p 60; 36, p 174; 48, p 195; 65, p 311; 83, p 203; 98, pp 255-256; 128, pp 107-108.

Discharge: Ann 18, iv, p 119; WS 15, p 64; 27, p 65; 36, p 174; 48, p 195; 65, p 311; 83, p 203; 98, p 256; 128, p 108.

Discharge, monthly: Ann 18, iv, pp 120-122; 19, iv, p 261; 20, iv, p 210; 21, iv, p 168; 22, iv, p 228; WS 75, p 109; 83, p 205; 98, p 257.

Discharge, yearly: Ann 20, iv, p 52.

Gage heights: WS 11, pp 43-46; 15, p 64; 27, p 64; 36, p 175; 48, p 195; 65, p 312; 83, p 203; 98, p 256; 128, p 108.

Hydrographs: Ann 19, iv, p 262; 20, iv, p 211; 21, iv, p 168; 22, iv, p 228; WS 75, p 109.

Rating tables: Ann 18, iv, p 120; 19, iv, p 260; WS 39, p 446; 27, p 66; 52, p 515; 65, p 324; 83, p 204; 98, p 257.

Discharge measurements of Tennessee River at Chattanooga, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 9	W. E. Hall	1,097	11,190	3.58	6.65	40,020
June 13	B. S. Drane	1,055	7,188	2.26	2.92	16,250
June 29	do	1,072	10,760	3.32	6.28	35,680
July 22	Hall and Hoyt	1,081	9,418	3.10	5.32	29,160
October 11	F. A. Murray	1,007	5,801	1.77	1.65	10,270
December 28	do	1,104	12,150	3.57	7.44	43,380

Daily gage height, in feet, of Tennessee River at Chattanooga, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.7	2.8	8.6	4.8	8.6	5.9	8.6	3.8	3.4	1.3	2.6	1.5
2	5.4	3.2	7.9	4.8	8.0	5.4	6.3	3.8	3.3	1.3	2.4	1.6
3	5.4	3.2	7.3	4.5	6.9	4.8	5.2	4.3	3.5	1.4	2.2	2.4
4	4.0	3.1	6.8	4.4	6.2	4.3	4.4	3.9	3.3	1.4	2.0	6.6
5	4.2	3.0	6.4	4.3	5.7	4.1	4.2	3.3	3.5	1.6	1.9	10.5
6	4.5	3.8	6.1	4.4	5.3	3.8	4.1	3.0	3.5	1.7	1.8	9.7
7	4.3	5.1	5.9	4.5	5.1	3.7	3.9	3.0	3.3	1.7	1.7	8.8
8	4.6	6.4	5.6	5.0	5.5	3.5	4.0	2.8	3.3	1.6	1.6	7.1
9	4.8	12.1	5.9	4.9	6.5	3.4	4.5	3.2	3.2	1.5	1.6	6.6
10	5.2	20.4	10.6	6.2	7.9	3.4	4.6	3.5	3.0	1.5	1.6	9.5
11	5.0	22.4	16.2	6.3	8.0	3.1	4.5	5.1	2.7	1.6	1.6	9.7
12	5.1	20.2	17.3	6.7	7.2	3.0	5.2	6.5	2.5	2.6	1.5	9.4
13	9.6	16.0	15.4	7.0	6.3	2.9	6.6	7.2	2.8	3.2	1.5	8.1
14	17.2	13.6	13.4	7.3	5.8	3.0	10.5	8.4	2.7	3.7	1.4	6.8
15	16.4	13.3	10.6	7.8	5.8	3.1	12.7	8.9	2.5	3.0	1.4	6.1
16	15.1	12.2	8.8	7.4	7.2	3.2	11.3	8.8	2.4	3.0	1.3	6.7
17	11.3	11.2	7.7	6.7	10.9	3.3	9.2	7.6	2.4	2.6	1.3	6.6
18	8.1	9.4	6.9	6.0	13.7	3.3	7.3	7.0	2.3	2.3	1.3	6.0
19	6.6	8.3	6.4	5.5	13.5	3.1	6.2	6.4	2.2	2.1	1.2	5.7
20	5.8	7.9	6.0	5.1	11.8	4.3	5.5	6.1	2.0	1.9	1.3	4.5
21	5.3	14.9	6.5	4.7	9.6	4.9	5.1	5.8	2.0	1.8	1.3	6.3
22	5.0	21.4	7.0	4.7	7.8	5.0	5.4	5.1	1.9	1.8	1.4	7.5
23	4.7	21.0	7.5	4.7	7.4	6.0	5.1	4.6	1.8	1.9	1.6	8.1
24	4.4	19.4	7.0	4.7	9.5	5.9	4.7	4.2	1.7	2.0	1.6	9.4
25	4.0	15.6	6.4	4.5	10.2	5.7	4.8	5.8	1.7	1.9	1.5	11.0
26	3.7	13.1	6.1	4.4	8.8	5.1	5.0	7.0	1.6	2.1	1.5	10.4
27	3.4	11.2	5.7	5.3	7.6	4.5	5.4	6.0	1.6	2.9	1.5	9.0
28	2.9	9.7	5.4	6.2	6.8	4.4	4.8	5.4	1.5	3.3	1.5	7.8
29	2.4	.....	5.2	6.4	6.1	6.0	4.2	5.0	1.4	3.3	1.5	7.0
30	2.4	.....	5.1	7.6	5.8	5.6	3.8	4.5	1.4	3.0	1.5	6.4
31	2.7	.....	4.9	.....	5.9	.....	3.8	4.0	.....	2.9	.....	6.0

Station rating table for Tennessee River at Chattanooga, Tenn., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
.00	4,800	1.10	8,210	2.20	12,790	3.60	19,520
.10	5,060	1.20	8,580	1.30	13,240	3.80	20,560
.20	5,330	1.30	8,960	2.40	13,700	4.00	21,620
.30	5,610	1.40	9,350	2.50	14,160	4.20	22,700
.40	5,900	1.50	9,750	2.70	14,620	4.40	23,820
.50	6,200	1.60	10,160	2.70	15,090	4.60	24,980
.60	6,510	1.70	10,590	2.80	15,560	4.80	26,180
.70	6,830	1.80	11,020	2.90	16,040	5.00	27,420
.80	7,160	1.90	11,460	3.00	16,520	5.20	28,680
.90	7,500	2.00	11,900	3.20	17,500	5.40	29,960
1.00	7,850	2.10	12,340	3.40	18,500	5.60	31,260

NOTE.—The above table is based on discharge measurements made during 1904–5. It is well defined between gage heights 1.2 feet and 7.5 feet. The table has been extended beyond these limits. Above gage height 5.50 feet the rating curve is a tangent, the difference being 660 per tenth.

Estimated monthly discharge of Tennessee River at Chattanooga, Tenn., for 1904–5.

[Drainage area, 21,400 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
January	64,260	9,750	20,840	0.974	1.12
February	53,700	13,240	26,620	1.24	1.34
March	138,200	32,580	62,750	2.93	3.38
April	53,700	20,040	28,570	1.34	1.50
May	44,460	14,620	26,690	1.25	1.44
June	26,800	11,900	17,200	.804	.897
July	23,260	10,590	15,670	.732	.844
August	22,160	12,790	16,380	.765	.882
September	13,700	6,510	9,169	.428	.478
October	6,830	5,060	5,507	.257	.296
November	8,210	5,060	7,067	.330	.368
December	61,620	8,210	20,130	.941	1.08
The year	138,200	5,060	21,380	.999	13.62
1905.					
January	107,800	13,700	35,470	1.66	1.91
February	142,100	15,560	71,110	3.32	3.46
March	108,500	26,800	47,030	2.20	2.54
April	45,780	23,260	31,160	1.46	1.63
May	84,720	28,040	45,700	2.14	2.47
June	33,900	16,040	23,430	1.09	1.22
July	78,120	20,560	33,110	1.55	1.79
August	53,040	15,560	29,850	1.40	1.61
September	19,010	9,350	14,180	.663	.740
October	20,040	8,960	12,850	.600	.692
November	14,620	8,580	10,220	.478	.533
December	66,900	9,750	42,390	1.98	2.28
The year	142,100	8,580	33,040	1.54	20.88

DAVIDSONS RIVER NEAR DAVIDSONS RIVER, N. C.

This station was established May 19, 1904, by M. R. Hall. It is located at English Bridge, about 2 miles from Davidsons River, N. C., and about 500 feet above the mouth of Avery Creek.

The channel is straight for about 500 feet above and below the station. The current is moderately swift. The right bank is high, rocky, wooded, and is not subject to overflow. The left bank is low, but is not subject to overflow. The bed of the stream is composed of rock, mostly loose bowlders and shingle, and is clean and permanent. There is but one channel at all stages.

Discharge measurements are made from the single-span wooden highway bridge, with log abutments. The floor of the bridge is about 12 feet above low water. The initial point for soundings is the edge of the wooden crib abutment on the upstream side at the left bank. The gage is a vertical timber 10 feet long, spiked to the downstream side of a maple tree on the left bank, 40 feet below the bridge. The gage is read once each day by J. J. Perry. It is referred to bench marks as follows: (1) Two wire nails driven into the downstream side of the tree to which the gage is attached; elevation, 4.00 feet. (2) A cross cut on the top of solid rock at edge of water, 8 feet below the bridge, at right bank; elevation, 1.48 feet. (3) The center of a nail head in the third log from the bottom of crib at the right bank on

the upstream side; elevation, 7.00 feet. (4) The top of the head of a large nail driven horizontally into an 18-inch white-oak tree on the left bank, just upstream from the end of the bridge; the nail is in the quarter of the tree downstream and away from the river, and about 5 feet above the root of the tree; elevation, 14.12 feet. Elevations refer to datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 109–110.

Discharge measurements of Davidsons River near Davidsons River, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 13	B. S. Drane	71	128	1.03	1.25	132
April 13	do	71	128	1.04	1.24	133
June 23	do	67	116	.98	1.16	113
June 23	do	67	116	.99	1.16	115
August 30	do	66	111	.85	1.08	94
August 30	do	66	111	.88	1.08	98
November 14	W. E. Hall	64	90	.42	.75	38

Daily gage height, in feet, of Davidsons River near Davidsons River, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.9	0.9	1.2	1.05	1.05	1.15	1.7	1.05	1.05	0.8	0.8	0.75
2	.9	.9	1.2	1.05	1.05	1.1	1.3	1.05	1.1	.8	.8	.75
3	.95	.9	1.2	1.0	1.2	1.1	1.15	1.05	1.05	.8	.8	1.55
4	.9	1.1	1.2	1.0	1.2	1.05	1.1	1.05	1.05	.9	.8	1.1
5	.9	1.1	1.2	1.15	1.35	1.05	1.05	1.1	1.0	.85	.8	.95
6	1.25	1.15	1.15	1.1	1.5	1.0	1.25	1.05	1.0	.8	.8	.95
7	1.1	1.05	1.2	1.05	1.4	1.0	1.15	1.05	1.0	.8	.8	.9
8	1.0	1.05	1.15	1.0	1.3	1.0	1.25	1.35	1.0	.8	.8	1.2
9	.95	1.4	1.25	1.15	1.25	.95	1.15	1.2	.95	.8	.8	1.8
10	.95	1.35	1.55	1.05	1.2	.95	1.1	1.6	.95	.9	.8	1.35
11	.95	1.15	1.3	1.05	1.15	.95	2.6	2.15	.95	1.3	.8	1.2
12	2.6	1.3	1.3	1.4	1.15	.95	2.95	2.0	1.0	.9	.8	1.1
13	1.6	1.7	1.25	1.25	1.1	.9	2.05	1.75	.95	.85	.75	1.05
14	1.4	1.3	1.25	1.2	1.1	.9	1.9	1.6	.95	.85	.75	1.0
15	1.25	1.3	1.2	1.15	1.05	.9	1.7	1.5	.9	.85	.75	1.45
16	1.2	1.3	1.2	1.1	1.3	1.35	1.6	1.4	.9	.85	.75	1.15
17	1.15	1.15	1.15	1.1	1.15	1.15	1.5	1.35	.9	.8	.75	1.1
18	1.1	1.15	1.15	1.05	1.1	1.1	1.45	1.3	.9	.8	.75	1.05
19	1.05	1.05	1.1	1.05	1.1	1.3	1.45	1.3	.9	.8	.75	1.0
20	1.05	1.6	1.1	1.05	1.05	1.3	1.4	1.25	.9	.8	.85	1.15
21	1.0	1.55	1.3	1.0	1.1	1.2	1.35	1.25	.9	.8	.8	1.5
22	1.0	1.5	1.2	1.0	1.05	1.3	1.3	1.2	.9	.8	.75	1.3
23	1.0	1.45	1.15	1.0	1.15	1.15	1.25	1.2	.85	.8	.75	1.25
24	.95	1.35	1.15	1.0	1.15	1.1	1.25	1.2	.85	.8	.75	1.2
25	.95	1.3	1.1	1.0	1.2	1.05	1.2	1.2	.85	.82	.8	1.15
26	1.0	1.3	1.1	1.15	1.5	1.0	1.2	1.2	.85	.87	.75	1.1
27	1.0	1.25	1.1	1.05	1.45	1.0	1.15	1.15	.85	.85	.75	1.1
28	1.0	1.25	1.05	1.0	1.45	.95	1.2	1.1	.85	.8	.75	1.05
29	.95	.....	1.05	1.0	1.3	.98	1.15	1.1	.8	.8	.75	1.2
30	.95	.....	1.1	1.1	1.2	1.1	1.15	1.1	.8	.8	.75	1.1
31	.9	.....	1.05	.....	1.2	.....	1.1	1.05	.....	.8	.....	1.1

Station rating table for Davidsons River near Davidsons River, N. C., from June 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
.60	24	1.30	146	1.90	311	2.50	512
.70	32	1.40	171	2.00	342	2.60	549
.80	44	1.50	197	2.10	374	2.70	587
.90	60	1.60	224	2.20	407	2.80	626
1.00	79	1.70	252	2.30	441	2.90	666
1.10	100	1.80	281	2.40	476	3.00	707
1.20	122						

NOTE.—The above table is based on 15 discharge measurements made during 1904–5. It is well defined between gage heights 0.7 foot and 1.3 feet. Beyond these limits the table is uncertain.

Estimated monthly discharge of Davidsons River near Davidsons River, N. C., for 1904–5.

[Drainage area, 41 square miles.]

Month.	Discharge in second-feet.			Run-off.		Rainfall in inches.[a]
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	
1904.						
June	111	52	73.0	1.78	1.99	4.51
July	90	44	55.4	1.35	1.56	2.54
August	238	60	113	2.76	3.18	5.51
September	100	44	67.3	1.64	1.83	1.38
October	44	38	39.7	.968	1.12	.00
November	122	38	47.0	1.15	1.28	2.11
December	146	38	59.8	1.46	1.68	4.4
1905.						
January	549	60	104	2.54	2.93	5.49
February	252	60	135	3.29	3.43	6.73
March	210	90	119	2.90	3.34	2.95
April	171	79	95.7	2.33	2.60	4.30
May	197	90	126	3.07	3.54	10.19
June	158	60	94.0	2.29	2.56	3.89
July	686	90	186	4.54	5.23	8.94
August	390	90	147	3.59	4.14	6.81
September	100	44	66.5	1.62	1.81	2.40
October	146	44	50.8	1.24	1.43	3.72
November	52	38	41.3	1.01	1.13	.18
December	281	38	114	2.78	3.20	9.71
The year	686	38	107.7	2.60	35.34	65.31

[a] At Brevard.

AVERY CREEK AT DAVIDSONS RIVER, N. C.

This station was established May 19, 1904, for the purpose of making miscellaneous measurements. It is located about one-fourth mile above the junction of Avery Creek with Davidsons River and a less distance from the regular gaging station on the latter stream.

The channel is curved for about 100 feet above and straight for 50 feet below the station, when it curves to the right. The current is swift. The right bank is high, wooded, and not liable to overflow. The left bank is low, wooded, and overflows at high stages. The bed of the stream is rocky along the right bank and sandy for the remainder. It is not liable to change. There is but one channel at all stages.

The bench mark is a small shelf chipped in the upper edge of the upstream face of the large rock on the right bank upon which the end of the foot log rests; elevation, 5.00 feet above datum of assumed gage.

A description of this station and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 110–111.

Discharge measurements of Avery Creek at Davidsons River, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 13	B. S. Drane	18	16	1.39	1.91	23
June 23	do	18	14	1.23	1.82	18
November 14	W. E. Hall	19	17	.41	1.63	7

LITTLE RIVER AT CALHOUN, N. C.

This station was established July 19, 1904, for the purpose of making miscellaneous measurements. It is located at the highway bridge, about one-fourth mile from Calhoun post-office, N. C., and about 1 mile above the mouth of Little River.

The channel is curved for about 75 feet above and 100 feet below the station. The current is swift. The right bank is a high rock cliff; the left bank is composed of earth, steep and wooded. Neither bank is liable to overflow. The bed of the stream is composed of rock along the right bank and of sand for the greater part of the distance. There is one channel at all stages, broken by one pier. Possibly a freshet in French Broad River would make a sluggish backwater at this station, but this is not liable to occur.

Discharge measurements are made from the upstream side of the two-span wooden bridge. The initial point for soundings is the right end of the upstream guard rail.

Bench marks were established as follows: (1) The upstream end of the horizontal strap binding the upstream guard rail to the girder, 31 feet from the initial point for soundings; elevation, 16.00 feet. (2) The upper edge of a small ledge of rock overhanging the water just under a point on the upstream side of the bridge, 6 feet from the initial point, marked by a nick in the rock on either side; elevation, 3.00 feet. Elevations refer to datum of assumed gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, page 111.

Discharge measurements of Little River at Calhoun, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 13	B. S. Drane	45	101	1.53	1.51	154
June 23	do	49	134	1.92	2.03	257
August 30	do	49	132	1.78	2.22	234

NORTH FORK MILLS RIVER AT PINKBED, N. C.

This station was established May 18, 1904, by M. R. Hall. It is located at the wagon bridge in the village of Pinkbed, N. C., about three-fourths of a mile below the post-office.

The channel is straight for about 200 feet above and below the station. The current is swift. Both banks are about 10 feet above low water and are not liable to overflow. There is a wide, level stretch of land from the left bank to the foot of the hill. The bed of the stream is composed of loose rock and is probably permanent. There is but one channel at all stages.

Discharge measurements are made from the single 39-foot span wagon bridge. The bridge rests upon log-crib abutments and the floor is about 10 feet above low water. The initial point for soundings is the edge of the crib abutment at the left bank, on the downstream side of the bridge.

The gage is a vertical timber 10 feet long, spiked to the log crib on the right bank at the upper side of the bridge. It is read once each day by J. T. Davenport. The gage is referred to bench marks as follows: (1) A nail driven into the bottom log of the crib on the right bank, at the downstream corner of the crib; elevation, 1.70 feet. (2) The center of a nail driven into a notch on a small poplar tree on the left bank about 40 feet above the bridge; elevation, 5.70 feet. Elevations refer to the datum of the gage.

A description of this station, gage height, and discharge data and rating table are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 112–114.

Discharge measurements of North Fork Mills River at Pinkbed, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 12	B. S. Drane	39	51	1.73	1.28	88
April 12	do	39	51	1.75	1.29	89
June 22	do	39	43	1.73	1.12	74
June 22	do	39	43	1.81	1.12	78
August 29	do	39	38	1.94	1.08	73
August 29	do	39	38	1.71	1.08	66
November 11	W. E. Hall	38	24	1.38	.68	33

Daily gage height, in feet, of North Fork Mills River at Pinkbed, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.55	0.65	1.1	0.9	0.9	1.0	1.6	1.1	1.0	0.8	0.7	0.6
2	.55	.65	1.1	.85	.9	1.0	1.3	1.05	1.05	.8	.7	.6
3	.6	.6	1.1	.85	1.0	.9	1.15	1.05	1.0	.8	.7	1.5
4	.7	.6	1.1	.85	.95	.9	1.1	1.05	1.05	.8	.7	.9
5	.7	.65	1.1	.95	1.25	.9	1.0	1.05	.9	.8	.7	.8
6	.8	.7	1.05	.95	1.2	.9	1.1	1.05	.9	.8	.7	.75
7	.8	.75	1.1	.9	1.15	.8	1.05	1.0	.9	.75	.7	.7
8	.75	.75	1.1	.9	1.1	.85	1.1	1.0	.9	.75	.7	.9
9	.7	.85	1.1	1.05	1.1	.8	1.0	1.1	.9	.7	.7	1.8
10	.6	.9	1.4	.9	1.05	.8	1.1	1.1	.9	.7	.65	1.3
11	.6	.8	1.15	.9	1.0	.8	1.9	1.4	.9	1.3	.65	.9
12	2.5	.85	1.2	1.4	1.0	.8	4.0	1.6	.9	.8	.65	.9
13	1.45	1.2	1.1	1.15	1.0	.8	2.4	1.5	.9	.8	.65	.9
14	1.15	.85	1.1	1.1	1.0	.75	2.2	1.3	.85	.75	.6	.9
15	.9	1.0	1.1	1.05	1.0	.75	1.9	1.25	.85	.75	.6	1.2
16	.85	.9	1.05	1.05	1.2	1.50	1.7	1.2	.8	.75	.6	1.0
17	.95	.8	1.0	1.05	1.1	1 7	1.6	1.15	.8	.75	.6	.9
18	.8	.95	1.0	1.0	1.05	1.4	1.5	1.15	.8	.75	.6	.9
19	.75	.8	1.0	1.0	1.0	1.3	1.5	1.15	.8	.75	.7	.95
20	.75	.9	.9	1.0	1.0	1.3	1.5	1.1	.8	.75	.7	1.0
21	.7	1.25	1.25	.95	1.1	1.25	1.4	1.1	.9	.7	.7	1.5
22	.7	1.3	1.05	.95	1.0	1.15	1.4	1.05	.8	.7	.6	1.2
23	.7	1.4	1.05	.95	1.05	1.05	1.3	1.05	.8	.7	.6	1.2
24	.7	1.3	1.0	.9	1.05	1.0	1.3	1.2	.8	.7	.6	1.2
25	.65	1.25	1.0	.9	1.0	1.0	1.25	1.25	.8	.7	.6	1.1
26	1.0	1.2	.95	1.0	1.2	.95	1.2	1.35	.8	.7	.6	1.0
27	1.0	1.15	.9	.9	1.1	1.05	1.2	1.15	.8	.75	.6	1.0
28	.75	1.1	.9	.9	1.3	.95	1.2	1.1	.75	.75	.6	.95
29	.65	.....	.9	1.05	1.2	.9	1.2	1.1	.75	.75	.6	1.05
30	.65	.....	1.0	.95	1.1	1.3	1.2	1.05	.8	.75	.6	1.0
31	.65	.....	.9	.....	1.05	.....	1.1	1.0	.....	.7	.....	.9

Station rating table for North Fork Mills River at Pinkbed, N. C., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	17	1.10	73	1.60	123	2.10	177
.60	26	1.20	83	1.70	133	2.20	188
.70	35	1.30	93	1.80	144	2.30	199
.80	44	1.40	103	1.90	155	2.40	211
.90	53	1.50	113	2.00	166	2.50	223
1.00	63						

NOTE.—The above table is based on seven discharged measurements made during 1905. It is well defined between gage heights 0.6 foot and 1.3 feet. Above 1.3 feet the table is roughly approximate.

Estimated monthly discharge of North Fork Mills River at Pinkbed, N. C., for 1905.

[Drainage area, 24 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	223	22	47.5	1.98	2.28
February	103	26	57.0	2.38	2.48
March	103	53	68.6	2.86	3.30
April	103	48	60.5	2.52	2.81
May	93	53	69.8	2.91	3.36
June	133	40	65.2	2.72	3.04
July	418	63	112	4.67	5.38
August	123	63	78.3	3.26	3.76
September	68	40	49.9	2.08	2.32
October	93	35	41.3	1.72	1.98
November	35	26	30.1	1.25	1.40
December	144	26	65.0	2.71	3.12
The year	418	26	62.1	2.59	35.23

SOUTH FORK MILLS RIVER NEAR SITTON, N. C.

This station was established May 18, 1904, by M. R. Hall. It is located at Sycamore Church, about 1 mile below Sitton's mill, Sitton, N. C.

The channel above curves about 90° in 500 feet and is straight for 200 feet below the station. The current is moderately swift, but may be rather sluggish above the station at low stages. Both banks are high and clean and are subject to overflow at extreme high water. The bed of the stream is composed of rock, and is clean and constant. There is but one channel at all stages.

Discharge measurements are made from a foot log about 150 feet above the ford. Owing to the overflowing of the banks discharge measurements can not be made at high water.

The gage is a vertical timber 10 feet long, spiked to a white-oak tree on the right bank of the river about 40 feet above the foot log. It is read once each day by W. E. Field. Bench marks were established as follows: (1) The center of two nail heads driven into the tree to which the gage is attached on the side next the river; elevation, 5.00 feet. (2) The center of nails in the root of a white-oak tree on the right bank, 50 feet below the gage; elevation, 5.00 feet. (3) Nails driven into a beech tree on the right bank, about 90 feet below the gage; elevation, 8.00 feet. (4) The head of a large nail driven vertically into a notch on the face toward the river of a 20-inch white-oak tree on the right bank, 25 feet above the gage; elevation, 9.94 feet. Elevations refer to the datum of the gage.

A description of this station, gage height, discharge data, and rating table are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 114–116.

Discharge measurements of South Fork Mills River near Sitton, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 12	B. S. Drane	37	87	1.80	1.44	157
April 12	do	37	86	1.85	1.44	160
June 22	do	40	86	1.56	1.28	135
June 22	do	40	86	1.53	1.29	132
August 29[a]	do	58	107	1.38	1.30	149
November 11[a]	W. E. Hall	45	32	1.78	.84	57
November 11[a]	do	24	27	2.26	.84	61

[a] Measured at different sections.

Daily gage height, in feet, of South Fork Mills River near Sitton, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.85	1.0	1.4	1.1	1.1	1.35	2.15	1.25	1.2	0.9	0.9	0.8
2	.9	1.0	1.4	1.1	1.1	1.3	1.65	1.2	1.3	.9	.9	.8
3	.9	1.05	1.4	1.1	1.15	1.25	1.4	1.2	1.2	.9	.85	2.5
4	1.0	1.1	1.35	1.1	1.2	1.25	1.3	1.25	1.3	1.0	.85	1.25
5	1.0	1.1	1.4	1.2	1.75	1.2	1.25	1.2	1.15	.95	.9	1.0
6	1.25	1.2	1.35	1.2	1.7	1.15	1.5	1.2	1.15	.9	.9	1.0
7	1.25	1.2	1.4	1.1	1.55	1.1	1.25	1.15	1.1	.9	.9	.95
8	1.05	1.9	1.4	1.1	1.4	1.1	1.4	1.15	1.1	.9	.85	1.0
9	1.3	2.15	1.35	1.2	1.4	1.05	1.25	1.4	1.1	.9	.85	2.6
10	1.0	1.45	1.85	1.15	1.35	1.05	1.35	1.5	1.05	.9	.85	1.7
11	1.0	1.3	1.6	1.1	1.3	1.05	2.7	2.5	1.05	1.7	.85	1.4
12	3.7	1.3	1.55	1.55	1.25	1.05	5.2	2.2	1.05	1.1	.85	1.25
13	2.15	1.5	1.5	1.4	1.2	1.05	3.3	1.7	1.05	1.0	.85	1.2
14	1.65	1.5	1.45	1.3	1.2	1.0	2.8	1.55	1.0	.95	.85	1.1
15	1.4	1.55	1.35	1.25	1.25	1.1	2.45	1.45	1.0	.9	.85	1.4
16	1.3	1.5	1.3	1.25	1.5	2.65	2.1	1.4	1.0	.95	.85	1.25
17	1.4	1.5	1.3	1.2	1.3	1.8	1.9	1.4	1.0	.9	.85	1.2
18	1.3	1.45	1.25	1.15	1.25	1.65	1.8	1.4	1.0	.95	.85	1.2
19	1.1	1.1	1.25	1.15	1.2	1.6	1.7	1.4	1.0	.9	.85	1.15
20	1.1	1.7	1.2	1.1	1.15	1.55	2.4	1.3	1.0	.9	.9	1.2
21	1.05	1.7	1.8	1.1	1.2	1.4	1.6	1.3	1.1	.9	.85	1.8
22	1.05	1.65	1.35	1.1	1.2	1.3	1.65	1.25	1.0	.9	.85	1.5
23	1.0	1.7	1.3	1.05	1.35	1.3	1.5	1.25	1.0	.9	.8	1.45
24	1.0	1.6	1.25	1.05	1.3	1.2	1.45	1.8	.95	.9	.8	1.4
25	1.0	1.5	1.25	1.05	1.2	1.15	1.45	1.68	.95	.9	.8	1.3
26	1.05	1.5	1.2	1.15	1.65	1.1	1.4	1.65	.95	.9	.8	1.25
27	1.05	1.4	1.2	1.15	1.7	1.2	1.35	1.45	.95	.95	.8	1.2
28	1.1	1.4	1.15	1.1	2.2	1.1	1.55	1.35	.95	.9	.8	1.3
29	1.05	.....	1.15	1.1	1.75	1.1	1.35	1.3	.9	.9	.8	1.35
30	1.05	.....	1.2	1.2	1.55	1.4	1.3	1.25	.9	.9	.8	1.25
31	1.0	.....	1.1	.....	1.45	.....	1.25	1.2	.....	.9	.....	1.2

Station rating table for South Fork Mills River near Sitton, N. C., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.8	55	1.7	206	2.6	375	3.8	626
.9	70	1.8	224	2.7	395	4.0	670
1.0	86	1.9	242	2.8	415	4.2	716
1.1	102	2.0	260	2.9	435	4.4	762
1.2	119	2.1	279	3.0	455	4.6	809
1.3	136	2.2	298	3.2	497	4.8	857
1.4	153	2.3	317	3.4	539	5.0	905
1.5	170	2.4	336	3.6	582	5.2	955
1.6	188	2.5	355				

NOTE.—The above table is based on seven discharge measurements made during 1905. It is well defined between gage heights 0.8 foot and 1.5 feet. The table has been extended beyond these limits. Above 1.5 feet the table is roughly approximate.

Estimated monthly discharge of South Fork Mills River near Sitton, N. C., for 1905.

[Drainage area, 40.5 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	604	62	126	3.11	3.58
February	288	86	159	3.93	4.09
March	233	102	146	3.60	4.15
April	179	94	112	2.77	3.09
May	298	102	151	3.73	4.30
June	385	86	134	3.31	3.69
July	955	128	236	5.83	6.72
August	355	110	159	3.93	4.53
September	136	70	93.9	2.32	2.59
October	206	70	77.7	1.92	2.21
November	70	55	61.7	1.52	1.70
December	375	55	141	3.48	4.01
The year	955	55	133	3.29	44.66

PIGEON RIVER NEAR WAYNESVILLE, N. C.

This station was established April 15, 1905, for the purpose of making miscellaneous measurements. It is located at Ironduff Bridge, 3½ miles above the mouth of Richland Creek, about 8 miles from Waynesville, N. C.

The channel is straight for 300 feet above and below the station. There is a good current. Both banks are high and not liable to overflow. The bed is partly of rock and partly of shifting sand. There is but one channel, broken by one pier. A large rock protrudes about 50 feet above the bridge and causes irregularities in the current.

Discharge measurements are made from the downstream side of the two-span bridge. The initial point for soundings is the left end of the bridge, downstream side.

The bench mark is on top of a steel plate bolted to the top of the lower chord over the downstream end of the first floor beam from the left of the bridge; elevation, 23.00 feet above datum of assumed gage.

Discharge measurements of Pigeon River near Waynesville, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 15	B. S. Drane	132	299	1.45	2.95	536
August 28	do	132	253	1.30	2.52	328

PIGEON RIVER AT NEWPORT, TENN.

This station was established September 4, 1900, by E. W. Myers. It is located at the highway bridge in the eastern part of Newport, Tenn., 1 mile from the railroad station and 1 mile above the dam of the Newport Flouring Mill, out of reach of backwater.

The channel is straight for about 300 feet above and 200 feet below the station. The section is deep, rough, and irregular in shape; the velocity is poorly distributed and about 50 feet of the total width at low stages is still water or has a negative velocity. The right bank is low and overflows to some extent, but all water passes beneath the bridge and its approach. The left bank is a high, vertical rock cliff. The bed of the stream is rocky near the left bank and sandy near the right bank.

Discharge measurements are made from the lower side of the single-span steel highway bridge. The initial point for soundings is the end of the hand rail over the left bank on the downstream side of the bridge. The section is better for measurement at the Southern Railway bridge, about 300 feet below, at which point some of the measurements have been made.

The original wire gage was replaced April 30, 1903, by a standard chain gage fastened to the lower chord of the bridge in the third panel on the downstream side. The datum of the two gages is the same; chain length, 29.94 feet. Since it was first established the gage has been damaged several times, and the records are continuous only from December 14, 1902. The gage is read once each day by S. R. McSween. Bench marks were established as follows: (1) The top surface of the outer left corner of the hanger plate at the bottom of the downstream end of the second floor beam from the left bank; elevation, 26.87 feet. (2) The top of a copper plug set in cement on the top of a limestone outcrop about 5 feet upstream and 3 feet to the left of the end of the upstream hand rail on the left bank; elevation, 32.61 feet. Elevations refer to datum of the gage. This station was discontinued December 31, 1905.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 48, p 188; 65, p 302; 83, pp 223–224; 98, pp 282–283; 128, pp 116–117, 155.
Discharge: 48, p 188; 65, p 302; 98, p 283; 128, pp 117, 155.
Discharge, monthly: 98, p 285; 128, p 119.
Gage heights: 48, p 188; 65, p 303; 98, pp 283–284; 128, p 118.
Rating table: 98, p 284; 128, p 118.

Discharge measurements of Pigeon River at Newport, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 9	B. S. Drane	164	1,415	3.35	4.28	4,737
May 11	W. E. Hall	130	925	.97	1.75	920
June 21	B. S. Drane	139	1,054	1.28	2.13	1,348
August 21	W. E. Hall	127	920	1.06	1.75	973
December 19	F. A. Murray	140	979	.89	1.63	865
December 26	do	141	1,036	1.28	2.03	1,325

Daily gage height, in feet, of Pigeon River at Newport, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.35	1.35	2.0	1.6	1.9	1.9	1.5	1.4	1.4	0.9	0.95	0.9
2	1.3	1.3	1.95	1.5	1.7	1.75	1.45	1.4	1.45	.95	.95	.95
3	1.4	1.2	1.8	1.5	1.6	1.6	1.45	1.35	1.45	.95	.9	4.1
4	1.45	1.05	1.75	1.55	1.6	1.6	1.3	1.35	1.4	1.0	.9	3.5
5	1.55	1.1	1.75	1.6	1.65	1.55	1.4	1.3	1.3	1.2	1.0	2.0
6	1.7	1.45	1.7	1.75	2.0	1.5	1.55	1.25	1.2	1.0	1.0	1.6
7	2.0	1.9	1.8	2.1	2.0	1.4	1.5	1.25	1.2	.9	1.0	1.7
8	1.5	1.7	1.9	2.0	2.0	1.5	1.45	1.35	1.2	.9	1.0	1.75
9	1.15	4.9	2.0	2.4	2.0	1.45	1.4	2.35	1.2	.9	.95	2.15
10	1.45	3.3	3.4	2.2	1.95	1.35	1.5	1.85	1.15	.9	.95	2.0
11	1.35	2.55	2.8	2.05	2.0	1.3	1.9	1.9	1.15	1.1	.9	1.9
12	5.0	2.5	2.3	2.6	1.7	1.3	7.6	3.15	1.15	1.15	.9	1.8
13	4.0	2.4	2.15	2.4	1.8	1.55	4.1	2.5	1.15	1.2	.9	1.7
14	2.8	2.55	2.1	2.2	1.8	1.35	2.9	2.3	1.1	1.1	.9	1.75
15	2.4	2.25	2.0	2.05	2.5	1.35	2.4	2.1	1.05	1.1	.9	1.75
16	2.3	2.1	1.9	2.0	3.9	1.4	2.1	2.0	1.05	1.05	.85	1.7
17	1.9	2.0	1.85	1.85	3.0	1.9	2.0	2.25	1.05	1.0	.85	1.7
18	1.8	1.95	1.85	1.8	2.35	1.8	2.0	2.45	1.0	.95	.8	1.65
19	1.75	1.85	1.8	1.75	2.1	1.6	2.0	2.0	1.0	.95	.8	1.6
20	1.65	4.0	2.0	1.7	2.0	1.55	1.9	1.9	1.2	1.0	1.0	1.6
21	1.55	5.0	2.25	1.7	1.95	2.1	1.85	1.75	1.3	1.2	1.1	1.95
22	1.5	3.8	2.1	1.7	2.1	1.8	1.85	1.75	1.2	1.1	1.1	2.2
23	1.4	3.1	1.95	1.65	2.7	1.85	1.8	1.7	1.05	1.0	1.05	2.0
24	1.2	3.0	1.9	1.6	2.2	1.75	1.75	1.8	1.05	.95	1.0	2.0
25	1.05	2.5	1.85	1.55	2.1	1.6	1.7	2.0	1.05	1.0	.9	2.0
26	.95	2.3	1.8	1.5	2.05	1.55	1.6	1.8	1.0	1.05	.9	1.9
27	.8	2.2	1.7	1.75	2.55	2.45	1.55	1.75	.95	1.1	.95	1.8
28	1.2	2.1	1.7	1.6	2.25	2.0	1.55	1.6	.95	1.2	.85	1.75
29	1.25	.....	1.6	1.65	2.1	1.75	2.0	1.5	.9	1.1	.85	1.6
30	1.25	.....	1.7	2.0	1.95	1.6	1.8	1.45	.9	1.0	.9	1.65
31	1.3	.....	1.7	.....	1.95	.....	1.65	1.4	.....	1.0	.....	1.65

Station rating table for Pigeon River at Newport, Tenn., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
.80	300	2.20	1,460	3.60	3,640	4.90	6,170
0.90	345	2.30	1,590	3.70	3,830	5.00	6,370
1.00	400	2.40	1,720	3.80	4,020	5.20	6,770
1.10	460	2.50	1,860	3.90	4,210	5.40	7,170
1.20	525	2.60	2,000	4.00	4,400	5.60	7,580
1.30	595	2.70	2,140	4.10	4,590	5.80	8,000
1.40	665	2.80	2,290	4.20	4,780	6.00	8,420
1.50	740	2.90	2,440	4.30	4,970	6.20	8,840
1.60	820	3.00	2,600	4.40	5,170	6.40	9,260
1.70	910	3.10	2,760	4.50	5,370	6.60	9,690
1.80	1,010	3.20	2,930	4.60	5,570	6.80	10,130
1.90	1,110	3.30	3,100	4.70	5,770	7.00	10,570
2.00	1,220	3.40	3,280	4.80	5,970	7.50	11,670
2.10	1,340	3.50	3,460				

NOTE.—The above table is based on discharge measurements made during 1904–5. It is fairly well defined between gage heights 1.6 feet and 4.5 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Pigeon River at Newport, Tenn., for 1905.

[Drainage area, 655 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	6,370	300	1,111	1.70	1.96
February	6,370	430	1,956	2.99	3.11
March	3,280	820	1,220	1.86	2.14
April	2,000	740	1,080	1.65	1.84
May	4,210	820	1,402	2.14	2.47
June	1,790	595	1,211	1.85	2.06
July	11,890	595	1,463	2.23	2.57
August	2,845	560	1,068	1.63	1.88
September	702	345	491	.750	.837
October	525	345	419	.640	.738
November	460	300	365	.557	.621
December	4,590	345	1,177	1.80	2.08
The year	11,890	300	1,080	1.65	22.31

NOLICHUCKY RIVER NEAR GREENEVILLE, TENN.

This station was established May 7, 1903, by E. W. Myers. It is located at Jones's bridge, 5 miles southeast of Greeneville, Tenn., which is the nearest railroad station.

The channel is straight for about 700 feet above and below the station. The right bank is high, but at flood stages part of the water will pass around the end of the bridge. The left bank is high and can never overflow. The section is regular, and the bed is composed of gravel and is not subject to change. The velocity is uniform and well distributed except at extreme low water (below gage height 0.5 foot), when the middle pier and a small bar of gravel and small stones throw the current toward both banks.

Discharge measurements are made from the downstream side of the two-span steel highway bridge. The initial point for soundings is the left end of the top bar of the downstream hand rail.

A standard chain gage is bolted to the lower chord of the bridge on the upstream side midway between the second and third intermediate post from the right bank; length of chain, 33.63 feet. The gage is read once each day by B. H. Jones. Bench marks were established as follows: (1) A standard iron bench-mark post of the United States Geological Survey, set on the left bank just below the bridge, 5.5 feet downstream from the left end of the bridge; elevation, 26.80 feet. (2) The upper outer edge of the outer eyebar of the ower chord of the bridge, 3.6 feet to the right of the center of the third intermediate post from the right bank, marked by a spot of white paint and the letters "B. M.;" elevation, 32.03 feet. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 285–286; 128, pp 119–120.
Discharge: 98, p 286; 128, p 120.
Discharge monthly: 98, p 287; 128, p 121.
Gage heights: 98, p 286; 128, p 120.
Rating table: 98, p 287; 128, p 121.

Discharge measurements of Nolichucky River near Greeneville, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 7	B. S. Drane	264	916	1.39	0.87	1,271
February 7	do	264	915	1.44	.87	1,323
May 15	W. E. Hall	266	1,263	2.76	2.19	3,486
June 15	B. S. Drane	265	818	1.13	.55	924
August 24	W. E. Hall	266	983	1.51	1.01	1,487
December 25	F. A. Murray	267	1,086	2.01	1.40	2,182

Daily gage height, in feet, of Nolichucky River near Greeneville, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.55	0.55	1.4	0.8	1.1	1.05	0.7	0.95	0.65	0.25	0.25	0.2
2	.55	.6	1.35	.7	1.0	.95	.7	.75	.65	.2	.25	.2
3	.7	.6	1.35	.7	.8	.85	.85	.7	.8	.35	.25	3.4
4	.9	.4	1.2	.7	.85	.7	1.05	.7	.15	.35	.2	2.6
5	.7	.5	1.2	.7	.9	.7	2.3	.7	.65	.4	.2	1.3
6	.65	.7	1.3	1.25	1.1	.65	.2	.7	.6	.35	.25	.8
7	1.15	.9	1.2	1.55	3.4	.65	1.0	.7	.5	.25	.3	.65
8	1.1	1.0	1.3	1.25	2.8	.65	.8	1.15	.5	.2	.25	.6
9	.7	2.6	1.4	1.35	2.4	.65	.7	1.75	.45	.25	.25	.8
10	.7	2.4	1.9	2.2	1.75	.55	.65	1.8	.45	.2	.2	2.6
11	.8	1.9	2.4	1.75	1.85	.5	.65	2.1	.4	.3	.2	1.6
12	1.3	1.5	1.85	2.7	1.7	.5	5.5	4.4	.4	.8	.15	1.15
13	4.0	1.5	1.7	2.4	1.6	.55	6.1	3.5	.6	.6	.2	.95
14	2.4	2.2	1.55	1.9	2.6	.7	3.1	2.8	.5	.35	.2	.8
15	1.75	1.5	1.4	1.55	2.2	.6	2.3	2.1	.4	.3	.15	.8
16	1.15	1.25	1.2	1.4	4.2	.5	1.8	2.05	.4	.25	.15	1.0
17	.95	1.2	1.2	1.25	3.6	2.6	1.85	1.75	.3	.25	.2	1.0
18	1.0	1.1	1.1	1.1	2.7	3.1	1.45	1.5	.35	.25	.2	.9
19	1.05	1.0	1.05	1.0	2.0	1.75	2.7	1.4	.35	.25	.15	.8
20	.95	2.1	1.05	.95	1.75	1.55	1.7	1.25	.35	.3	.2	.75
21	.85	4.2	1.1	.9	1.5	1.4	1.35	1.2	.35	.3	.25	.85
22	.8	3.6	1.2	.95	1.35	1.2	1.35	1.15	.35	.3	.25	1.8
23	.7	3.1	1.05	.9	1.65	1.1	1.45	1.0	.35	.3	.2	1.35
24	.6	2.4	.95	.8	1.7	1.05	1.25	1.0	.3	.25	.15	1.75
25	.65	2.0	.9	.75	1.4	.9	1.15	1.05	.25	.25	.15	1.5
26	.3	1.95	1.0	.7	1.25	.85	1.0	1.25	.25	.35	.15	1.15
27	.25	1.7	.9	.8	1.3	.85	.9	1.0	.2	.55	.2	1.0
28	.25	1.5	.8	1.0	1.3	.75	.9	.9	.2	.5	.2	1.15
29	.45	.....	.8	.9	1.9	.7	1.2	.7	.25	.4	.15	.8
30	.55	.....	.8	1.15	1.25	.7	1.15	.7	.2	.3	.2	.8
31	.55	.....	.85	.....	1.25	.....	1.15	.65	.....	.3	.....	.7

Station rating table for Nolichucky River near Greeneville, Tenn., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.00	430	1.20	1,770	2.40	3,940	4.20	7,690
0.10	515	1.30	1,930	2.50	4,140	4.40	8,130
0.20	600	1.40	2,100	2.60	4,340	4.60	8,570
0.30	690	1.50	2,270	2.70	4,540	4.80	9,010
0.40	780	1.60	2,440	2.80	4,740	5.00	9,450
0.50	880	1.70	2,620	2.90	4,940	5.20	9,890
0.60	990	1.80	2,800	3.00	5,140	5.40	10,330
0.70	1,100	1.90	2,980	3.20	5,540	5.60	10,790
0.80	1,220	2.00	3,170	3.40	5,960	5.80	11,250
0.90	1,350	2.10	3,360	3.60	6,380	6.00	11,710
1.00	1,480	2.20	3,550	3.80	6,810		
1.10	1,620	2.30	3,740	4.00	7,250		

NOTE.—The above table is based on six discharge measurements made during 1905. It is fairly well defined between gage heights 0.5 foot and 2.2 feet. Beyond these limits it is uncertain.

Estimated monthly discharge of Nolichucky River near Greeneville, Tenn., for 1905.

[Drainage area, 1,099 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth, in inches.
January	7,250	645	1,513	1.38	1.59
February	7,690	780	2,604	2.37	2.47
March	3,940	1,220	1,872	1.70	1.96
April	4,540	1,100	1,852	1.69	1.89
May	7,690	1,220	2,909	2.65	3.06
June	5,340	880	1,543	1.40	1.56
July	11,940	1,045	2,650	2.41	2.78
August	8,130	1,045	2,230	2.03	2.34
September	1,220	600	815	.742	.828
October	1,220	600	722	.657	.757
November	690	558	604	.550	.614
December	5,960	600	1,820	1.66	1.91
The year	11,940	558	1,761	1.60	21.76

SOUTH FORK HOLSTON RIVER AT BLUFF CITY, TENN.

This station was originally established by the United States Weather Bureau at the highway bridge at Bluff City, Tenn. Readings were begun July 17, 1900, by the United States Geological Survey in connection with the general hydrographic investigation of the southern Appalachian region.

The channel is straight above the bridge for a distance of 300 feet, to the bridge of the Virginia and Southwestern Railway, and for about 1,000 feet below the bridge. The bed is rocky and permanent. The bottom is very rough, and rocky ledges just above and below the bridge cause back currents, eddies, and sudden variations in the velocity. Both banks are high and do not overflow.

Discharge measurements are made from the lower side of the four-span highway bridge. This bridge is a short distance below the Virginia and Southwestern Railway bridge. The initial point for soundings is the end of the guard rail on the downstream side of the bridge over the left abutment.

The gage, which is the property of the United States Weather Bureau, is a timber bolted to the downstream side of the first pier from the right bank. The gage readings are furnished by the United States Weather Bureau. The gage is referred to a United States Geological Survey bronze bench mark tablet set in the upstream side of the capstone of the left abutment; elevation, 20.44 feet above the zero of the gage and 1,389 feet above sea level.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 48, p 182; 65, p 297; 83, p 227; 98, pp 287–288; 128, pp 122, 154.
Discharge: 48, p 182; 65, p 297; 83, p 227; 98, p 288; 128, pp 122, 155.
Discharge, monthly: 83, p 229; 98, p 290; 128, p 124.
Gage heights: 48, p 183; 65, p 298; 83, p 228; 98, pp 288–289; 128, p 123.
Rating tables: 65, p 323; 83, p 228; 98, p 289; 128, p 123.

Discharge measurements of South Fork Holston River at Bluff City, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 6	B. S. Drane	185	501	1.65	1.40	[a] 825
May 12	W. E. Hall	231	650	1.89	1.78	[a] 1,227
May 12	do	122	578	2.11	1.78	[b] 1,222
June 16	B. S. Drane	133	454	.88	.52	[b] 398
August 22	W. E. Hall	125	500	1.34	1.10	[b] 669
December 21	F. A. Murray	135	508	.88	.78	[b] 445
December 23	do	226	506	1.63	1.37	[a] 823

[a] Wagon bridge. [b] Virginia and Southwestern Railway bridge.

Daily gage height, in feet, of South Fork Holston River at Bluff City, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.0	0.9	2.4	1.2	1.8	1.3	0.7	2.0	1.3	0.3	0.3	0.4
2	1.0	.9	2.2	1.2	1.5	1.0	.6	1.6	.9	.3	.3	.3
3	1.0	1.6	2.4	1.2	1.4	.9	.6	1.4	1.0	.4	.3	3.0
4	1.9	.5	2.4	1.1	1.3	.7	.6	1.0	1.5	.4	.3	3.2
5	1.4	1.0	2.4	2.6	1.2	.6	.7	1.0	3.2	.4	.3	2.0
6	1.5	1.4	2.3	3.7	1.9	.5	.9	1.7	2.0	.3	.3	1.5
7	1.8	1.7	2.3	3.4	2.2	.5	1.5	1.8	1.5	.3	.3	1.3
8	1.6	1.4	2.2	2.8	2.8	.8	1.3	2.0	1.3	.3	.3	1.0
9	1.3	5.4	2.9	2.4	2.6	.8	.9	1.7	1.0	.3	.3	1.2
10	1.5	3.4	4.5	2.2	2.2	.6	.7	1.6	1.0	.2	.2	1.6
11	1.3	2.8	4.4	1.9	1.8	.8	.8	1.5	.9	.5	.2	1.3
12	2.2	2.4	3.2	2.1	1.8	.8	1.2	1.8	.8	.6	.2	1.1
13	4.9	3.4	2.8	2.0	4.2	.7	6.2	2.1	.9	.5	.2	1.1
14	3.4	4.0	2.4	1.9	3.8	.6	3.1	2.0	.8	.4	.2	1.0
15	2.5	3.2	2.2	1.7	3.4	.6	2.4	1.8	.7	.3	.2	1.0
16	1.9	2.2	1.9	1.7	3.4	.5	1.7	1.8	.7	.3	.2	1.0
17	1.7	2.2	1.8	1.4	4.1	.7	1.4	2.6	.6	.3	.2	.9
18	1.8	1.9	1.7	1.6	3.3	.7	1.0	1.8	.5	.3	.2	.8
19	1.6	1.8	1.7	1.3	2.7	.8	1.5	1.5	.5	.3	.3	.8
20	1.4	1.9	1.6	1.2	2.2	.7	1.2	1.3	.4	.4	.3	.8
21	1.3	3.4	1.6	1.1	1.9	1.2	1.0	1.1	.4	.4	.3	.8
22	1.1	3.4	1.7	1.3	1.8	1.0	2.6	1.0	.5	.3	.3	.8
23	1.0	3.7	1.6	1.2	1.8	.7	3.8	1.0	.4	.3	.3	1.1
24	1.0	3.4	1.5	1.1	1.7	1.0	2.7	1.0	.4	.3	.3	2.0
25	.9	2.8	1.5	1.0	1.5	1.0	2.0	1.1	.4	.3	.3	1.9
26	.9	2.8	1.5	1.0	1.6	.8	1.7	1.9	.3	.4	.3	1.7
27	.9	2.6	1.4	1.1	1.4	1.0	.8	1.6	.3	.6	.3	1.4
28	1.0	2.6	1.4	1.8	1.2	1.1	1.4	1.4	.3	.4	.3	1.3
29	.8	.....	1.4	1.9	1.0	.8	1.7	1.0	.3	.4	.3	1.2
30	.8	.....	1.5	1.8	1.0	.8	3.4	.9	.3	.4	.3	1.1
31	.8	.....	1.4	.....	1.1	.....	2.8	.8	.....	.4	.....	1.0

Station rating table for South Fork Holston River at Bluff City, Tenn., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.30	265	1.50	950	2.70	2,190	3.90	3,980
0.40	300	1.60	1,030	2.80	2,310	4.00	4,160
0.50	340	1.70	1,120	2.90	2,430	4.20	4,530
0.60	385	1.80	1,210	3.00	2,550	4.40	4,910
0.70	435	1.90	1,310	3.10	2,680	4.60	5,310
0.80	485	2.00	1,410	3.20	2,820	4.80	5,730
0.90	540	2.10	1,510	3.30	2,970	5.00	6,180
1.00	600	2.20	1,620	3.40	3,120	5.20	6,650
1.10	665	2.30	1,730	3.50	3,280	5.40	7,130
1.20	730	2.40	1,840	3.60	3,450	5.60	7,630
1.30	800	2.50	1,950	3.70	3,620	5.80	8,130
1.40	870	2.60	2,070	3.80	3,800	6.00	8,630

NOTE.—The above table is based on discharge measurements made during 1904–5. It is well defined between gage heights 0.5 foot and 3.5 feet. The table has been extended beyond these limits. Above gage height 3 feet the table is the same as for 1904.

Estimated monthly discharge of South Fork Holston River at Bluff City, Tenn., for 1905.

[Drainage area, 828 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	5,950	485	1,105	1.33	1.53
February	7,130	340	2,115	2.55	2.66
March	5,110	870	1,656	2.00	2.31
April	3,620	600	1,237	1.49	1.66
May	4,530	600	1,674	2.02	2.33
June	800	340	493	.595	.664
July	9,130	385	1,404	1.70	1.96
August	2,070	485	997	1.20	1.38
September	2,820	265	574	.693	.773
October	385	235	289	.349	.402
November	265	235	256	.309	.345
December	2,820	265	855	1.03	1.19
The year	9,130	235	1,055	1.27	17.20

HOLSTON RIVER AT AUSTINS MILLS, TENNESSEE.

This station is maintained in cooperation with the United States Weather Bureau, by which the gage readings are furnished. It is located at the Southern Railway bridge at Austins Mills, Tennessee.

The channel is straight for about 2,000 feet above and for 1,000 feet below the bridge. The right bank will overflow gradually above gage height 10 feet, and the left bank above gage height 8 feet. There is a fringe of trees along both banks. The bed of the stream is composed of rock and gravel and is permanent. All the water passes beneath the bridge and trestles, there being one channel broken by three piers at ordinary stages.

Discharge measurements are made from the downstream side of the bridge. This is a deck bridge, 800 feet long, resting on stone piers. Six spans are wooden trusses, and piers have been built for two more spans at each end, but the track is carried on trestle work. The initial point for soundings is the end of the bridge truss over the center of the pier on the right bank, downstream side.

The gage is 49 feet long, and is attached vertically to the downstream end of the pier nearest the right bank. It is read once each day by Fred Beal.

A description of this station, gage-height and discharge data, and rating table are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 124–126.

Discharge measurements of Holston River at Austins Mills, Tennessee, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 10	B. S. Drane	414	2,904	4.32	5.30	12,550
May 16	W. E. Hall	412	2,796	3.89	4.87	10,880
June 20	B. S. Drane	383	1,590	1.57	2.05	2,489
August 25	W. E. Hall	373	1,592	1.47	2.25	2,347

Daily gage height, in feet, of Holston River at Austins Mills, Tennessee, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	1.8	3.5	2.4	2.7	2.3	1.8	3.4	2.6	1.5	1.5	1.4
2	2.1	1.8	3.3	2.3	2.5	2.3	1.7	2.7	2.6	1.5	1.5	1.4
3	2.2	1.9	3.2	2.3	2.3	2.1	1.7	2.4	2.3	1.5	1.5	3.2
4	2.6	2.0	3.4	2.2	2.3	2.0	1.7	2.2	2.3	1.5	1.5	5.0
5	2.9	1.8	3.2	2.2	2.2	2.0	1.7	2.1	2.6	1.5	1.4	3.9
6	2.4	1.9	3.2	3.0	2.2	2.0	1.7	2.2	3.1	1.5	1.4	3.0
7	3.5	2.5	3.3	4.0	3.0	1.9	2.3	2.4	2.4	1.5	1.4	2.4
8	3.2	2.8	3.1	3.8	3.6	1.9	2.2	2.4	2.2	1.4	1.4	2.2
9	2.7	5.5	3.4	3.6	4.1	1.9	2.0	3.5	2.1	1.4	1.4	2.4
10	2.3	6.0	5.8	3.5	3.5	2.0	2.0	3.3	2.0	1.4	1.3	2.5
11	2.5	4.8	6.3	3.2	3.1	1.8	1.9	3.3	2.0	1.4	1.3	2.6
12	3.1	4.0	5.2	3.4	3.0	1.7	1.8	3.8	1.8	1.5	1.3	2.4
13	5.9	4.2	4.3	3.8	3.2	2.1	6.3	3.8	1.9	1.7	1.3	2.2
14	5.6	5.6	3.8	3.5	5.3	2.0	5.7	3.7	2.0	1.6	1.3	2.1
15	4.2	4.5	3.4	3.2	5.5	1.9	3.9	3.4	1.9	1.6	1.3	2.1
16	3.4	3.9	3.1	3.0	4.8	1.9	3.2	3.2	1.8	1.5	1.3	2.0
17	2.9	3.4	2.9	2.8	5.9	1.8	2.6	3.1	1.8	1.5	1.3	2.0
18	2.7	3.3	2.9	2.6	5.3	2.0	2.6	3.3	1.7	1.5	1.3	2.0
19	2.6	3.0	2.7	2.5	4.7	2.0	2.3	2.8	1.7	1.5	1.2	2.0
20	2.6	3.0	2.6	2.4	3.6	2.1	2.5	2.5	1.7	1.5	1.2	1.9
21	2.4	4.6	2.5	2.3	3.2	2.2	2.3	2.3	1.7	1.6	1.2	1.9
22	2.4	5.2	2.5	2.3	2.9	2.2	2.2	2.1	1.6	1.5	1.2	2.0
23	2.2	5.2	2.5	2.5	3.1	2.0	3.2	2.1	1.8	1.5	1.2	2.6
24	2.1	5.0	2.5	2.4	3.1	2.0	4.0	2.5	1.7	1.5	1.2	3.2
25	2.0	4.3	2.4	2.2	2.8	2.3	3.3	2.2	1.7	1.4	1.2	3.2
26	1.8	4.0	2.4	2.2	2.5	2.2	2.7	2.3	1.7	1.5	1.2	3.0
27	2.0	3.8	2.4	2.1	2.5	2.3	2.4	2.5	1.7	1.6	1.2	2.6
28	2.2	3.5	2.4	2.1	2.4	2.1	2.2	2.4	1.6	1.6	1.2	2.4
29	2.2	.....	2.4	2.2	2.3	2.0	2.2	2.4	1.6	1.6	1.2	2.3
30	2.0	.....	2.4	2.5	2.2	1.9	2.6	2.3	1.5	1.6	1.4	2.1
31	2.0	.....	2.4	.....	2.2	.....	4.6	2.1	.....	1.5	.....	2.1

Station rating table for Holston River at Austins Mills, Tennessee, from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	645	1.70	1,695	2.30	3,035	2.80	4,380
1.20	805	1.80	1,900	2.40	3,285	2.90	4,675
1.30	970	1.90	2,110	2.50	3,545	3.00	4,980
1.40	1,140	2.00	2,330	2.60	3,815	3.10	5,290
1.50	1,315	2.10	2,555	2.70	4,095	3.20	5,610
1.60	1,500	2.20	2,790				

NOTE.—The above table is based on discharge measurements made during 1904-5. It is well defined between gage heights 1.1 feet and 2 feet. The table has been extended beyond these limits. Above gage height 3.2 feet the rating curve is a tangent, the difference being 330 per tenth. Below gage height 3.4 feet the table is the same as for 1904.

Estimated monthly discharge of Holston River at Austins Mills, Tennessee, for 1905.

[Drainage area, 3,060 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	14,520	1,900	4,393	1.44	1.66
February	14,850	1,900	7,417	2.42	2.52
March	15,840	3,285	5,749	1.88	2.17
April	8,250	2,555	4,363	1.43	1.60
May	14,520	2,790	6,051	1.98	2.28
June	3,035	1,695	2,406	.786	.877
July	15,840	1,695	4,353	1.42	1.64
August	7,590	2,555	4,307	1.41	1.63
September	5,290	1,315	2,271	.742	.828
October	1,695	1,140	1,341	.438	.505
November	1,315	805	990	.324	.362
December	11,550	1,140	3,593	1.17	1.35
The year	15,840	805	3,936	1.29	17.42

WATAUGA RIVER NEAR ELIZABETHTON, TENN.

This station was established May 11, 1903, by E. W. Myers. It is located on the Virginia and Southwestern Railway bridge at Siam, about 4 miles from Elizabethton, Tenn.

The channel is straight for 1,000 feet above and below the station. The right bank is high and will overflow only at flood stages. All water will, however, pass under the bridge and the trestle approach. The left bank is a perpendicular masonry abutment and will not overflow. The section underneath the bridge is smooth and consists of sand, silt, and some small rocks, and does not appear to be shifting. At ordinary stages the channel is divided into three parts by the bridge piers. At flood stages there is an additional flood channel on the right bank. A shallow stretch 1,000 feet below the bridge makes the current under the bridge sluggish at low stages.

Discharge measurements are made from the lower side of the bridge. The bridge crosses the river at an angle of about 14° with the normal to the direction of the current. The initial point for soundings is the top of the first bolt on the downstream guard rail over the middle of the left abutment.

A standard chain gage is fastened on the downstream side of the middle span on the inside of the guard rail; the zero of the scale is opposite a point 142 feet from the initial point for soundings; length of chain, 22.66 feet. The gage is read once each day by J. B. Nave. Bench marks were established as follows: (1) A standard copper bolt set in the cap of the abutment on the left bank, upstream side of the bridge; elevation, 21.11 feet. (2) The upper edge of the plate connecting the lower bracing system with the lower chord and floor beam opposite the middle of the gage box on the downstream side of the bridge; this floor beam is the fourth from the left end of the middle span; elevation, 19.60 feet. Elevations refer to the datum of the gage.

During the summer and fall of 1902 a line of levels was run from Carter station, Tennessee, near the mouth of the river, to a point near Shull's mill, in North Carolina, near the head of the river, locating the water powers of this stream. These powers are numerous and of considerable magnitude.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey reports as follows:

Description: 98, pp 290–291; 128, pp 126–127.
Discharge: 49, p 215; 98, p 291; 128, p 127.
Discharge, monthly: 98, p 292; 128, p 129.
Gage heights: 98, pp 291–292; 128, p 128.
Rating table: 98, p 292; 128, p 128.

Discharge measurements of Watauga River near Elizabethton, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 4	B. S. Drane	205	688	0.44	1.42	296
February 4	do	205	685	.45	1.41	297
May 13	W. E. Hall	209	1,127	2.01	3.61	2,263
June 17	B. S. Drane	207	644	.84	1.78	543
August 23	W. E. Hall	204	704	.95	1.93	670
December 22	F. A. Murray	207	787	1.12	2.24	879

Daily gage height, in feet, of Watauga River near Elizabethton, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.6	1.5	2.4	1.7	1.8	1.8	1.65	3.0	1.7	1.3	1.3	1.2
2	1.6	1.45	2.4	1.6	1.8	1.8	1.65	2.5	1.6	1.5	1.3	1.3
3	1.7	1.4	2.3	1.6	1.9	1.7	1.65	2.4	1.7	1.4	1.3	4.3
4	1.7	1.3	2.3	1.7	1.9	1.7	1.65	2.4	1.75	1.4	1.3	2.6
5	1.65	1.4	2.3	1.95	2.2	1.65	2.1	2.6	1.8	1.3	1.3	2.0
6	1.65	1.5	2.2	2.7	2.6	1.6	2.2	2.7	1.8	1.3	1.3	1.6
7	1.7	1.8	2.2	2.5	3.5	1.6	2.0	3.0	1.8	1.3	1.3	1.6
8	1.8	1.8	2.3	2.3	3.1	1.5	1.9	3.9	1.7	1.3	1.3	1.6
9	1.8	1.9	2.7	2.3	2.9	1.5	1.8	4.0	1.6	1.3	1.3	1.65
10	1.7	2.0	3.1	2.3	2.8	1.5	1.6	4.5	1.55	1.3	1.3	2.9
11	1.75	3.8	3.1	2.3	2.6	1.5	1.7	4.5	1.5	1.4	1.3	2.3
12	3.6	2.8	3.0	3.0	2.9	1.6	8.4	4.7	1.7	1.5	1.2	2.2
13	3.7	3.7	2.7	3.0	3.5	1.6	6.5	4.4	1.6	1.4	1.2	2.0
14	3.0	2.8	2.2	2.8	5.6	1.55	4.8	3.9	1.6	1.4	1.2	1.9
15	2.5	2.7	2.2	2.3	4.8	1.5	2.9	3.2	1.55	1.35	1.2	1.8
16	2.3	2.5	2.1	2.2	5.4	1.5	2.6	3.0	1.55	1.35	1.2	1.8
17	2.2	2.2	2.0	2.0	4.6	1.5	2.6	2.6	1.5	1.3	1.2	1.8
18	2.0	1.8	2.0	2.0	3.5	1.6	2.5	2.5	1.5	1.3	1.2	1.9
19	1.9	1.8	1.95	1.95	3.0	2.6	2.5	2.4	1.45	1.4	1.2	2.0
20	1.9	2.0	1.9	1.9	2.8	2.5	2.4	2.3	1.4	1.4	1.2	2.2
21	1.9	4.0	1.9	1.8	2.7	1.9	2.4	2.2	1.7	1.4	1.2	3.1
22	1.9	3.9	1.85	1.9	2.7	1.85	2.3	2.2	1.6	1.4	1.2	2.3
23	1.85	3.6	1.8	1.9	2.9	1.8	2.2	2.0	1.5	1.35	1.2	2.2
24	1.85	3.2	1.7	1.85	2.3	1.8	2.1	2.0	1.5	1.35	1.2	2.2
25	1.8	3.0	1.9	1.8	2.2	1.8	2.0	2.2	1.4	1.35	1.2	2.0
26	1.8	2.7	1.85	1.8	2.0	1.75	1.8	2.5	1.4	1.4	1.2	1.95
27	1.75	2.6	1.7	1.7	1.9	1.7	1.6	2.4	1.35	1.4	1.2	1.9
28	1.75	2.5	1.6	1.7	1.9	1.7	1.8	2.3	1.3	1.4	1.2	1.85
29	1.75	.....	1.6	1.9	1.9	1.7	2.5	2.0	1.3	1.4	1.2	1.8
30	1.75	.....	1.8	1.9	1.85	1.7	4.5	1.85	1.3	1.35	1.2	1.8
31	1.5	.....	1.7	.....	1.8	.....	3.8	1.7	.....	1.35	.....	1.7

Station rating table for Watauga River near Elizabethton, Tenn., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	130	2.20	835	3.40	2,070	5.20	4,570
1.10	165	2.30	920	3.50	2,200	5.40	4,880
1.20	205	2.40	1,010	3.60	2,330	5.60	5,200
1.30	250	2.50	1,100	3.70	2,460	5.80	5,520
1.40	300	2.60	1,190	3.80	2,590	6.00	5,840
1.50	355	2.70	1,285	3.90	2,720	6.20	6,180
1.60	410	2.80	1,385	4.00	2,850	6.40	6,520
1.70	470	2.90	1,490	4.20	3,110	6.60	6,860
1.80	535	3.00	1,600	4.40	3,390	6.80	7,200
1.90	605	3.10	1,710	4.60	3,670	7.00	7,540
2.00	680	3.20	1,825	4.80	3,970	7.50	8,440
2.10	755	3.30	1,945	5.00	4,270	8.00	9,340

NOTE.—The above table is based on discharge measurements made during 1904-5. It is well defined between gage heights 1.4 feet and 3.7 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Watauga River near Elizabethton, Tenn., for 1905.

[Drainage area, 408 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,460	355	712	1.75	2.02
February	2,850	250	1,140	2.79	2.90
March	1,710	410	827	2.03	2.34
April	1,600	410	765	1.88	2.10
May	5,200	535	1,558	3.82	4.40
June	1,190	355	494	1.21	1.35
July	10,100	410	1,509	3.70	4.27
August	3,820	470	1,536	3.76	4.34
September	535	250	389	.953	1.06
October	355	250	283	.694	.800
November	250	205	222	.544	.607
December	3,250	205	769	1.88	2.17
The year	10,100	205	850	2.08	28.29

DOE RIVER AT ELIZABETHTON, TENN.

This station was established May 22, 1904, for the purpose of making miscellaneous measurements. It is located at the covered wagon bridge in the town of Elizabethton, Tenn.

The channel is straight for 500 feet above and below the station. The current is extremely sluggish at low water. Both banks are high and do not overflow. All the water passes between the stone abutments of the bridge. The bed of the stream is composed of sand and is very shifting. There is but one channel at all stages. A low dam about 300 feet below the bridge will affect the flow considerably at low stages.

Discharge measurements are made from the downstream side of the bridge by lowering the meter between the sill and the edge of the floor. The initial point for soundings is the left bank end of the downstream hand rail.

The bench mark is the top of the lower downstream hand rail opposite the tension rods at the middle of the bridge, 65 feet from the initial point for soundings; elevation, 16.00 feet above datum of assumed gage.

A description of this station and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 129–130.

Discharge measurements of Doe River at Elizabethton, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 12	W. E. Hall	128	353	2.48	2.30	875
June 16	B. S. Drane	129	234	1.00	1.21	234
August 22	W. E. Hall	128	201	.79	.97	159
December 22	F. A. Murray	128	262	.61	1.55	160
December 22	do	128	270	.63	1.57	169

LITTLE TENNESSEE RIVER AT JUDSON, N. C.

Little Tennessee River rises in the extreme northeastern part of Georgia, with tributaries from the mountains between North Carolina and Georgia, and flows in a northwesterly direction, emptying into Tennessee River at Lenoir, Tenn. Measurements of flow are made at Judson, N. C., below the mouth of Sawyer Branch. The area drained is mountainous and covered with forest growth. The station was established in June, 1896, by E. W. Myers. It is located on the Southern Railway bridge, about one-fourth mile from Judson, N. C.

The channel is straight for several hundred yards above and below the station; the bottom rocky and very rough on the west side and sandy on the east side. The current is swift and considerably obstructed by two wide timber piers. The section is constant, but not a good one for measurements.

The original gage was a standard chain gage located on the downstream side of the first span from the left end of the bridge; length of chain, 26.29 feet. In 1905 a vertical gage was installed, two chains having been stolen from the chain gage. The vertical gage is in two sections; the first, reading from 1.5 feet to 6. feet, is bolted to a solid rock on the right bank, about 100 feet above the bridge. The second section, reading from 6 to 11 feet, is fastened to a maple tree about 30 feet downstream from the first section. This gage was set to read with the chain gage at a gage height of 3 feet, but owing to the large amount of slope in the river, the actual elevation of its zero is 0.50 foot above the datum of the chain gage. The gage is read once each day by J. L. Enloe. Bench marks were established as follows: (1) The top of the angle block on the lower chord at the middle of the first span from the left end of the bridge, on the downstream side; elevation, 22.86 feet. (2) A standard copper bolt set in the rock near the end of the tunnel on the right bank, 130 feet from the end of the bridge and 8 feet from the center of the track; elevation, 27.64 feet. Elevations refer to the datum of the vertical gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper; Bull=Bulletin):

Description: Ann 18, iv, pp 117–118; WS 15, p 62; 27, p 59; 36, p 168; 48, p 189; 65, p 305; 83, p 216; 98, pp 270–271; 128, p 130.

Discharge: Ann 18, iv, p 118, Bull 140, p 82; WS 15, p 62; 27, p 65; 36, p 168; 48, p 189; 65, p 305; 83, p 216; 98, p 271; 128, p 131.

Discharge, monthly: Ann 20, iv, p 207; 21, iv, p 163; 22, iv, p 224; WS 75, p 105; 83, p 218; 98, p 272; 128, p 132.

Discharge, yearly: Ann 20, iv, p 52.

Gage heights: WS 11, p 42; 15, p 62; 27, p 63; 36, p 169; 48, p 190; 65, p 306; 83, p 217; 98, p 271; 128, p 131.

Hydrographs: Ann 20, iv, p 208; 21, iv, p 164; WS 75, p 105.

Rating tables: WS 27, p 66; 39, p 446; 52, p 515; 65, p 324; 83, p 217; 98, p 272; 128, p 132.

Discharge measurements of Little Tennessee River at Judson, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 14	B. S. Drane	150	416	4.12	3.60	1,714
June 14	O. P. Hall	139	305	3.10	3.02	944
October 14	do	139	298	2.85	2.79	851

Daily gage height, in feet, of Little Tennessee River at Judson, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.95	3.0	3.9	3.35	4.1	3.4	3.15	3.0	2.4	2.5	2.55	2.65
2	2.9	3.0	3.9	3.3	3.65	3.4	3.2	2.6	3.2	2.55	2.5	2.55
3	2.1	2.9	3.7	3.25	.....	3.35	3.0	3.0	2.4	2.65	2.5	8.0
4	2.8	2.9	3.5	3.25	.....	3.25	2.9	3.5	3.0	3.5	2.5	3.85
5	2.7	2.75	3.4	3.25	.....	3.3	2.85	2.6	2.9	2.75	2.5	3.5
6	3.0	3.9	3.5	3.5	.....	3.25	2.9	3.5	2.85	2.6	2.5	3.3
7	3.95	3.55	3.4	3.35	4.2	3.15	3.2	2.9	2.9	2.5	2.5	4.8
8	3.1	3.45	3.5	3.3	4.0	3.25	2.75	2.25	2.8	2.5	2.5	3.4
9	2.7	8.0	3.4	3.4	4.0	3.1	2.9	3.5	2.8	2.5	2.5	6.9
10	3.1	5.1	4.3	3.45	3.6	3.1	3.0	3.35	2.75	2.6	2.5	6.0
11	3.1	4.4	4.2	3.45	3.5	3.1	4.3	4.4	2.25	3.85	2.45	4.8
12	8.2	4.0	4.1	3.85	3.45	3.15	7.6	6.1	2.9	3.6	2.45	4.2
13	6.3	4.9	4.0	3.9	3.45	3.1	5.8	3.8	2.8	3.65	2.45	3.95
14	4.8	4.7	3.9	4.2	3.35	3.0	4.4	3.75	2.45	2.9	2.45	3.8
15	4.1	4.3	3.6	3.4	3.35	3.0	4.4	3.95	2.45	2.75	2.4	3.9
16	3.55	3.8	3.6	3.6	4.8	3.1	4.3	3.4	2.7	2.8	2.4	3.9
17	3.45	4.0	3.5	3.45	4.1	3.2	4.0	3.55	2.7	2.7	2.4	3.85
18	3.5	3.8	3.5	3.35	4.0	3.1	3.6	3.45	2.65	2.6	2.4	3.65
19	3.4	3.7	3.45	3.35	3.6	3.4	3.9	3.1	2.65	2.6	2.4	3.5
20	3.35	4.0	3.45	3.25	3.5	3.15	3.6	3.1	2.65	2.6	3.0	4.7
21	3.3	6.8	4.4	3.25	3.5	3.2	3.3	3.0	2.7	2.6	2.7	3.35
22	3.2	5.8	4.1	3.35	3.5	3.35	3.3	3.35	2.6	2.6	2.5	3.35
23	3.1	5.1	4.1	3.25	3.5	3.85	3.35	3.7	2.6	2.55	2.5	4.5
24	3.0	4.8	3.8	3.15	4.0	3.2	3.05	3.75	2.5	2.5	2.5	4.8
25	2.95	4.4	3.65	3.1	3.5	2.75	3.2	3.1	2.5	2.55	2.5	4.4
26	2.95	4.2	3.5	3.2	3.5	3.0	4.3	3.4	2.5	3.0	2.65	4.1
27	2.9	4.1	3.45	3.6	4.5	3.2	3.0	3.3	2.5	3.8	2.5	3.9
28	2.85	3.9	3.45	3.45	3.45	3.25	2.95	3.3	2.5	2.6	2.45	3.8
29	2.85	.....	3.3	3.4	3.95	2.9	3.95	3.8	2.5	2.6	2.65	4.1
30	3.0	.....	3.5	4.6	3.95	3.0	3.85	3.1	2.45	2.55	2.9	3.8
31	2.9	.....	3.4	.....	3.95	.....	3.85	3.0	.....	2.55	.....	3.75

NOTE.—Readings July 1 to December 31 taken from vertical gage.

Station rating table for Little Tennessee River at Judson, N. C., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.20	335	3.40	1,580	4.60	3,580	6.60	8,050
2.30	405	3.50	1,720	4.70	3,780	6.80	8,540
2.40	485	3.60	1,860	4.80	3,980	7.00	9,050
2.50	575	3.70	2,000	4.90	4,180	7.20	9,590
2.60	675	3.80	2,140	5.00	4,380	7.40	10,160
2.70	775	3.90	2,300	5.20	4,820	7.60	10,780
2.80	875	4.00	2,460	5.40	5,260	7.80	11,470
2.90	985	4.10	2,620	5.60	5,700	8.00	12,200
3.00	1,100	4.20	2,800	5.80	6,140	8.50	14,200
3.10	1,220	4.30	2,980	6.00	6,580	9.00	16,200
3.20	1,340	4.40	3,180	6.20	7,070	9.50	18,450
3.30	1,460	4.50	3,380	6.40	7,560	10.00	20,700

NOTES.—The above table is based on 40 discharge measurements made during 1896–1905. It is well defined between gage heights 2.2 feet and 5 feet. The table has been extended beyond these limits. Above gage height 10 feet the rating curve is a tangent, the difference being 480 per tenth.

Estimated monthly discharge of Little Tennessee River at Judson, N. C., for 1905.

[Drainage area, 675 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	13,000	275	1,909	2.83	3.26
February	12,200	825	3,196	4.74	4.94
March	3,180	1,460	2,013	2.98	3.44
April	3,580	1,220	1,681	2.49	2.78
May[a]	3,980	1,520	2,150	3.19	3.68
June	2,220	825	1,326	1.96	2.19
July	10,780	825	2,177	3.23	3.72
August	6,825	370	1,694	2.51	2.89
September	1,340	370	734	1.09	1.22
October	2,220	575	905	1.34	1.54
November	1,100	485	602	.892	.995
December	12,200	625	2,997	4.44	5.12
The year	13,000	275	1,782	2.64	35.78

[a] Mean for 27 days taken as mean for month.

LITTLE TENNESSEE RIVER AT M'GHEE, TENN.

This station was established in 1904 by the United States Weather Bureau. It is located at the Louisville and Nashville Railroad bridge, about one-third of a mile south of McGhee Station, Tenn. During 1905 discharge measurements have been made by the Geological Survey, and gage-height records have been furnished by the Weather Bureau.

The channel is practically straight for 2,000 feet above the station and is only slightly curved for the same distance below. The section is about 530 feet wide at ordinary stages, but at low water the width is considerably less. The current is very swift even at low water and is somewhat broken at places, partly owing to temporary obstruction. It is fairly good for measuring purposes.

Discharge measurements are made from the new nine-span railway bridge, which has a total length of about 973 feet. Four truss spans are each 140 feet long and five girder spans are each 82.5 feet long, three of the latter being on the right bank and two on the left bank.

A standard chain gage, which is the property of the Weather Bureau, was located on the upstream side of the old bridge near the right bank, but during 1905 a new location of the railroad was made, requiring a new crossing of the river about 1,000 feet above the old one. The old bridge was taken down and the gage moved to the new bridge December 1, 1905, and set to agree with the old gage when the latter read 3.95 feet. The gage is located on the upstream side of the bridge at the third floor beam from the right-bank end of the truss bridge, resting on the cross-ties outside the guard rail; length of chain, 54.13 feet. The slope of the water surface between the two points was 0.30 foot, so that the new datum for the gage was made 0.30 foot higher than the former datum and the elevations of the bench marks reduced by that amount. The bench marks are as follows: (1) The top of the upstream end of the third floor beam from the right-bank end of the main bridge; elevation, 52.93 feet. (2) The under surface at the middle point of the projecting cap on the downstream side of the concrete pier supporting the left end of the first girder span on the right bank; elevation, 39.90 feet. Elevations refer to the datum of the new gage.

Discharge measurements at this station are contained in Water-Supply Paper of the United States Geological Survey, No. 98, page 293.

Discharge measurements of Little Tennessee River at McGhee, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 2	B. S. Drane	465	1,878	1.81	3.18	3,392
February 16	do	478	2,871	2.98	4.95	8,442
April 13	O. P. Hall	470	2,747	2.94	5.02	8,063
June 17	do	451	1,970	1.97	3.36	3,884
October 9[a]	do	348	587	2.92	2.25	1,715
December 14[a]	M. R. Hall	452	1,364	3.95	3.95	5,382

[a] Measurement made from new bridge.

Daily gage height, in feet, of Little Tennessee River at McGhee, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	3.1	4.6	3.8	5.2	3.9	4.3	3.0	3.0	2.3	2.3	2.2
2	2.0	3.1	4.4	3.7	4.6	3.7	3.8	2.9	3.6	2.3	2.2	2.7
3	2.4	2.8	4.3	3.7	4.2	3.5	3.5	2.9	3.4	2.3	2.2	7.8
4	2.6	3.1	4.2	3.7	4.2	3.5	3.3	2.9	3.1	2.8	2.2	7.0
5	2.1	3.1	4.1	3.8	4.1	3.4	3.2	2.9	3.0	2.9	2.2	4.8
6	2.1	4.6	4.1	4.3	4.6	3.4	3.4	2.9	2.9	2.5	2.3	3.9
7	2.8	4.4	4.0	4.4	4.7	3.3	3.8	2.9	2.8	2.4	2.4	3.6
8	2.7	4.5	4.0	4.1	4.8	3.2	3.4	3.2	2.8	2.3	2.4	3.6
9	2.6	14.0	4.4	4.4	5.0	3.1	3.2	3.8	2.7	2.2	2.4	6.4
10	2.8	8.8	7.4	4.6	4.4	3.1	3.3	3.7	2.7	2.3	2.3	7.5
11	3.5	6.3	6.6	4.2	4.0	3.0	3.4	5.0	2.7	3.2	2.3	6.0
12	4.9	4.3	5.4	4.8	4.0	3.1	6.3	5.6	2.7	4.7	2.3	4.6
13	13.0	6.0	5.0	5.2	3.8	3.3	8.7	4.9	3.0	3.1	2.3	4.2
14	7.0	5.5	4.7	4.6	3.7	3.2	5.8	4.4	2.8	2.7	2.3	3.9
15	5.5	5.6	4.5	4.2	3.6	3.0	5.2	5.1	2.6	2.6	2.2	4.0
16	4.6	4.7	4.3	4.1	5.6	3.5	4.7	4.6	2.5	2.5	2.2	4.3
17	4.0	4.9	4.1	4.0	6.4	3.4	4.3	4.3	2.5	2.5	2.2	4.1
18	3.8	4.6	4.0	3.8	5.1	3.3	4.0	4.1	2.5	2.5	2.2	3.9
19	3.8	4.2	4.0	3.7	4.6	3.3	3.9	4.1	2.5	2.4	2.2	3.7
20	3.7	5.2	4.0	3.6	4.4	3.6	4.1	3.8	2.5	2.5	2.4	3.6
21	3.6	13.7	4.6	3.6	4.1	3.6	3.8	3.6	2.5	2.7	2.8	4.9
22	3.5	9.1	5.3	3.7	4.3	3.9	3.8	3.4	2.5	2.5	2.6	5.1
23	3.5	7.6	4.5	3.6	4.6	4.3	4.1	3.4	2.5	2.4	2.4	6.0
24	3.3	6.9	4.3	3.5	5.6	3.9	3.7	6.1	2.4	2.3	2.3	6.4
25	3.2	5.8	4.3	3.4	5.0	3.5	3.5	4.9	2.3	2.3	2.3	5.5
26	2.4	5.5	4.2	3.5	4.5	3.3	3.4	4.0	2.3	2.5	2.3	4.8
27	2.3	5.1	4.1	4.3	4.3	4.2	3.3	3.7	2.3	3.1	2.3	4.4
28	2.3	4.8	4.0	4.2	4.2	5.0	3.2	3.4	2.3	2.8	2.3	4.2
29	3.0	.....	3.9	4.3	4.1	3.8	3.5	3.2	2.3	2.6	2.3	4.3
30	3.1	.....	3.9	6.5	4.0	3.5	3.3	3.1	2.3	2.4	2.2	4.2
31	3.1	.....	4.0	.....	4.2	.....	3.1	3.0	.....	2.4	.....	4.0

Station rating table for Little Tennessee River at McGhee, Tenn., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	1,390	3.70	4,720	5.20	8,850	7.40	15,600
2.10	1,520	3.80	4,970	5.30	9,140	7.60	16,240
2.20	1,650	3.90	5,230	5.40	9,430	7.80	16,880
2.30	1.790	4.00	5,490	5.50	9,720	8.00	17,520
2.40	1,940	4.10	5,760	5.60	10,020	8.20	18,180
2.50	2,090	4.20	6,030	5.70	10,320	8.40	18,840
2.60	2,250	4.30	6,300	5.80	10,620	8.60	19,500
2.70	2,420	4.40	6,580	5.90	10,920	8.80	20,160
2.80	2,600	4.50	6,860	6.00	11,220	9.00	20,820
2.90	2,800	4.60	7,140	6.20	11,840	10.00	24,220
3.00	3,020	4.70	7,420	6.40	12,460	11.00	27,720
3.10	3,250	4.80	7,700	6.60	13,080	12.00	31,320
3.20	3,490	4.90	7,980	6.80	13,700	13.00	35,020
3.30	3,730	5.00	8,270	7.00	14,320	14.00	38,820
3.40	3,970	5.10	8,560	7.20	14,960		
3.50	4,220						
3.60	4,470						

NOTE.—The above table is based on six discharge measurements made during 1905. It is well defined between gage heights 2.2 feet and 5 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Little Tennessee River at McGhee, Tenn., for 1905.

[Drainage area, 2,470 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	35,020	1,390	4,959	2.01	2.32
February	38,820	2,600	10,990	4.45	4.63
March	15,600	5,230	6,880	2.79	3.22
April	12,770	3,970	5.836	2.36	2.63
May	12,460	4,470	6,928	2.80	3.23
June	8,270	3,020	4,312	1.75	1.95
July	19,830	3,250	5,661	2.29	2.64
August	11,530	2,800	5,168	2.09	2.41
September	4,470	1,790	2,423	.981	1.09
October	7,420	1,650	2,363	.957	1.10
November	2,600	1,650	1,811	.733	.818
December	16,880	1,650	7,586	3.07	3.54
The year	38,820	1,390	5,410	2.19	29.58

TUCKASEGEE RIVER AT BRYSON, N. C.

Tuckasegee River rises in the southwestern part of North Carolina, at the base of Tennessee Ridge, which separates Jackson and Transylvania counties. It flows in a northwesterly direction, emptying into Little Tennessee River at Bushnell, N. C. Measurements of discharge are made at Bryson, N. C., 2 miles below the mouth of Newton Mill Creek. The drainage area is largely rough and mountainous and covered with forest growth.

This station was originally established in June, 1896, by E. W. Myers, at the Southern Railway bridge about 3 miles above Bryson, N. C., just below Governor Island postoffice. This station was abandoned March 25, 1897, on account of the poor section. The present station was established November 7, 1897, at the highway bridge in the town of Bryson, N. C.

The channel is straight for about 600 feet above and below the station. The water is moderately swift, but the current is obstructed by the remnants of two old bridge piers. The right bank is low at the bridge and overflows to a slight extent, but all water passes beneath the bridge and its approach. The left bank is high and rocky and does not overflow. The bed is of gravel and sand and is fairly constant.

Discharge measurements are made from the sidewalk on the downstream side of the single-span steel highway bridge. The initial point for soundings is the end of the handrail at the left bank on the downstream side of the bridge.

The gage is a vertical rod bolted to the north pier on the right bank at the downstream side of the bridge. It is read once each day by J. M. Welch. The gage is referred to benchmarks as follows: (1) A copper bolt set in the stone sill beneath the large window in the northwest corner of D. K. Collin's brick store, about 80 feet east of the northeast corner of the county court-house; elevation, 22.30 feet. (2) A chisel mark on the top of the handrail on the downstream footway, 6 inches to the right of the post connected with the downstream end of the first floor beam from the right bank end of the main span; elevation, 21.56 feet. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water Supply Paper; Bull=Bulletin):

Description: Ann 18, iv, pp 116–117; Bull 140, p 82; WS 15, p 61; 27, p 59; 36, p 167; 48, p 188; 65, p 304; 83, p 218; 98, p 273; 128, p 133.

Discharge: Ann 18, iv, p 117; Bull 140, p 82; WS 15, p 61; 27, p 65; 36, p 167; 48, p 189; 65, p 304; 83, p 218; 98, p 274; 128, p 134.

Discharge, monthly: Ann 20, iv, p 206; 21, iv, p 162; 22, iv, p 223; WS 75, p 104; 83, p 220; 98, p 275; 128, p 135.

Discharge, yearly: Ann 20, iv, p 52.

Gage heights: WS 11, p 42; 15, p 61; 27, p 63; 36, p 168; 48, p 189; 65, p 305; 83, p 219; 98, p 274; 128, p 134.

Hydrographs: Ann 20, iv, p 206; 21, iv, p 162.

Rating tables: WS 27, p 66; 39, p 446; 52, p 515; 65, p 324; 83, p 219; 98, p 275; 128, p 135.

Discharge measurements of Tuckasegee River at Bryson, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 14	B. S. Drane	190	963	1.62	1.91	1,563
April 15	do	190	955	1.54	1.85	1,469
June 15	O. P. Hall	186	804	1.08	1.45	868
October 14	do	182	844	.71	1.20	602

Daily gage height, in feet, of Tuckasegee River at Bryson, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.3	1.3	2.0	1.65	1.8	1.7	1.7	1.5	1.4	1.1	1.1	1.1
2	1.3	1.35	2.0	1.6	1.7	1.7	1.7	1.45	1.7	1.1	1.1	1.2
3	1.5	1.3	1.9	1.6	1.75	1.65	1.5	1.45	1.65	1.4	1.1	5.2
4	1.2	1.2	1.85	1.6	1.8	1.6	1.5	1.45	1.45	1.3	1.1	2.1
5	1.3	1.4	1.9	1.9	1.8	1.6	1.45	1.5	1.4	1.15	1.1	1.7
6	1.5	2.0	1.9	1.8	2.1	1.6	1.8	1.45	1.35	1.1	1.2	1.55
7	1.55	1.7	2.0	1.7	2.3	1.6	1.6	1.5	1.35	1.1	1.15	1.5
8	1.3	2.4	2.1	1.65	2.1	1.5	1.6	2.3	1.3	1.1	1.1	2.0
9	1.4	3.7	3.8	2.0	2.0	1.45	1.5	1.8	1.3	1.1	1.1	3.9
10	1.35	2.8	3.6	1.8	1.85	1.4	1.7	2.7	1.3	1.3	1.1	2.5
11	1.4	2.4	2.5	1.75	1.8	1.4	3.1	3.3	1.3	2.65	1.1	2.0
12	6.4	2.3	2.4	2.35	1.7	1.55	5.2	2.8	1.5	1.4	1.1	1.9
13	3.45	3.3	2.2	2.1	1.75	1.45	3.2	2.4	1.3	1.25	1.05	1.7
14	2.5	2.5	2.1	1.9	1.75	1.4	2.8	2.3	1.3	1.2	1.05	1.7
15	2.05	2.3	2.0	1.85	2.0	1.45	2.6	2.1	1.25	1.2	1.05	1.9
16	1.85	2.1	1.9	1.8	3.1	1.7	2.2	2.0	1.25	1.2	1.05	1.75
17	1.8	2.0	1.9	1.7	2.3	1.55	2.1	2.1	1.2	1.15	1.05	1.7
18	1.7	1.8	1.85	1.7	2.1	1.6	2.0	1.95	1.2	1.15	1.05	1.6
19	1.6	1.8	1.8	1.65	2.0	1.9	2.05	1.8	1.25	1.15	1.1	1.6
20	1.55	4.0	2.0	1.7	1.9	1.8	2.0	1.8	1.2	1.3	1.3	1.75
21	1.5	3.8	2.8	1.6	2.0	1.8	1.9	1.75	1.2	1.15	1.15	1.55
22	1.45	3.2	2.15	1.6	2.0	1.8	2.25	1.65	1.2	1.15	1.1	1.95
23	1.4	2.9	2.05	1.6	2.5	1.8	1.9	1.8	1.15	1.1	1.1	3.0
24	1.4	2.6	2.0	1.55	2.2	1.65	1.8	2.0	1.1	1.1	1.05	2.2
25	1.2	2.5	1.9	1.5	2.05	1.6	1.7	1.75	1.1	1.55	1.1	2.0
26	1.2	2.3	1.85	1.7	2.1	1.5	1.65	1.7	1.1	1.3	1.1	1.9
27	1.5	2.2	1.8	1.7	2.0	2.2	1.6	1.6	1.1	1.3	1.05	1.8
28	1.5	2.1	1.75	1.6	1.95	1.75	1.8	1.55	1.1	1.2	1.05	1.9
29	1.5	.....	1.7	2.1	1.85	1.6	1.7	1.5	1.1	1.2	1.3	1.9
30	1.4	.....	1.8	1.95	1.9	1.6	1.6	1.5	1.1	1.1	1.3	1.7
31	1.35	.....	1.7	.....	1.85	.....	1.5	1.45	.....	1.1	.....	1.7

Station rating table for Tuckasegee River at Bryson, N. C., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	380	2.50	2,480	4.10	6,070	6.40	15,520
1.00	460	2.60	2,660	4.20	6,350	6.60	16,680
1.10	550	2.70	2,850	4.30	6,630	6.80	17,840
1.20	650	2.80	3,050	4.40	6,920	7.00	19,000
1.30	750	2.90	3,250	4.50	7,220	7.20	20,160
1.40	860	3.00	3,460	4.60	7,530	7.40	21,320
1.50	980	3.10	3,670	4.70	7,840	7.60	22,480
1.60	1,100	3.20	3,890	4.80	8,160	7.80	23,640
1.70	1,230	3.30	4,110	4.90	8,480	8.00	24,800
1.80	1,370	3.40	4,330	5.00	8,800	8.50	27,700
1.90	1,510	3.50	4,560	5.20	9,475	9.00	30,600
2.00	1,660	3.60	4,800	5.40	10,250	9.50	33,500
2.10	1,810	3.70	5,040	5.60	11,125	10.00	36,400
2.20	1,970	3.80	5,290	5.80	12,100	10.50	39,300
2.30	2,130	3.90	5,540	6.00	13,200	11.00	42,200
2.40	2,300	4.00	5,800	6.20	14,360		

NOTE.—The above table is based on discharge measurements made during 1904–5. It is well defined to 3 feet.

Estimated monthly discharge of Tuckasegee River at Bryson, N. C., for 1905.

[Drainage area, 662 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	14,250	650	1,542	2.33	2.69
February	5,800	650	2,348	3.55	3.70
March	5,290	1,230	1,880	2.84	3.27
April	2,130	980	1,312	1.98	2.21
May	3,670	1,230	1,680	2.54	2.93
June	1,970	860	1,149	1.74	1.94
July	9,475	920	1,849	2.79	3.22
August	4,110	920	1,527	2.31	2.66
September	1,230	550	731	1.10	1.23
October	2,755	550	720	1.09	1.26
November	750	505	563	.850	.948
December	9,475	550	1,828	2.76	3.18
The year	14,250	505	1,427	2.16	29.24

HIWASSEE RIVER AT MURPHY, N. C.

This station was established July 26, 1896, by E. W. Myers. It is located at the highway bridge, Murphy, N. C., about 80 feet above the Atlanta, Knoxville and Northern Railroad bridge and one-half mile above the mouth of Valley River.

The channel is straight for about 500 feet above and below the station. The right bank is high and rocky and will not overflow. The left bank will overflow for a short distance around the abutment. The bed of the stream is rocky and rough, and makes soundings uncertain. The bed is permanent and the flow is rapid.

Discharge measurements are made from the sidewalk on the upstream side of the single span highway bridge. The bridge is 195 feet long, supported by stone abutments. The initial point for soundings is the end of the iron hand rail on the right bank, upstream side of the bridge.

A standard chain gage is fastened to the top of the downstream end of the first iron floor beam from the right bank in the space beween the bridge floor and the lower chords; length of chain, 27.05 feet. The gage is read once each day by William Mingus. Bench marks were established as follows: (1) The downstream side of the top of the stone pier at the right bank; elevation, 22.55 feet. (2) The top of the downstream end of the first iron floor beam from the right end of the bridge; elevation, 25.05 feet. (3) A cut with large nail on a large white-oak tree in the grounds of the Atlanta, Knoxville and Northern Railroad station, on the left side of the street leading from the highway bridge to the town and 325 feet from the end of the bridge; elevation, 31.57 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper; Bull=Bulletin):

Description: Ann 18, iv, p 118; 19, iv, p 259; WS 15, p 63; 27, p 60; 36, pp 169–170; 48, p 190; 65, p 306; 83, p 214; 98, p 268; 128, pp 135–136.

Discharge: Ann 18, iv, p 118; Bull 140, p 82; WS 15, p 63; 27, p 65; 36, p 170; 48, p 190; 65, p 306; 83, p 214; 98, p 268; 128, p 136.

Discharge, monthly: Ann 19, iv, p 260; 20, iv, p 209; 21, iv, p 165; 22, iv, p 224; WS 75, p 106; 83, p 216 98, p 270; 128, p 138.

Discharge, yearly: Ann 20, iv, p 52.

Gage heights: WS 11, p 43; 15, p 63; 27, p 64; 36, p 170; 48, p 191; 65, p 307; 83, p 215; 98, p 269; 128, p 137.

Hydrographs: Ann 20, iv, p 209; 21, iv, p 165.

Rating tables: Ann 19, iv, p 259; WS 27, p 66; 39, p 446; 52, p 515; 65, p 324; 83, p 215; 98, p 269; 128, p 137.

Discharge measurements of Hiwassee River at Murphy, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 15	O. P. Hall	168	445	2.01	5.84	896
June 13	do	167	342	1.51	5.38	517
October 13	do	162	332	1.27	5.16	421

Daily gage height, in feet, of Hiwassee River at Murphy, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.25	5.3	5.8	5.55	6.3	5.7	5.85	5.2	5.15	5.0	5.0	5.2
2	5.2	5.25	5.8	5.55	6.05	5.65	6.0	5.2	5.25	4.95	5.0	5.15
3	5.45	5.2	5.7	5.5	5.9	5.55	5.45	5.15	5.3	5.0	5.0	10.0
4	5.4	5.2	5.6	5.5	5.9	5.55	5.35	5.15	5.2	5.5	5.0	6.5
5	5.35	5.2	5.6	5.65	5.8	5.5	5.65	5.2	5.15	5.1	5.0	5.9
6	5.35	5.95	5.6	5.65	6.1	5.5	5.4	5.15	5.1	5.0	5.0	5.65
7	5.8	5.75	5.6	5.7	6.2	5.5	5.45	5.15	5.1	5.0	5.1	5.55
8	5.5	5.7	5.6	5.6	6.7	5.45	5.35	5.35	5.1	5.0	5.0	5.55
9	5.45	8.75	5.6	5.7	6.05	5.4	5.35	5.35	5.1	4.95	5.0	8.7
10	5.4	6.95	6.1	5.65	5.9	5.4	6.35	5.25	5.05	5.0	5.0	7.0
11	5.4	6.3	6.0	5.6	5.8	5.35	6.55	6.3	5.15	7.55	5.0	6.35
12	5.5	6.1	5.8	5.85	5.75	5.4	10.3	5.8	5.15	5.45	5.0	6.05
13	6.6	7.0	5.8	5.85	5.9	5.35	6.85	5.75	5.1	5.2	5.0	5.85
14	6.55	6.3	5.7	5.75	5.7	5.4	6.15	6.3	5.1	5.1	5.0	5.75
15	6.6	6.3	5.6	5.7	5.65	5.3	5.85	5.9	5.05	5.1	5.0	5.85
16	5.8	6.0	5.6	5.8	7.2	5.4	5.8	5.75	5.05	5.2	5.0	5.8
17	5.65	5.9	5.6	5.7	6.45	5.5	5.65	5.6	5.05	5.1	5.0	5.7
18	5.6	5.8	5.6	5.65	6.1	5.4	5.55	5.5	5.0	5.05	5.0	5.65
19	5.5	5.7	5.55	5.6	5.95	5.6	5.6	5.45	5.0	5.05	5.0	5.6
20	5.6	6.2	5.65	5.55	5.85	5.5	5.5	5.4	5.0	5.05	5.35	5.65
21	5.45	8.2	7.0	5.55	5.8	5.5	5.4	5.35	5.0	5.05	5.15	6.6
22	5.4	7.2	6.25	5.65	5.85	5.8	5.5	5.3	5.0	5.0	5.1	6.2
23	5.35	6.6	6.05	5.5	6.45	6.75	5.4	5.25	5.0	5.0	5.05	6.15
24	5.35	6.4	5.9	5.5	6.95	5.55	5.35	6.5	4.95	5.0	5.0	6.4
25	5.3	6.2	5.85	5.45	6.35	5.55	5.4	5.5	4.95	5.0	5.15	6.1
26	5.25	6.1	5.75	5.5	6.2	5.35	5.3	5.6	4.95	5.3	5.2	5.95
27	5.25	6.0	5.7	5.9	6.1	5.35	5.3	5.35	4.95	5.15	5.1	5.8
28	5.2	5.9	5.65	5.8	5.95	5.45	5.35	5.3	4.95	5.1	5.1	5.75
29	5.15	.....	5.65	5.7	5.85	5.4	5.45	5.25	4.95	5.05	5.1	5.9
30	5.3	.....	5.65	6.95	5.8	5.55	5.3	5.2	4.95	5.05	5.2	5.7
31	5.2	.....	5.6	.....	5.95	.....	5.25	5.2	.....	5.0	.....	5.65

Station rating table for Hiwassee River at Murphy, N. C., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.80	190	5.60	710	6.30	1,540	7.00	2,740
4.90	235	5.70	800	6.40	1,690	7.10	2,930
5.00	285	5.80	900	6.50	1,850	7.20	3,130
5.10	340	5.90	1,010	6.60	2,020	7.30	3,330
5.20	400	6.00	1,130	6.70	2,190	7.40	3,540
5.30	470	6.10	1,260	6.80	2,370	7.50	3,750
5.40	540	6.20	1,400	6.90	2,550	7.60	3,960
5.50	620						

NOTE.—The above table is based on 62 discharge measurements made during 1900–1905. It is well defined between gage heights 4.8 feet and 6.8 feet. The table has been extended beyond these limits. Above 7.6 feet the rating curve is a tangent, the difference being 220 per tenth.

Estimated monthly discharge of Hiwassee River at Murphy, N. C., for 1905.

[Drainage area, 410 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,020	370	695	1.70	1.96
February	6,600	400	1,602	3.91	4.07
March	2,740	665	907	2.21	2.55
April	2,645	580	815	1.99	2.22
May	3,130	755	1,282	3.13	3.61
June	2,280	470	664	1.62	1.81
July	10,500	435	1,102	2.69	3.10
August	1,850	370	647	1.58	1.82
September	470	260	307	.749	.836
October	3,855	260	449	1.10	1.27
November	505	285	316	.771	.860
December	9,550	370	1,518	3.70	4.27
The year	10,500	260	859	2.10	28.38

HIWASSEE RIVER AT RELIANCE, TENN.

This station was established August 17, 1900, by O. P. Hall. It is located at the Atlanta, Knoxville and Northern Railroad bridge, near the ferry landing at Reliance, Tenn.

Above the station the channel makes a sharp bend to the east for a distance of 800 feet. Below the station the channel makes a sharp bend to the west for about 1,000 feet. At ordinary stages the river is about 350 feet wide at this point, and the section is a fairly good one. The water is held back by a ledge of rock below, and is rather sluggish at low stages. Both banks overflow, but all water passes beneath the bridge and its approaches.

Discharge measurements are made from the railroad bridge and from the wooden trestles on both banks. The railroad track is about 34 feet above low water. The initial point for soundings is the center of the bridge pin about 1 foot from the end of the bridge on the right bank, downstream side. Discharge measurements at low stages can be made at a ferry near Wetmore, 6 miles below.

The gage is a vertical rod 10 feet long, fastened to an oak tree on the right bank 150 feet above the railroad bridge and 40 feet below the ferry landing and a 5-foot section, reading from 10 to 15 feet, attached to a sycamore tree on the downstream side of the road leading to the ferry, about 400 feet from the river. The gage is read once each day by C. V. Higdon. Bench marks were established as follows: (1) A cut in a hickory tree on the right bank of the river about 75 feet upstream from the bridge; elevation, 5.82 feet. (2) The top of the downstream iron girder under the cross-ties at a point about 40 feet from the end of the bridge on the right bank; elevation, 23.90 feet. (3) The top of the capstone of the right-bank pier on the upstream side of the bridge; elevation, 19.26 feet. (4) A copper plug set in a stone post flush with the surface of the ground at the south end of C. V. Higdon's house, under the south window. This house stands on the right bank, about 50 feet up from the foot of the hill, 600 feet north of the right-bank end of the bridge, and opposite a point on the river about 300 feet above the bridge; elevation of the bench mark, 27.16 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 48, p 191; 65, p 308; 83, p 210; 98, pp 262–263; 128, pp 138–139.
Discharge: Ann 19, iv, p 260; WS 27, p 45; 36, p 171; 48, p 191; 65, p 308; 83, p 210; 98, p 263; 128, p 139.
Discharge, monthly: Ann 22, iv, p 225; WS 75, p 107; 83, p 212; 98, p 265; 128, p 141.
Gage heights: WS 48, p 192; 65, p 309; 83, p 211; 98, p 263–264; 128, p 140.
Rating tables: WS 52, p 515; 65, p 324; 83, p 211; 98, p 264; 128, p 140.

Discharge measurements of Hiwassee River at Reliance, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 12	Olin P. Hall	318	2,103	1.12	1.98	2,347
June 19	do	311	1,927	.75	1.56	1,436
October 6	do	299	1,780	.40	1.07	708
October 7	do	301	1,794	.40	1.05	718
December 30	M. R. Hall	320	2,049	1.29	2.13	2,634

Daily gage height, in feet, of Hiwassee River at Reliance, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.4	1.4	2.05	1.8	2.5	1.9	2.2	1.3	1.2	0.95	1.1	1.35
2	1.4	1.4	2.0	1.75	2.3	1.85	2.0	1.25	1.35	1.0	1.1	1.25
3	1.5	1.35	1.9	1.7	2.2	1.85	1.8	1.25	1.4	1.05	1.1	5.5
4	1.75	1.5	1.85	1.7	2.15	1.7	1.55	1.2	1.6	1.6	1.1	3.5
5	1.5	1.9	1.85	1.8	2.0	1.65	1.45	1.2	1.25	1.55	1.1	2.3
6	1.5	2.15	1.8	1.9	1.95	1.65	1.6	1.2	1.2	1.15	1.1	1.95
7	2.4	2.1	1.75	1.85	2.3	1.6	1.75	1.2	1.25	1.05	1.1	1.75
8	1.9	2.15	1.75	1.8	2.2	1.55	1.5	1.5	1.15	1.0	1.15	1.75
9	1.65	7.2	1.85	1.8	2.4	1.55	1.6	1.6	1.1	1.0	1.1	4.7
10	1.55	3.9	2.5	1.95	2.2	1.5	1.4	1.45	1.2	1.0	1.1	3.7
11	1.6	2.85	2.5	1.8	2.0	1.45	1.5	2.05	1.15	1.8	1.15	2.8
12	2.9	2.4	2.2	2.0	1.9	1.45	2.3	2.3	1.2	2.2	1.1	2.4
13	5.0	2.8	2.15	2.2	1.9	1.5	3.3	2.0	1.3	1.45	1.05	2.1
14	5.5	3.2	2.0	2.0	1.95	1.45	2.4	1.8	1.2	1.3	1.05	1.9
15	3.1	2.7	1.95	1.9	1.8	1.45	2.05	1.8	1.1	1.2	1.05	2.1
16	2.1	2.4	1.9	2.0	3.2	1.45	2.05	1.9	1.1	1.2	1.05	2.2
17	1.9	2.25	1.8	1.9	3.0	1.6	1.8	1.4	1.1	1.25	1.05	2.0
18	1.8	2.1	1.8	1.8	2.5	1.55	1.9	1.9	1.05	1.15	1.05	1.9
19	1.75	2.0	1.8	1.75	2.2	1.55	1.8	1.6	1.05	1.2	1.05	1.8
20	1.65	2.7	1.8	1.75	2.0	1.75	1.75	1.55	1.15	1.15	1.15	1.8
21	1.65	6.3	2.1	1.7	2.0	1.75	1.65	1.4	1.15	1.15	1.35	2.6
22	1.6	3.9	2.9	1.8	2.0	2.0	1.7	1.3	1.1	1.1	1.25	2.7
23	1.55	3.2	2.3	1.7	2.3	2.0	1.6	1.3	1.0	1.1	1.15	2.5
24	1.5	2.4	2.1	1.6	3.7	2.0	1.45	2.0	1.0	1.1	1.1	3.2
25	1.45	2.6	2.1	1.6	2.7	1.7	1.35	2.0	1.0	1.1	1.1	2.6
26	1.5	2.25	2.0	1.65	2.4	1.55	1.45	1.6	1.0	1.15	1.2	2.3
27	1.45	2.25	1.95	2.15	2.3	1.5	1.35	1.5	1.0	1.3	1.2	2.2
28	1.35	2.15	1.9	2.3	2.1	1.7	1.35	1.5	1.0	1.25	1.15	2.0
29	1.4	.....	1.8	3.5	2.0	1.5	1.45	1.35	.95	1.25	1.15	2.0
30	1.5	.....	1.85	2.8	1.95	1.7	1.45	1.3	.95	1.15	1.3	2.0
31	1.45	.....	1.85	.....	2.0	.....	1.4	1.35	.....	1.15	.....	1.9

Station rating table for Hiwassee River at Reliance, Tenn., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.70	380	1.70	1,725	2.60	4,090	3.50	7,300
0.80	460	1.80	1,940	2.70	4,410	3.60	7,690
0.90	550	1.90	2,165	2.80	4,745	3.70	8,080
1.00	655	2.00	2,400	2.90	5,090	3.80	8,475
1.10	770	2.10	2,650	3.00	5,445	3.90	8,875
1.20	895	2.20	2,915	3.10	5,805	4.00	9,280
1.30	1,030	2.30	3,190	3.20	6,170	4.10	9,685
1.40	1,180	2.40	3,480	3.30	6,540	4.20	10,090
1.50	1,345	2.50	3,780	3.40	6,915	4.30	10,500
1.60	1,525						

NOTE.—The above table is based on 12 discharge measurements made during 1904-5 and 1 measurement made in 1901. It is well defined between gage heights 0.7 foot and 2.3 feet.

Estimated monthly discharge of Hiwassee River at Reliance, Tenn., for 1905.

[Drainage area, 1,180 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	15,440	1,105	2,680	2.27	2.62
February	22,700	1,105	4,886	4.14	4.31
March	5,090	1,832	2,446	2.07	2.39
April	7,300	1,525	2,320	1.97	2.20
May	8,080	1,940	3,174	2.69	3.10
June	2,400	1,262	1,640	1.39	1.55
July	6,540	1,105	1,912	1.62	1.87
August	3,190	895	1,504	1.27	1.46
September	1,525	602	832	.705	.787
October	2,915	602	976	.827	.953
November	1,105	712	803	.681	.760
December	15,440	962	3,846	3.26	3.76
The year	22,700	602	2,252	1.91	25.77

VALLEY RIVER AT TOMOTLA, N. C.

This station was established June 29, 1904, by M. R. Hall. It is located at a footbridge about 250 feet below a public-road ford at Tomotla, N. C., and 5 miles above Murphy, N. C.

The channel is straight for about 500 feet above and 1,000 feet below the station. The current is moderately swift. Both banks are high and rocky and are not liable to overflow. The bed of the stream is composed of rock, but there is a fairly smooth and permanent section. There is but one channel at all stages.

Discharge measurements are made from the single-span footbridge, the floor of which is 10 to 15 feet above low water. The initial point for soundings is the upstream edge of the abutment, next to the water on the right bank.

The gage is a vertical timber 10 feet long, fastened to a pine timber which is spiked to the upstream side of a maple tree on the right bank about 50 feet below the ford. The gage is read once each day by J. T. Hayes. Bench marks were established as follows: (1) A cross on the head of a large spike driven into the downstream side of an elm tree about 10 feet upstream from the gage; elevation, 8.50 feet. (2) A cross on a point of rock at a spring on the right bank about 50 feet above the footbridge; elevation, 3.00 feet. Elevations refer to the datum of the gage.

A description of this station, gage height and discharge data, and rating table is contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 141–143.

Discharge measurements of Valley River at Tomotla, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.		*Feet.*	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
December 15	M. R. Hall	55	101	0.68	1.10	69
1905.						
April 17	O. P. Hall	58	150	1.36	1.79	204
June 16	do	56	125	.94	1.42	118
June 16	M. R. Hall	55	125	1.00	1.42	125
October 13	O. P. Hall	55	110	.71	1.20	78

Mean daily gage height, in feet, of Valley River at Tomotla, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.4	1.3	2.1	1.85	2.45	1.75	2.3	1.4	1.5	1.05	1.15	1.45
2	1.4	1.4	2.1	1.85	2.25	1.65	2.2	1.4	1.4	1.05	1.05	1.6
3	1.4	1.4	2.0	1.85	2.05	1.65	1.8	1.3	1.4	1.55	1.05	7.75
4	1.4	1.5	1.9	1.75	1.95	1.55	1.8	1.3	1.4	1.35	1.05	3.55
5	1.5	1.7	1.9	1.75	1.85	1.55	1.6	1.3	1.4	1.25	1.05	2.65
6	1.9	2.4	1.9	1.85	1.85	1.45	2.0	1.3	1.3	1.15	1.05	2.35
7	1.9	2.1	1.8	1.85	2.15	1.45	1.8	1.4	1.3	1.15	1.25	1.95
8	1.7	3.1	1.8	2.05	2.05	1.45	1.6	1.8	1.3	1.15	1.15	3.35
9	1.5	7.9	2.6	2.35	1.95	1.35	1.6	1.5	1.3	1.15	1.15	4.55
10	1.6	3.7	2.8	2.05	1.95	1.35	1.8	2.0	1.3	1.35	1.15	2.75
11	1.8	2.9	2.5	1.85	1.85	1.35	2.1	1.8	1.3	2.55	1.15	2.45
12	7.5	2.9	2.3	2.45	1.85	1.25	9.6	2.3	1.2	1.75	1.15	2.35
13	3.7	3.9	2.2	2.05	1.85	1.25	4.2	2.6	1.2	1.35	1.15	2.35
14	2.7	3.3	2.1	1.95	1.85	1.35	2.6	3.2	1.2	1.15	1.05	2.25
15	2.5	2.7	2.0	1.85	2.15	1.35	2.4	2.1	1.2	1.15	1.05	2.35
16	2.1	2.6	2.0	2.15	3.15	1.35	2.2	2.8	1.2	1.15	1.05	2.35
17	1.9	2.4	1.9	1.85	2.45	1.35	2.4	2.2	1.2	1.15	1.05	2.25
18	1.7	2.2	1.85	1.85	2.25	1.35	2.2	1.8	1.2	1.05	1.05	2.15
19	1.7	2.7	1.8	1.85	2.05	1.35	2.1	1.6	1.2	1.25	1.15	2.15
20	1.6	7.6	2.2	1.75	1.95	1.35	2.0	1.6	1.2	1.15	1.55	2.15
21	1.6	5.4	3.4	1.75	2.05	1.45	1.8	1.5	1.1	1.15	1.35	2.75
22	1.6	3.9	2.5	1.95	2.05	1.45	1.8	1.6	1.1	1.15	1.25	2.35
23	1.5	3.1	2.2	1.85	2.35	1.65	1.7	1.8	1.1	1.15	1.15	3.75
24	1.4	2.9	2.3	1.85	2.35	1.45	1.7	2.9	1.1	1.15	1.15	3.55
25	1.3	2.7	2.3	1.85	2.05	1.35	1.7	1.8	1.1	1.15	1.45	2.75
26	1.2	2.5	2.1	2.05	1.95	1.45	1.6	1.7	1.1	1.85	1.35	2.35
27	1.1	2.3	2.1	1.95	1.85	1.45	1.6	1.6	1.1	1.55	1.25	2.25
28	1.1	2.2	2.0	1.85	1.85	1.45	1.5	1.6	1.0	1.25	1.35	2.15
29	1.1	.....	2.3	2.85	1.85	2.85	1.5	1.5	1.1	1.15	1.75	2.15
30	1.2	.....	2.1	3.15	1.85	2.85	1.5	1.5	1.1	1.15	1.65	2.05
31	1.4	.....	1.9	.....	1.75	.....	1.5	1.4	.....	1.15	.....	2.05

NOTE.—The rating table for this station as published in the 1904 report applies quite closely for gage heights less than 2 feet.

NOTTELY RIVER AT RANGER, N. C.

This station was established February 16, 1901, by O. P. Hall. It is located at the wooden wagon bridge one-half mile from the railroad station at Ranger, N. C., and one-fourth mile below the Atlanta, Knoxville and Northern Railroad bridge.

The bridge is at a flat bend in the river, the channel curving slightly above and below the station for 600 feet. The right bank is high, rocky, and somewhat wooded and will overflow around the end of the bridge for about 50 feet only. The left bank is low and will overflow for a distance of 700 feet at a gage height of from 15 to 18 feet. The bed of the stream is of gravel and sand and probably shifts considerably. The current is somewhat broken and irregular, caused mostly by the piers. There is a moderate velocity and a depth of from 2 to 5 feet at low stages.

Discharge measurements are made from the wagon bridge, a wooden structure of 3 spans supported by 2 wooden piers and 2 stone abutments. The center span is 55 feet long, and the end spans are each 36 feet long. The floor of the bridge is about 20 feet above low water. The initial point for soundings is the inside face of the stone abutment on the right bank.

The gage is a vertical board in two sections, each 8 feet long, fastened to the left side of the first wooden pier from the right bank. The gage is read once each day by A. D. Kilpatrick. Bench marks were established as follows: (1) The heads of large wire nails driven into the top of the downstream end of the wooden cap on the left bent of the wooden pier nearest the right bank of the river; elevation, 20.05 feet. (2) A cut on a maple tree 18

inches in diameter, 25 feet from the upstream side of the bridge on the right bank, 25 feet from the edge of the water; elevation, 15.00 feet. (3) A cut on a red-oak tree about 15 inches in diameter, on the left bank of the river 35 feet from the end of the bridge near the downstream side of the road; elevation, 17.27 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 307; 83, p 212; 98, pp 265–266; 128, pp 143–144.
Discharge: 49, p 217; 65, p 307; 83, p 212; 98, p 266; 128, p 144.
Discharge, monthly: 75, p 106; 83, p 214; 98, p 267; 128, p 145.
Gage heights: 65, p 308; 83, p 213; 98, p 266; 128, p 144.
Rating tables: 65, p 324; 83, p 213; 98, p 267; 128, p 145.

Discharge measurements of Nottely River at Ranger, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 17	O. P. Hall	70	248	1.70	3.48	421
June 20	do	71	224	1.78	3.51	399
June 21	do	72	268	2.01	3.98	538
October 12	do	69	226	1.40	3.22	315

Daily gage height, in feet, of Nottely River at Ranger, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.0	2.9	3.7	3.3	3.9	3.5	3.9	2.7	3.4	2.3	2.6	2.6
2	2.9	2.9	3.6	3.3	3.8	3.3	4.1	2.7	3.1	2.3	2.6	2.7
3	3.5	2.9	3.6	3.3	3.7	3.5	3.6	2.7	3.0	2.8	2.7	11.8
4	3.1	3.0	3.6	3.2	3.6	3.4	3.4	2.7	3.0	3.0	2.7	4.8
5	3.1	2.9	3.6	3.4	3.5	3.3	3.1	2.7	2.9	3.0	2.7	3.2
6	3.1	4.0	3.5	3.5	5.8	3.2	4.2	2.6	2.9	3.0	2.6	2.9
7	3.0	3.9	3.5	3.6	5.6	3.2	4.1	2.8	2.8	2.9	2.6	2.7
8	3.5	5.4	3.5	3.5	5.2	3.2	3.9	2.7	2.8	2.5	2.6	9.9
9	3.1	10.2	3.4	3.5	4.9	3.1	3.1	3.1	2.6	2.5	2.6	7.2
10	3.0	5.2	4.7	3.4	4.2	3.0	3.0	3.9	2.4	2.4	2.6	5.8
11	2.9	4.3	4.1	3.4	4.0	3.0	4.5	3.9	2.4	6.6	2.6	4.2
12	11.4	4.2	3.8	3.8	3.8	3.0	9.0	4.0	2.6	3.8	2.6	4.0
13	7.2	5.9	3.9	3.7	3.7	3.0	5.0	4.2	2.5	3.2	2.5	4.0
14	5.3	4.6	3.8	3.6	3.5	3.0	4.1	3.9	2.5	2.8	2.5	3.9
15	5.1	4.2	3.5	3.5	3.5	3.1	3.9	3.4	2.4	2.5	2.5	3.9
16	4.5	4.0	3.5	3.9	6.6	3.1	3.3	3.3	2.4	2.5	2.4	3.4
17	4.5	3.8	3.5	3.5	4.9	3.2	3.5	3.3	2.4	2.5	2.4	3.5
18	3.4	3.6	3.4	3.4	4.2	3.0	3.3	3.2	2.4	2.6	2.3	3.5
19	3.3	3.7	3.4	3.4	3.9	3.3	3.2	3.0	2.4	2.6	2.3	3.4
20	3.3	4.0	3.5	3.4	3.8	3.4	3.4	3.0	2.3	2.6	2.3	4.6
21	3.3	7.8	7.5	3.4	3.6	4.0	3.3	2.9	2.3	2.6	2.3	5.9
22	3.2	5.2	4.8	3.5	3.4	3.9	3.2	2.8	2.3	2.6	2.4	5.1
23	3.2	5.0	4.4	3.4	5.3	5.0	3.0	2.8	2.3	2.5	2.4	5.0
24	3.1	4.7	4.2	3.3	5.0	3.6	3.0	2.8	2.4	2.5	2.4	5.4
25	3.0	4.6	3.7	3.3	4.7	3.4	2.9	2.7	2.4	2.5	2.3	5.2
26	3.0	4.4	3.6	3.4	4.3	3.4	2.8	2.6	2.4	3.2	2.4	4.9
27	3.0	3.9	3.6	4.4	4.0	3.3	2.7	2.6	2.3	2.8	2.5	4.7
28	2.9	3.8	3.5	3.8	3.9	3.3	2.8	2.7	2.3	2.7	2.5	4.6
29	3.4	.....	3.4	3.8	3.8	3.4	3.0	2.7	2.3	2.7	2.7	4.2
30	3.1	.....	3.4	4.6	3.6	3.2	3.0	2.6	2.3	2.6	2.7	4.0
31	2.9	.....	3.4	.....	4.0	.....	2.8	2.6	.....	2.6	.....	3.5

Station rating table for Nottely River at Ranger, N. C., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.20	101	2.60	184	3.00	272	3.40	373
2.30	120	2.70	206	3.10	295	3.50	402
2.40	141	2.80	228	3.20	320	3.60	432
2.50	162	2.90	250	3.30	346		

NOTE.—The above table is based on 22 discharge measurements made during 1901–1905. It is well defined between gage heights 2.25 feet and 3.5 feet. The table has been extended beyond these limits. Above gage height 3.6 feet the rating curve is a tangent, the difference being 32 per tenth.

Estimated monthly discharge of Nottely River at Ranger, N. C., for 1905.

[Drainage area, 272 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,992	250	501	1.84	2.12
February	2,544	250	716	2.63	2.74
March	1,680	373	506	1.86	2.14
April	752	320	420	1.54	1.72
May	1,392	373	640	2.35	2.71
June	880	272	364	1.34	1.50
July	2,160	206	455	1.67	1.92
August	624	184	288	1.06	1.22
September	373	120	174	.640	.714
October	1,392	120	247	.908	1.05
November	206	120	165	.607	.677
December	3,056	184	780	2.87	3.31
The year	3,056	120	438	1.61	21.82

OCOEE RIVER AT M'CAYS, TENN.

This station was established March 21, 1903, by O. P. Hall. It is located at a suspension footbridge just below McCay's ferry, at McCays, Tenn., near the Georgia-Tennessee boundary, and one-half mile below the railroad bridge of the Atlanta, Knoxville and Northern Railroad.

The channel is practically straight for about 800 feet above and below the station. The right bank will overflow at about 14 feet gage height for about 500 feet; the left bank will overflow at gage height 12 to 20 feet for about 400 feet. The water is confined to one channel and the bed is probably constant. The current is fairly swift and the section is good for measurement.

Discharge measurements are made from the suspension footbridge.

The gage is in two sections, the inclined section reading from −0.3 to 8.5 feet, set in a trench and held in place by posts driven into the ground. The vertical section, reading from 8 to 18 feet, is attached to the bridge posts on the right bank. The gage is read twice each day by Arch Ballew. Bench marks were established as follows: (1) A cut on a walnut tree on the downstream side of the road, about 50 feet from the left-bank landing of McCay's ferry; elevation, 12.59 feet. (2) The head of a large nail in the center of a post at the right-bank end of the footbridge on the downstream side; elevation, 16.10 feet. This post is an anchor post for the cable of the suspension bridge and may be pulled out of place. (3) A

copper plug set in solid rock at the outer edge of the side ditch of the railroad bed, about 800 feet west of the railroad station at McCays, 11 feet north of the center of the track, and slightly higher than the railroad; elevation, 20.98 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 259–260; 128, p 146.
Discharge: 98, p 260; 128, p 147.
Discharge, monthly: 98, p 262; 128, p 148.
Gage heights: 98, p 261; 128, p 147.
Rating table: 98, p 261; 128, p 148.

Discharge measurements of Ocoee River at McCays, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second feet.*
April 10	O. P. Hall	148	477	1.4	1.22	666
June 19	do	150	460	1.32	1.18	608
October 5	do	143	369	1.12	.77	413

Daily gage height, in feet of Ocoee River at McCays, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.7	0.77	1.5	1.3	1.45	1.4	1.7	0.9	0.8	0.92	0.68	0.6
2	.7	.8	1.4	1.2	1.35	1.3	1.25	.82	1.7	.7	.6	.6
3	.7	.8	1.4	1.2	1.3	1.3	1.1	.8	1.1	.88	.6	4.6
4	.7	.75	1.4	1.2	1.5	1.25	1.0	.8	.92	1.2	.65	1.6
5	.63	1.0	1.3	1.4	1.4	1.2	1.0	.8	.8	.78	.62	1.4
6	.8	1.55	1.3	1.45	1.65	1.2	1.0	.75	.8	.68	.63	1.2
7	.5	1.25	1.4	1.4	1.7	1.2	1.0	.9	.8	.6	.62	1.2
8	.9	1.45	1.3	1.3	1.7	1.15	1.15	1.25	.8	.6	.6	3.6
9	.8	3.1	1.7	1.2	1.8	1.1	1.0	1.0	.8	.6	.6	3.4
10	.9	2.45	2.0	1.2	1.55	1.0	1.2	1.15	.72	.8	.6	2.4
11	.95	1.85	1.25	1.2	1.4	1.0	1.5	2.15	.75	3.3	.6	1.9
12	6.4	1.65	1.5	1.7	1.35	1.15	4.4	1.75	1.15	1.35	.6	1.65
13	3.5	1.7	1.55	1.35	1.3	1.1	2.0	1.65	.8	.95	.6	1.5
14	2.0	1.85	1.5	1.2	1.2	1.0	1.5	1.8	.73	.8	.6	1.55
15	1.1	1.75	1.4	1.35	1.55	1.5	1.3	1.95	.72	.82	.6	1.7
16	1.1	1.5	1.3	1.4	2.8	1.5	1.45	1.45	.72	.9	.6	1.6
17	1.1	1.5	1.3	1.2	1.8	1.65	1.3	1.4	.7	.8	.6	1.45
18	1.0	1.4	1.3	1.2	1.6	1.3	1.15	1.2	.7	.72	6	1.4
19	1.0	1.3	1.25	1.2	1.5	1.3	1.4	1.1	.65	.68	.55	1.35
20	1.0	4.2	1.7	1.15	1.5	1.1	1.2	1.0	.7	.6	.8	1.7
21	.98	4.1	3.0	1.15	1.45	1.4	1.1	1.0	.7	.65	.75	2.7
22	.93	3.3	1.95	1.25	1.4	1.25	1.1	1.0	.62	.62	.6	2.0
23	.9	2.25	1.7	1.1	3.0	1.85	1.0	1.1	.6	.65	.6	2.2
24	.83	2.15	1.7	1.1	2.2	1.25	1.0	1.1	.6	.6	.72	2.0
25	.8	2.0	1.6	1.1	1.85	1.2	1.05	1.15	.6	.7	.7	1.75
26	.8	1.85	1.5	1.25	1.8	1.15	.95	1.4	.6	1.2	.62	1.6
27	.75	1.65	1.4	1.7	1.7	1.3	.9	1.0	.55	.85	.62	1.55
28	1.1	1.55	1.4	1.45	1.6	1.5	.9	.95	.55	.75	.6	1.5
29	1.1	.....	1.35	1.5	1.5	1.8	2.15	.85	.55	.7	.65	1.7
30	.9	.....	1.45	1.85	1.45	1.65	1.0	.8	.58	.7	.75	1.5
31	.85	.....	1.3	.....	1.5	.....	1.0	.8	.....	.7	.....	1.45

Station rating table for Ocoee River at McCays, Tenn., from March 20, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	200	1.30	655	2.30	1,275	3.60	2,200
0.30	230	1.40	710	2.40	1,340	3.80	2,350
0.40	262	1.50	767	2.50	1,410	4.00	2,500
0.50	296	1.60	826	2.60	1,480	4.20	2,650
0.60	332	1.70	887	2.70	1,550	4.40	2,800
0.70	370	1.80	950	2.80	1,620	4.60	2,950
0.80	411	1.90	1,015	2.90	1,690	4.80	3,100
0.90	455	2.00	1,080	3.00	1,760	5.00	3,250
1.00	502	2.10	1,145	3.20	1,900	5.50	3,650
1.10	551	2.20	1,210	3.40	2,050	6.00	4,050
1.20	602						

NOTE.—The above table is based on 18 discharge measurements made during 1903–1905. It is well defined between gage heights 0.25 foot and 3.4 feet.

Estimated monthly discharge of Ocoee River at McCays, Tenn., for 1905.

[Drainage area, 374 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,370	296	649	1.74	2.01
February	2,650	390	1,012	2.71	2.82
March	1,760	628	786	2.10	2.42
April	982	551	663	1.77	1.98
May	1,760	602	859	2.30	2.65
June	982	502	661	1.77	1.98
July	2,800	455	687	1.84	2.12
August	1,178	390	592	1.58	1.82
September	887	314	401	1.07	1.19
October	1,975	332	459	1.23	1.42
November	411	314	344	.920	1.03
December	2,950	332	991	2.65	3.06
The year	4,370	296	675	1.81	24.50

FIGHTINGTOWN CREEK AT M'CAYS, TENN.

This station was established August 27, 1904, for the purpose of making miscellaneous measurements. It is located about one-half mile above the mouth of the creek which flows into Ocoee River about one-half mile below the gaging station on Ocoee River at McCays, Tenn.

Both banks are open cultivated lands, which will probably overflow. The bed is sandy and will probably change much.

Discharge measurements are made by means of a boat or by wading.

The bench mark is two small nails driven into the largest of a cluster of small maple sprouts on the right bank, 40 feet above the mouth of a small branch; elevation, 5.00 feet above datum of assumed gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 148–149.

Discharge measurements of Fightingtown Creek at McCays, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 20	O. P. Hall	42	138	0.89	2.00	123
October 6	do	40	114	.52	1.61	59

ELK RIVER NEAR ELKMONT, ALA.

This station was established June 24, 1904, by M. R. Hall. It is located at the wagon bridge near Wilson's store, about 5 miles east of Elkmont, Ala., and 3 miles below the bridge of the Louisville and Nashville Railroad.

The channel is nearly straight for about 1,500 feet above and straight for about 2,500 feet below the station. The current is swift. Both banks are high, cultivated, and liable to overflow. The bed of the stream is composed of rock, and is permanent. There is but one channel, broken by two piers at ordinary stages.

Discharge measurements are made from the downstream side of the bridge. This bridge is of iron, with stone abutments and cylindrical iron piers, having a span of 82 feet at the right bank, a main span of 181 feet, and two spans of 82 and 20 feet, respectively, at the left bank. The initial point for soundings is the end of the bridge at the right bank, downstream side.

A standard chain gage is attached to the upstream lattice iron fencing of the bridge about 125 feet from the right end; length of chain, 36.45 feet. The gage is read once each day by J. D. Tennison. Bench marks were established as follows: (1) A point marked with white paint on the top of the downstream pier at the right bank; elevation, 30.96 feet. (2) A chisel mark on the intermediate post at the end of the gage box, which is at the upstream end of the second floor beam from the right-bank end of the main span; elevation, 35.00 feet. (3) A copper plug set in the upstream corner of the right abutment; elevation, 29.33 feet. (4) A horizontal cut in the head of a lag screw driven into the downstream side of a large white oak tree, 6 feet upstream from the right end of the bridge and 50 feet back from the river; elevation, 25.00 feet. Elevations refer to the datum of the gage.

A description of this station, gage-height and discharge data, and rating tables are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 150–152.

Discharge measurements of Elk River near Elkmont, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 12	W. E. Hall	235	629	2.20	2.71	1,382
June 19	F. A. Murray	232	590	1.96	2.51	1,157
September 30	do	201	360	.88	1.51	315
November 28	W. E. Hall	202	414	1.11	1.81	461

Daily gage height, in feet, of Elk River near Elkmont, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	2.9	4.0	3.1	4.0	3.2	13.2	2.1	1.8	1.7	2.6	2.1
2	3.2	3.1	3.8	3.0	3.7	3.1	11.6	2.05	3.5	1.8	2.5	1.9
3	3.0	2.8	3.6	3.0	3.3	2.85	6.9	2.0	5.2	2.5	2.4	3.2
4	2.9	2.9	3.4	3.1	3.0	2.7	4.7	2.0	3.0	2.25	2.35	3.4
5	2.75	3.15	3.1	3.3	2.9	2.6	4.4	2.0	2.5	1.9	2.25	2.8
6	2.6	8.3	3.2	3.4	2.8	2.5	4.0	2.0	2.0	1.8	2.2	2.7
7	2.75	5.9	3.1	3.1	3.4	2.4	3.6	2.3	2.0	1.7	2.15	2.6
8	2.65	8.0	3.0	3.0	3.9	3.1	4.1	2.2	2.0	1.6	2.1	3.2
9	2.65	8.2	8.9	2.9	3.3	3.2	3.7	2.0	1.9	1.5	2.1	3.7
10	2.55	14.8	13.1	2.85	3.2	3.0	3.5	2.3	2.0	1.7	2.0	3.5
11	3.2	10.2	10.6	2.8	3.1	2.9	3.7	4.5	2.7	6.5	2.0	3.4
12	11.1	7.7	7.4	2.7	2.9	2.7	4.3	3.0	2.2	5.2	1.9	3.2
13	11.5	7.1	5.4	2.7	2.8	2.6	3.8	2.7	1.8	3.0	1.9	3.2
14	6.1	6.6	4.6	2.65	2.7	2.45	3.7	2.4	1.7	2.4	1.85	3.1
15	5.5	5.9	4.2	2.6	2.5	2.3	3.1	3.2	1.7	2.6	1.8	8.4
16	4.6	4.7	3.8	2.55	3.0	2.7	3.0	2.5	1.7	2.6	1.9	8.7
17	3.7	4.5	3.6	2.4	3.3	3.6	2.8	2.35	1.65	2.4	1.8	6.2
18	3.5	4.3	3.5	2.35	3.4	3.0	2.7	2.3	1.6	2.2	1.75	5.2
19	3.4	4.0	3.6	2.3	3.5	2.6	2.5	3.0	1.55	2.2	1.8	4.5
20	3.6	11.6	5.9	2.25	3.4	2.6	2.4	2.3	2.4	3.3	1.8	4.2
21	3.4	15.6	6.2	2.2	3.1	2.7	2.3	2.1	2.7	4.3	1.95	6.6
22	3.2	13.1	6.3	2.7	3.0	8.2	2.2	2.0	2.0	3.2	1.85	8.2
23	3.1	11.1	5.9	2.8	10.5	8.5	2.4	1.9	1.9	2.7	1.8	12.4
24	2.8	8.0	5.2	2.7	7.2	5.8	2.3	1.9	1.7	2.5	1.8	8.4
25	2.6	6.0	4.6	2.6	12.6	5.2	2.2	2.2	1.6	2.7	1.75	7.2
26	2.5	5.4	4.0	2.55	7.0	4.5	2.2	2.4	1.6	5.3	1.75	6.0
27	2.5	4.7	3.8	3.0	5.5	3.9	2.2	2.2	1.6	5.0	1.8	5.4
28	2.4	4.2	3.6	3.3	4.2	4.9	2.0	2.1	1.6	3.4	1.8	5.4
29	2.6	.....	3.5	3.2	3.9	10.4	2.0	2.0	1.55	3.1	1.8	4.9
30	3.2	.....	3.3	4.3	3.5	9.5	2.0	1.8	1.7	2.9	2.0	4.2
31	3.0	.....	3.2	.....	3.3	.....	2.1	1.7	.....	2.7	.....	4.0

NOTE.—As far as it goes (1.2 to 3 feet) the 1904 rating table applies to the 1905 gage heights. But owing to the fact that there are so many gage heights beyond the range of the table, no estimates are made for 1905.

DUCK RIVER AT COLUMBIA, TENN.

This is an old Weather Bureau station which has not been maintained continuously. Two discharge measurements were made in 1901 by M. R. Hall. During 1904 discharge measurements were made, and the gage heights have been regularly recorded since October 21, 1904. The station is located at the highway bridge two blocks north of the public square at Columbia, Tenn., three-fourths of a mile below a milldam.

The channel is curved for about 1,000 feet above and nearly straight for 2,000 feet below the station. The current is sluggish above and swift below the measuring section. Both banks are high and fringed with trees. The right bank overflows under the short span of the bridge during floods. The bed of the stream is composed of rock and gravel, free from vegetation, and constant. There is but one channel, all water passing under the left span at ordinary stages and under both spans at high stages.

Discharge measurements are made from the downstream side of the two-span bridge. The spans are 199 and 97 feet long, respectively. Low-water measurements are made from a boat about one-fourth mile above the bridge. The initial point for soundings is the end of the bridge on the left bank, downstream side.

Gage readings were made from the United States Weather Bureau gage, a vertical timber 38 feet long bolted to the downstream pier at the right bank. June 17, 1905, a standard chain gage was fastened to the intermediate post and diagonal braces on the downstream side of the bridge 120 feet from the left end; length of chain, 53.71 feet. The gage is read twice each day by W. O. Cherry. Bench marks were established as follows: (1) A chisel mark on the right side of the intermediate post to which the gage is attached, 119 feet from the left end of the bridge; elevation, 53.71 feet. (2) A copper plug set in the downstream end of the left-bank abutment; elevation, 46.07 feet. (3) A cross and the letters "B. M." cut into solid rock 25 feet to the left of and 12 feet downstream from the left end of the bridge; elevation, 52.06 feet. Elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 153–154.

Discharge measurements of Duck River at Columbia, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 14	W. E. Hall	115	772	0.69	1.21	533
June 16	F. A. Murray	134	823	.91	1.63	756
June 17	do	136	863	1.21	1.97	1,043
June 20	do	121	772	.78	1.34	599
September 29 [a]	do	86	95	1.42	.60	135
November 27	W. E. Hall	115	718	.33	.77	237

[a] Measured one-fourth mile above bridge.

Daily gage height, in feet, of Duck River at Columbia, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.8	0.45	2.5	1.55	1.9	2.25	10.2	0.6	0.8	0.45	1.45	1.2
2	2.5	.65	2.1	1.4	1.75	1.9	6.6	.6	2.05	.45	1.35	1.35
3	2.15	.7	1.8	1.3	1.45	1.75	4.2	.5	4.6	.9	1.25	3.8
4	1.7	.7	1.8	1.45	1.45	1.45	2.9	.55	1.9	.8	1.15	5.2
5	1.5	3.4	1.65	1.65	1.35	1.3	2.15	.55	1.4	.85	1.05	2.95
6	2.0	8.1	1.6	2.35	1.3	1.25	1.95	.55	1.1	.6	1.05	2.4
7	2.5	7.2	1.55	1.9	1.3	1.15	2.2	.65	.95	.6	.95	1.95
8	2.15	8.9	3.2	1.85	1.25	1.05	2.35	.6	.85	.55	1.0	1.75
9	2.2	17.2	17.8	1.55	1.2	1.0	2.7	.6	.7	.55	1.0	2.95
10	1.75	12.8	20.7	1.55	1.2	.95	1.95	1.35	.6	2.0	.9	3.4
11	2.4	7.6	12.8	1.45	1.15	1.0	3.2	4.2	1.2	3.2	.75	2.6
12	12.0	5.1	7.5	1.35	1.1	1.0	3.4	3.0	1.05	2.4	.75	2.2
13	14.0	4.6	5.2	1.3	1.15	.85	2.4	1.85	.7	1.7	.7	1.95
14	8.4	4.4	4.0	1.2	1.1	.85	1.8	1.9	.6	1.25	.8	2.0
15	4.8	3.7	3.3	1.15	1.1	1.45	1.5	3.6	.6	1.3	.6	9.2
16	3.4	3.1	2.9	1.1	1.2	2.75	1.4	3.4	.8	1.3	.65	11.4
17	3.0	2.7	2.65	1.05	2.05	2.0	1.1	1.95	.75	1.15	.65	7.0
18	2.5	2.5	2.35	1.0	2.35	2.2	1.0	1.5	.6	1.15	.65	4.8
19	2.4	3.0	2.15	1.0	2.1	1.6	.9	1.25	.55	2.4	.7	3.9
20	2.25	5.3	2.3	.95	1.6	1.3	.95	1.1	.8	4.0	.75	3.2
21	2.35	13.7	4.2	.9	1.45	1.8	.8	.95	.8	4.0	.75	5.2
22	2.0	11.5	5.2	.8	1.4	4.0	.85	.9	.65	2.5	.95	6.9
23	1.85	7.5	4.2	.9	21.6	11.4	.7	.85	.65	1.95	.9	9.0
24	1.7	5.4	3.3	1.0	29.3	10.4	.75	.85	.55	1.65	.8	9.4
25	1.55	4.4	3.0	1.0	27.7	4.7	.75	.9	.6	1.85	.85	6.4
26	1.3	3.6	2.7	1.0	13.9	3.5	.7	1.9	.55	4.6	.7	4.7
27	1.2	3.1	2.4	1.5	6.5	3.8	.7	1.35	.55	4.4	.75	3.6
28	1.2	2.8	2.1	1.7	4.4	3.7	.65	1.05	.55	2.95	.75	3.0
29	1.0	.....	1.95	1.5	3.2	7.9	.65	.8	.55	2.25	.8	2.8
30	.9	.....	1.7	2.15	2.7	7.5	.75	.55	.5	1.9	1.05	2.8
31	1.45	.....	1.6	.....	2.45	.....	.65	.75	.....	1.7	.....	2 4

MISCELLANEOUS MEASUREMENTS IN TENNESSEE RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in Tennessee River drainage basin during 1905:

Holston River (North Fork) near Mendota, Va.—This stream is a tributary of Holston River, which is one of the largest of the streams which form Tennessee River. A measurement was made June 17, 1905, from the Virginia and Southwestern Railway bridge, 1 mile east of Mendota, Va. The bench mark is the apex of the downstream side of the cast-iron beam at third tension rod from left end of bridge, downstream side; elevation, 26.00 feet above the datum of the assumed gage.

Width, 115 feet; area, 315 square feet; mean velocity, 0.90 foot per second; gage height, 1.82 feet; discharge, 283 second-feet.

Pigeon River at Clyde, N. C.—This stream enters French Broad River from the left. A measurement was made April 16, 1905, from a single-span iron highway bridge at Clyde, N. C., about 1 mile above Morgan's mill.

Width, 128 feet; area, 297 square feet; mean velocity, 1.10 feet per second; gage height, 1.50 feet; discharge, 327 second-feet.

LOWER EASTERN MISSISSIPPI RIVER DRAINAGE BASIN.

The streams flowing into Mississippi River from the east below the mouth of the Ohio are in the main comparatively small. In the lower portion they are practically a network of bayous. The following pages contain the results of data collected in the lower eastern Mississippi River drainage by the United States Geological Survey during 1905:

YAZOO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Yazoo River rises in the northwestern part of Mississippi. It flows southward just west of the central portion of the State and enters Mississippi River just above Vicksburg. The United States Geological Survey maintained a station on this river at Yazoo City during 1905 under the direction of M. R. Hall.

YAZOO RIVER AT YAZOO CITY, MISS.

River-height observations have been made on Yazoo River at Yazoo City, Miss., for a number of years, by the Engineer Corps of the Army.

The channel is straight for about 3,000 feet above the station and is curved for about 2,000 feet below. The current is moderately rapid. As this stream is connected with Mississippi River both above and below the station, it is influenced by the stage of that stream to such an extent that high-water measurements are of no value. The bed is of sand and mud, and is subject to change. The right bank is high, but overflows for a long distance at extreme floods; the left bank is high and overflows to the foot of the hill, about one-half mile from the river. There are trees along both banks.

Discharge measurements are made from the highway bridge, consisting of one span of 85 feet, a turn-span of 190 feet, an approach on the right bank of about 100 feet, and one on the left bank of about 1,200 feet. The bridge is one-half mile northwest of the Illinois Central Railroad station in Yazoo City. The initial point for soundings is the end of the iron bridge on the left bank, downstream side.

The original gage was replaced in 1901 by a new gage rod in three sections placed as follows: The lowest, marked from −3 to +4.5 feet, is attached to the protecting work of the above-mentioned highway bridge; the middle section, marked from 4.5 to 18.5 feet, is attached to the piling that protects the bridge pier; the uppermost section, continuing the graduation up to 32.3 feet, is on a post under the approach to the bridge. Daily gage heights are furnished by the Weather Bureau, the observer being P. C. Battaille.

A bench mark was established on the top of the upstream cylinder of the second pier from the left bank, at a distance of 85 feet from the initial point for soundings; elevation, 35.85 feet above the zero of the gage. Other important bench marks in Yazoo City are the following: P. B. M. 12, Yazoo City, is a copper bolt in a stone under ground, surmounted by an iron pipe and cap, in the north corner of the county court-house yard; elevation, 44.10 feet above the zero of the gage and 116.2 feet above mean sea level. P. B. M. 13, Yazoo City, is a copper bolt in a stone under ground, surmounted by an iron pipe and cap, in the north corner of the public school yard, near Washington and Main streets; elevation, 29.20 feet above the zero of the gage and 101.3 feet above mean sea level.

The highest known water occurred in 1882, reaching a gage height of 36.5 feet; the lowest occurred November 16–21 and 26–30, 1904, with a gage height of −3.0 feet. The danger line is at 25 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 287; 83, p 236; 98, pp 294-295; 128, p 158.
Discharge: 65, p 288; 83, p 236; 98, p 295; 128, p 159.
Discharge, monthly: 83, p 238; 98, p 297; 128, p 160.
Gage heights: 65, p 288; 83, p 237; 98, p 295; 128, p 159.
Rating tables: 83, p 237; 98, p 296; 128, p 160.

Discharge measurement of Yazoo River at Yazoo City, Miss., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 23	W. E. Hall	241	4,110	1.97	8.15	8,109

Daily gage height, in feet, of Yazoo River at Yazoo City, Miss., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10.3	17.3	20.5	21.1	19.0	19.9	10.0	4.0	3.5	1.6	0.7	.....
2	11.0	17.3	20.4	21.0	18.5	20.3	10.3	5.0	3.4	1.7	.7	.....
3	11.6	17.4	20.3	20.9	18.1	20.9	10.5	4.8	3.2	1.8	.7	.....
4	12.0	17.5	20.2	21.5	18.0	21.0	11.2	4.8	3.4	1.8	.8	.....
5	12.4	17.6	20.0	21.0	17.5	21.0	11.4	4.8	2.9	1.0	1.7	.....
6	12.9	18.3	20.0	21.0	17.2	20.9	11.7	4.3	2.8	.6	2.4	.....
7	13.0	18.2	20.0	20.9	17.5	20.9	11.7	3.8	2.6	.0	2.3	.....
8	13.2	19.5	20.0	20.8	17.5	20.7	12.1	3.4	1.0	−.6	2.0	.....
9	13.3	19.9	21.0	20.7	17.8	20.6	12.5	3.0	.8	−.6	1.3	.....
10	13.6	19.5	20.9	20.5	18.0	20.4	12.6	2.8	.0	−.6	1.4	.....
11	14.0	19.5	20.9	21.0	18.3	20.0	12.7	2.7	.0	−.4	1.4	.....
12	15.5	19.5	20.8	21.0	18.5	19.8	12.4	3.2	.0	−.3	1.0	.....
13	15.5	20.0	20.8	21.0	18.7	19.4	12.2	2.8	.6	.0	.8	.....
14	15.6	20.0	20.8	21.0	18.8	18.8	11.9	2.9	.4	.1	.8	.....
15	15.8	19.8	20.8	21.0	19.0	18.0	11.4	3.0	.0	1.5	1.1	.....
16	16.0	19.7	20.8	21.0	19.2	17.0	10.8	3.1	−.1	1.7	1.2	.....
17	16.2	19.5	20.8	20.8	19.2	15.9	10.4	3.2	.0	1.3	1.3	.....
18	16.3	19.5	20.8	20.4	19.2	14.5	9.7	3.4	.1	.9	1.3	.....
19	16.5	20.0	21.2	20.2	19.3	13.2	9.2	3.4	−.2	−.2	1.1	.....
20	16.5	21.2	21.5	19.8	19.3	11.5	8.7	3.6	.0	−.6	1.0	.....
21	16.5	21.0	21.5	19.4	19.3	10.5	8.0	3.9	.0	−.9	1.0	.....
22	16.5	20.9	21.5	19.0	19.9	9.5	7.5	3.9	.0	−1.2	.8	.....
23	16.5	20.9	21.4	18.6	20.0	8.3	7.3	3.4	.0	−1.3	.6	.....
24	16.6	20.9	21.4	18.4	19.9	7.5	7.0	3.1	.0	−1.4	.4	.....
25	16.6	20.9	21.4	18.2	19.9	7.3	6.7	3.3	.0	−.6	.1	.....
26	16.7	20.9	21.4	19.4	20.0	7.4	6.4	3.4	−.1	.0	−.2	.....
27	16.7	20.9	21.3	19.0	20.2	9.0	6.4	3.0	−.3	−.1	−.4	.....
28	16.7	20.7	21.2	18.8	20.4	8.3	6.0	3.0	−.4	−.1	−.8	.....
29	16.9	.....	21.5	18.5	20.5	9.4	5.7	3.2	.0	.0	−1.0	.....
30	17.3	.....	21.4	19.0	20.6	9.7	5.4	3.4	1.0	.2	−1.2	.....
31	17.3	.....	21.3	.....	20.6	.....	5.0	3.5	.....	.6	.....	.....

INDEX.

CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 169.]

The publications of the United States Geological Survey consist of (1) Annual Reports; (2) Monographs; (3) Professional Papers; (4) Bulletins; (5) Mineral Resources; (6) Water-Supply and Irrigation Papers; (7) Topographic Atlas of United States, folios and separate sheets thereof; (8) Geologic Atlas of United States, folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

Most of the above publications may be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they may be obtained, free of charge (except classes 2, 7, and 8), on application.

2. A certain number are delivered to Senators and Representatives in Congress, for distribution.

3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they may be had at practically cost.

4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they may be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large. They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, Hydrographic progress reports.

Series P.—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements. A detailed index of these reports (1888–1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Water-Supply Papers Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Water-Supply Papers Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

The Geological Survey and the Reclamation Service have suboffices in different parts of the United States, from which hydrographic and reclamation work in the respective localities is carried on, and where data may be obtained on application. These offices are located as follows:

Boston, Mass., 6 Beacon street; Utica, N. Y., 75 Arcade; Atlanta, Ga., 409 Temple court; Austin, Tex., University of Texas; Chicago, Ill., 876 Federal Building; Belle Fourche, S. Dak.; Cody, Wyo.; Denver, Colo., Chamber of Commerce Building; Salt Lake, Utah; Los Angeles, Cal., 1108 Union Trust Building; Phoenix, Ariz.; Carlsbad, N. Mex.; El Paso, Tex.; Billings, Mont.; Huntley, Mont.; Hazen, Nev.; Boise, Idaho; North Yakima, Wash.; Portland, Oreg., 351 Washington street.

Correspondence should be addressed to

THE DIRECTOR,
UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C.

MAY, 1906.

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