DEPARTMENT OF THE INTERIOR

NITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 244

ACE WATER SUPPLY OF THE UNITED STATES

1907-8

ART IV. ST. LAWRENCE RIVER BASIN

ARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

H. K. BARROWS, A. H. HORTON
AND R. H. BOLSTER

WASHINGTON
GOVERNMENT PRINTING OFFICE
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CONTENTS.

ILLUSTRATIONS.

SURFACE WATER SUPPLY OF THE ST. LAWRENCE RIVER BASIN, 1907-8.

By H. K. Barrows, A. H. Horton, and R. H. Bolster.

INTRODUCTION.

AUTHORITY FOR INVESTIGATIONS.

This volume contains results of flow measurements made on certain streams in the United States. The work was performed by the water-resources branch of the United States Geological Survey, either independently or in cooperation with organizations mentioned herein. These investigations are authorized by the organic law of the Geological Survey (Stat. L., vol. 20, p. 394), which provides, among other things, as follows:

> Provided that this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

Inasmuch as water is the most abundant and most valuable mineral in nature, the investigation of water resources is included under the above provision for investigating mineral resources. The work has been supported since the fiscal year ending June 30, 1895, by appropriations in successive sundry civil bills passed by Congress under the following item:

> For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

The various appropriations that have been made for this purpose are as follows:

Annual appropriations for the fiscal year ending June 30—

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000

SCOPE OF INVESTIGATIONS.

These investigations are not complete nor do they include all the river systems or parts thereof that might purposefully be studied. The scope of the work is limited to that which can be provided with the appropriations available. The field covered and the character of the work are believed to be the best that could be accomplished under the controlling conditions. It would undoubtedly be of more scientific importance and ultimately of more practical value if the money now applied to wide areas were concentrated on a few small basins. Such a course is impossible because general appropriations made by Congress are applicable to all parts of the country. Each part demands its proportionate share of the benefits.

It is essential that records of stream flow shall be maintained during a period of years sufficient to cover all stages, in order that within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum may be determined. The length of such a period manifestly varies for different streams and can not be absolutely determined. Experience has shown that the records should cover from five to ten years, or for some streams twenty years or more, the limit being determined by the relative importance of the stream and the interdependence of the results and other long-time records on adjacent streams.

In the performance of this work the Geological Survey endeavors to approach as nearly as possible the highest degree of precision which a rational expenditure of time and a judicious expenditure of a small amount of money will allow. In all engineering work there is a point of refinement beyond which it is needless and wasteful to proceed, and this principle applies with especial force to stream-flow measurements. It is confidently believed that with some unavoidable exceptions the stream-flow data presented in the publications of the Survey are sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of many stations. All persons are cautioned to exercise the greatest care in the utilization of such incomplete records.

Records of varying lengths have been obtained at about 1,400 different points in the United States, and in addition the surface water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, has been investigated. During 1907 and 1908 regular gaging stations were maintained by the Survey and cooperating organizations at about 740 points in the United States, and in addition numerous miscellaneous measurements were made. Data were also obtained in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country.

These data will be made available in the regular surface water-supply papers and in special papers from time to time.

PURPOSES OF THE WORK.

Among the purposes for which the results contained in this volume are requisite are navigation, irrigation, domestic water supply, water power, swamp and overflow land drainage, and flood prevention. The demands of all these interests are immediate.

Navigation.—The Federal Government has expended more than $250,000,000 for the improvement of inland navigation, and prospective expenditures will approximate several times this amount. It is obvious that the determination of stream flow is necessary to the intelligent solution of the many problems involved.

Irrigation.—The United States is now expending $42,000,000 on federal irrigation systems, and this amount is far exceeded by the private expenditures of this nature in the arid West. The integrity of any irrigation system is based absolutely on the amount of water available. Therefore investigations of stream flow in that portion of the country are of first importance in the redemption of the lands, as well as constituting an insurance of federal and private investments.

Domestic water supply.—The highest use of water is that of domestic supply, and, while the federal interest in this aspect of the matter is less direct than in the aspects already named, this use of water nevertheless has so broad a significance with respect to the general welfare that the Federal Government is ultimately and intimately concerned.

Water power.—The time is rapidly approaching when the development of the water power of the country will be an economic necessity. Our stock of coal is being rapidly depleted, and the cost of steam power is increasing accordingly. Industry will cease its growth if cheap power is not available, and in that event the United States as a nation will cease to progress. Water power is the only avenue now open. When the electric transmission of power was accomplished the relation of our water powers to national economy changed entirely. Previous to the day of electric transmission the importance of a water power was largely confined to the locality at which it was generated, but it has now become a public utility in which the individual citizen is vitally interested. Inasmuch as the amount of water power that may be made available is dependent on the flow of rivers, the investigation of flow becomes a prerequisite in the judicious management of this source of energy.

Drainage of swamp and overflowed lands.—More than 70,000,000 acres of the richest land in this country are now practically worthless, or of precarious value, by reason of overflow and swamp conditions. When this land is drained it becomes exceedingly productive and its value increases many fold. Such reclamation would add to the national assets at least $700,000,000. The study of run-off is the first consideration in connection with drainage projects. If, by the drainage of a large area into any particular channel that channel becomes so gorged with water which it had not hitherto been called upon to convey that overflow conditions are created in places where previously the land was not subject to inundation, then drainage results merely in an exchange of land values. This is not the purpose of drainage improvement.

Flood prevention.—The damage from floods in the United States exceeds $100,000,000 annually and in the year 1908 the aggregate damage, based on reliable data, approximated $250,000,000. Such an annual tax on the property of great regions should be reduced in the orderly progress of government. It goes without saying that any consideration of flood prevention must be based on a thorough knowledge of stream flow, both in the contributing areas which furnish the water and along the great lowland rivers.

PUBLICATIONS.

The data on stream flow collected by the United States Geological Survey since its inception have appeared in the annual reports, bulletins, and water-supply papers. Owing to natural processes of evolution and to changes in governmental requirements, the character of the work and the territory covered by these different publications have varied greatly. For the purpose of uniformity in the presentation of reports a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into twelve parts, whose boundaries coincide with certain natural drainage lines. The areas so described are indicated by the following list of papers on surface water supply for 1907 and 1908. The dividing line between the North Atlantic and South Atlantic drainage areas lies between York and James rivers.

Papers on surface water supply of the United States, 1907-8.

Part.	No.	Title.	Part.	No.	Title.
I	241	North Atlantic coast.	VI	246	Missouri River basin.
II	242	South Atlantic coast and eastern Gulf of Mexico.	VII	247	Lower Mississippi River basin.
			VIII	248	Western Gulf of Mexico.
III	243	Ohio River basin.	IX	249	Colorado River basin.
IV	244	St. Lawrence River basin.	X	250	Great Basin.
V	245	Upper Mississippi River and Hudson Bay basins.	XI	251	California.
			XII	252	North Pacific coast.

The following table gives the character of data regarding stream flow at regular stations to be found in the various publications of the United States Geological Survey exclusive of all special papers. Numbers of reports are inclusive and dates also are inclusive so far as the data are available.

Stream-flow data in reports of the United States Geological Survey.

[Ann.=Annual Report; B.=Bulletin; W. S.=Water-Supply Paper.]

Report.	Character of data.	Year.
10th Ann., pt. 2	Descriptive information only	
11th Ann., pt. 2	Monthly discharge	1884 to Sept., 1890.
12th Ann., pt. 2	....do	1884 to June 30, 1891.
13th Ann., pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th Ann., pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B. 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th Ann., pt. 2	Descriptive information only	
B. 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W. S. 11	Gage heights (also gage heights for earlier years)	1896.
18th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for earlier years).	1895 and 1896.
W. S. 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W. S. 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W. S. 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W. S. 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th Ann., pt. 4	Monthly discharge (also for many earlier years)	1898.
W. S. 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st Ann., pt. 4	Monthly discharge	1899.
W. S. 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d Ann., pt. 4	Monthly discharge	1900.
W. S. 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W. S. 75	Monthly discharge	1901.
W. S. 82 to 85	Complete data	1902.
W. S. 97 to 100	....do	1903.
W. S. 124 to 135	....do	1904.
W. S. 165 to 178	....do	1905.
W. S. 201 to 214	Complete data, except descriptions	1906.
W. S. 241 to 252	Complete data	1907–8.

NOTE.—No data regarding stream flow are given in the 15th and 17th annual reports.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing records prior to 1904 has been published in Water-Supply Paper 119. The first table which follows gives, by years and drainage basins, the numbers of the papers on surface water supply published from 1899 to 1908. Wherever the data for a drainage basin appear in two papers the number of one is placed in parentheses and the portion of the basin covered by that paper is indicated in the second table. For example, in 1904 the data for Missouri River were published in Water-Supply Papers 130 and 131, and the portion of the records contained in Water-Supply Paper 131, as indicated by the second table, is that relating to Platte and Kansas rivers.

Numbers of water-supply papers containing results of stream measurements, 1899–1908.

	1899.[a]	1900.[b]	1901.	1902.	1903.	1904.	1905.	1906.	1907-8
Atlantic coast and eastern Gulf of Mexico:									
New England rivers	35	47	65,75	82	97	124	165	201	241
Hudson River to Delaware River, inclusive	35	47,(48)	65,75	82	97	125	166	202	241
Susquehanna River to York River, inclusive	35	48	65,75	82	97	126	167	203	241
James River to Yadkin River, inclusive	(35),36	48	65,75	(82),83	(97),98	126	167	203	242
Santee River to Pearl River, inclusive	36	48	65,75	83	98	127	168	204	242
St. Lawrence River	36	49	65,75	(82),83	97	129	170	206	244
Hudson Bay	....	....	66,75	85	100	130	171	207	245
Mississippi River:									
Ohio River	36	48,(49)	65,75	83	98	128	169	205	243
Upper Mississippi River	36	49	65,75	83	98,(99)	128, (130)	171	207	245
Missouri River	(36),37	49,(50)	66,75	84	99	130, (131)	172	208	246
Lower Mississippi River	37	50	(65), 66,75	(83),84	(98),99	(128), 131	(169), 173	(205), 209	247
Western Gulf of Mexico	37	50	66,75	84	99	132	174	210	248
Pacific coast and Great Basin:									
Colorado River	(37), 38	50	66,75	85	100	133, (134)	175, (177)	211, (213)	249, (251)
Great Basin	38, (39)	51	66,75	85	100	133, (134)	176, (177)	212, (213)	250, (251)
South Pacific coast to Klamath River, inclusive	(38), 39	51	66,75	85	100	134	177	213	251
North Pacific coast	38	51	66,75	85	100	135	(177), 178	214	252

[a] Rating tables and index to Water-Supply Papers 35-39 contained in Water-Supply Paper 39.
[b] Rating tables and index to Water-Supply Papers 47-52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52.

Numbers of water-supply papers containing data covering portions of drainage basins.

No.	River basin.	Tributaries included.
35	James	
36	Missouri	Gallatin.
37	Colorado	Green, Gunnison, Grand above junction with Gunnison.
38	Sacramento	Except Kings and Kern.
39	Great Basin	Mohave.
48	Delaware	Wissahickon and Schuylkill.
49	Ohio	Scioto.
50	Missouri	Loup and Platte near Columbus, Nebr. All tributaries below junction with Platte.
65	Lower Mississippi	Yazoo.
82	James	
	St. Lawrence	Lake Ontario, tributaries to St. Lawrence River proper.
83	Lower Mississippi	Yazoo.
97	James	
98	Lower Mississippi	Do.
99	Upper Mississippi	Tributaries from the west.
128	Lower Mississippi	Yazoo.
130	Upper Mississippi	Tributaries from the west.
131	Missouri	Platte, Kansas.
134	Colorado	Data near Yuma, Ariz., repeated.
	Great Basin	Susan, Owens, Mohave.
169	Lower Mississippi	Yazoo.
177	Colorado	Below junction with Gila.
	Great Basin	Susan repeated, Owens, Mohave.
	North Pacific coast	Rogue, Umpqua, Siletz.
205	Lower Mississippi	Yazoo, Homochitto.
213	Colorado	Data at Hardyville repeated; at Yuma, Salton Sea.
	Great Basin	Owens, Mohave.
251	Colorado	All stations in Colorado and Great Basin drainages lying in California repeated.
	Great Basin	

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined on the basis of drainage area, local changes in name and lake surface being disregarded. After all stations from the source to the mouth of the main stem of the river have been given, the tributaries are taken up in regular order from source to mouth. The tributaries are treated the same as the main stream, all stations in each tributary basin being given before taking up the next one below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated above, and in the records for large lakes, where it is often clearer to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

DEFINITION OF TERMS.

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 inches, 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-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the rate of discharge 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 by the use of the factors given in the following table of equivalents.

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

The "miner's inch" is the rate of discharge of water that passes through an orifice 1 inch square under a head which varies locally. It is commonly used by miners and irrigators throughout the West and is defined by statute in each State in which it is used.

"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.

CONVENIENT EQUIVALENTS.

The following is a list of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).
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 or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equal 18.7 United States gallons per second.
100 California miner's inches equal 96.0 Colorado miner's inches.
100 California miner's inches for one day equal 4.96 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 104 California miner's inches.
100 Colorado miner's inches for one day equal 5.17 acre-feet.
100 United States gallons per minute equal 0.223 second-feet.
100 United States gallons per minute for one day equal 0.442 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 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 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.

$1\frac{1}{3}$ horsepower equal about 1 kilowatt.

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

EXPLANATION OF TABLES.

For each drainage basin there is given a brief description of general conditions covering such features as area, source, tributaries, topography, geology, conditions of forestation, rainfall, ice conditions, irrigation, storage, power possibilities, and other special features of importance or interest.

For each regular current-meter gaging station are given in general, and so far as available, the following data: Description of station, list of discharge measurements, table of daily gage heights, rating table, table of monthly and yearly discharges and run-off. For stations located at weirs or dams the gage height and rating tables are omitted and a table of daily discharge is substituted. For stations where the flow is computed by shifting-channel methods, a table of daily discharge is given in place of rating tables, which are not used in these methods of computation.

In addition to statements regarding the location and installation of current-meter stations the descriptions give information in regard to any conditions which may affect the constancy of the relation of gage height to discharge, covering such points as ice, logging, shifting conditions of flow, and backwater; also full information regarding diversions which decrease the total flow at the measuring section. Statements are also made regarding the accuracy and reliability of the data.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of hydrographer, width and area of cross section, gage height, and 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. At most stations the gage is read in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. All gage heights during ice conditions, backwater from obstructions, etc., are published as recorded, with suitable footnotes. The rating is not applicable for such periods unless the proper correction to the gage heights is known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitrary datum and has no relation to zero flow or the bottom of the river. In general, the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

The discharge measurements and gage heights are the base data from which the rating tables and monthly-discharge tables are computed.

The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river recorded during the period for which it is applicable. It is published to enable engineers to determine the daily discharge by its application to the table of gage heights or to check results in the table of monthly discharge.

In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the period when the water surface was at crest height and the corresponding discharge consequently 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 in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 13, are based.

FIELD METHODS OF MEASURING STREAM FLOW.

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 or dam; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen depends on 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, $v=c\sqrt{Rs}$. 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. It is seldom used by the United States Geological Survey. For full information regarding this method the reader is referred to the various text-books on hydraulics.

Weir method.—Relatively few stations are maintained at weirs or dams by the United States Geological Survey. Standard types of sharp-crested and broad-crested weirs within the limits for which accurate coefficients have been experimentally obtained give very accurate records of discharge if properly maintained. At practically all broad-crested weirs, however, there is a diversion of water either through or around the dam, usually for the purpose of development of water power. The flow is often complicated, and the records are subject to errors from such sources as leakage through the dam, backwater at high stages, uncertainty regarding coefficient, crest which is not level, obstructions from logs or ice, use of flashboards, old turbines with imperfect ratings, and many others depending on the type of development and the uses of the diverted water.

In general, records of discharge at dams are usually accurate enough for practical use if no others are available. It has been the general experience of the United States Geological Survey, however, that records at current-meter gaging stations under unobstructed channel conditions are more accurate than those collected at dams, and where the conditions are reasonably favorable are practically as good as those obtained at sharp-crested weirs.

The determination of discharge over the different types of weirs and dams is treated fully in "Weir experiments, coefficients, and formulas" (Water-Supply Paper 200 [a]) and in the various text-books on hydraulics. "Turbine water-wheel tests and power tables" (Water-Supply Paper 180) treats of the discharge through turbines when used as meters. The editions of both of these water-supply papers are practically exhausted. They can, however, be consulted at most of the larger libraries of the country, or they can be obtained from the Superintendent of Documents, Washington, D. C., at a cost of 20 cents for No. 180 and 35 cents for No. 200. Remittances must be made by postal money order, express order, or New York draft.

Velocity method.—Streams in general present throughout their courses, to a greater or less extent, all conditions of permanent, semi-permanent, and varying conditions of flow. In accordance with the location of the measuring section with respect to these physical conditions, current-meter gaging stations may in general be divided into four classes—(1) those with permanent conditions of flow; (2) those with beds which change only during extreme high water; (3) those with beds which change frequently but which do not cause a variation of more than about 5 per cent of the discharge curves from year to year; and (4) those with constantly shifting beds. In determining the daily flow different office methods are necessary for each class. The field data on which the determinations are based and the methods of collecting them are, however, in general the same.

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[a] Water-Supply Paper 200 is a revision of No. 150, the edition of which is exhausted.

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. They are located, as far as possible, at such points that the relation between gage height and discharge will always remain constant for any given stage. The experience of engineers of the Geological Survey has been that permanency of conditions of flow is the prime requisite of any current-meter gaging station when maintained for several years unless funds are available to cover all changes in conditions of flow. A straight, smooth section without cross currents, backwater, boils, etc., at any stage is highly desirable, but on most streams is not attainable except at the cost of a cable equipment. Rough, permanent sections, if measurements are properly made by experienced engineers, taking measuring points at a distance apart of 2 to 5 per cent or less of the total width, will within reasonable limits yield better results for a given outlay of money than semi-permanent or shifting sections with smooth, uniform current. So far as possible stations are located where the banks are high and not subject to overflow at high stages and out of the influence of tributary streams, dams, or other artificial obstructions which might affect the relation between gage height and discharge.

A gaging station consists essentially of a gage for determining the daily fluctuations of stage of the river and some structure or apparatus from which discharge measurements are made, usually a bridge or cable.

The two factors required to determine the discharge of a stream past a section perpendicular to the mean direction of the current are the area of the cross section and the mean velocity of flow normal to that section.

In making a measurement with a current meter a number of points, called measuring points, are measured off above and in the plane of the measuring section at which observations of depth and velocity are taken. (See Pl. I, *B*.) These points are spaced equally for those parts of the section where the flow is uniform and smooth and are spaced unequally for other parts, according to the discretion and judgment of the engineer. In general the points should not be spaced farther apart than 5 per cent of the distance between piers, nor farther apart than the approximate mean depth of the section at the time of measurement.

The measuring points divide the total cross section into elementary strips at each end of which observations of depth and velocity are made. The discharge of any elementary strip is the product of the average of the depths at the two ends times the width of the strip times the average of the mean velocities at the two ends of the strip. The sum of the discharges of the elementary strips is the total

A. CURRENT-METER RATING STATION AT LOS ANGELES, CAL.

B. BRIDGE STATION AND CROSS SECTION OF STREAM.

Illustrating 0.2 and 0.8 depth method.

discharge of the stream. (For a discussion of methods of computing the discharge of a stream see Engineering News, June 25, 1908.)

Depths for the determination of the area are usually obtained by sounding with the current meter and cable. In rough sections or swift current an ordinary weight and cable are used, particular care being taken that all observations shall be in the plane of the cross section.

Two methods of determining the velocity of flow of a stream are in general use—the float method and the current-meter method.

The float method with its various modifications of surface, subsurface, and tube or rod floats is now considered obselete in the ordinary practice of the United States Geological Survey. The use of this method is limited to special conditions where it is impracticable to use the current meter, such as in places where large quantities of ice or débris which may damage the meter are flowing with the current, and for miscellaneous measurements or other work where a high degree of accuracy is not necessary. Tube floats are very satisfactory for use in canals with regular bottoms and even flow of current. Measurements by the float method are made as follows: The velocity of flow of the stream is obtained by observing the time which it takes floats set free at different points across the stream to pass between two range lines about 200 feet apart. The area used is the mean value obtained from several cross sections measured between the two range lines. The chief disadvantages of this method are difficulty in obtaining the correct value of mean area for the course used and uncertainty regarding the proper coefficient to apply to the observed velocity. For further information regarding this method the reader is referred to Water-Supply Paper 95 and to the various text-books covering the general subject of stream flow.

The Price current meter is now used almost to the exclusion of other types of meters by the United States Geological Survey in the determination of the velocity of flow of water in open channels, a use for which it is adapted under practically all conditions. Plate II shows in the center the new type of penta-recording current meter equipped for measurements at bridge and cable stations. On the sides of the same type of meter is shown equipped for wading measurements to record by the acoustic method on the left and by the electric method on the right. Briefly, the meter consists of six cups attached to a vertical shaft which revolves on a conical hardened steel point when immersed in moving water. The number of revolutions is indicated electrically. The rating, or relation between the velocity of the moving water and the revolutions of the wheel, is determined for each meter by drawing it through still water for a given distance at different speeds and noting the number of revolutions for each run. (See Pl. I, *A*.) From these data a rating table is prepared which gives the velocity per second of moving water for any number of revolutions in a given time interval. The ratio of revolutions per second to velocity of flow in feet per second is very nearly a constant for all speeds and is approximately 0.45.

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

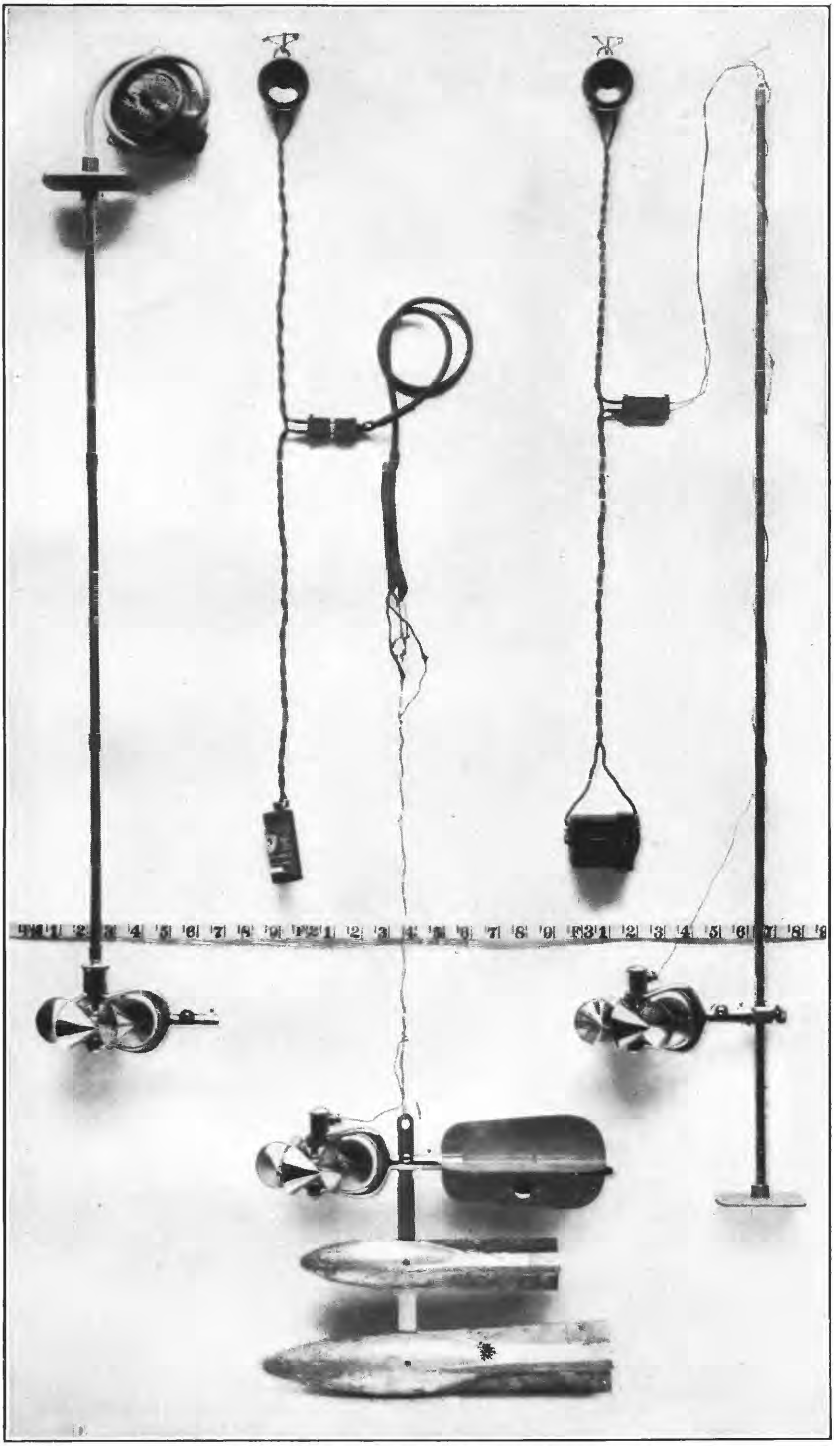
The two principal multiple-point methods in general use are the vertical velocity curve and 0.2 and 0.8 depth.

In the vertical velocity curve method a series of velocity determinations are made in each vertical at regular intervals, usually about 10 to 20 per cent of the depth 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. This method of obtaining the mean velocity in the vertical is probably the best known, but on account of the length of time required to make a complete measurement its use is largely 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 depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. (See Pl. I, *B*.) On the assumption that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this multiple-point method gives the mean velocity very closely for open-water conditions and that in a completed measurement it seldom varies as much as 1 per cent from the value given by the vertical velocity curve method. Moreover, the indications are that it holds nearly as well for ice-covered rivers. It is very extensively used in the regular practice of the United States Geological Survey.

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 or must be assumed.

Extensive experiments by means of vertical velocity curves show that the thread of mean velocity generally occurs between 0.5 and 0.7 total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and at this point the meter is held in most of the measurements made by the single-point method. A large number of vertical velocity curve measurements, taken on



PRICE PENTA-RECORDING CURRENT METERS.

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. The variation of the coefficient from unity in individual cases is, however, greater that in the 0.2 and 0.8 method and the general results are not as satisfactory.

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 in general from about 0.85 to 0.95, depending on 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 in the correct position for the other methods.

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 useful as a check on the point methods. In using the Price meter great care should be taken that the vertical movement of the meter is not rapid enough to vitiate the accuracy of the resulting velocity.

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 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 0.2 and 0.8 and the vertical velocity curve methods, 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, and the thickness and character of the ice. 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, the varying thickness of ice. For information in regard to flow under ice cover, see Water-Supply Paper 187.

OFFICE METHODS OF COMPUTING AND STUDYING DISCHARGE AND RUN-OFF.

At the end of each year the field or base data for current-meter gaging stations, consisting of daily gage heights, discharge measurements, and full notes, are assembled. The measurements are plotted on cross-section paper and rating curves are drawn wherever feasible.

The rating tables prepared from these curves are then applied to the tables of daily gage heights to obtain the daily discharges, and from these applications the tables of monthly discharge and run-off are computed.

Rating curves are drawn and studied with special reference to the class of channel conditions which they represent. (See p. 17.) The discharge measurements for all classes of stations when plotted with gage heights in feet as ordinates and discharges in second-feet as abscissas define rating curves which are more or less generally parabolic in form. In many cases curves of area in square feet and mean velocity in feet per second are also constructed to the same scale of ordinates as the discharge curve. These are used mainly to extend the discharge curves beyond the limits of the plotted discharge measurements, and for checking purposes to avoid errors in the form of the discharge curve and to determine and eliminate erroneous measurements.

For every published rating table the following assumptions are made for the period of application of the table: (*a*) That the discharge is a function of and increases gradually with the stage; (*b*) that the discharge is the same whenever the stream is at a given stage, and hence such changes in conditions of flow as may have occurred during the period of application are either compensating or negligible, except that the rating as stated in the footnote of each table is not applicable for known conditions of ice, log jams, or other similar obstructions; (*c*) that the increased and decreased discharge due to change of slope on rising and falling stages is either negligible or compensating.

As already stated, the gaging stations may be divided into several classes, as indicated in the following paragraphs:

The stations of class 1 represent the most favorable conditions for an accurate rating and are also the most economical to maintain. The bed of the stream is usually composed of rock and is not subject to the deposit of sediment and loose material. This class includes also many stations located in a pool below which is a permanent rocky riffle that controls the flow like a weir. Provided the control is sufficiently high and close to the gage to prevent cut and fill at the gaging point from materially affecting the slope of the water surface, the gage height will for all practical purposes be a true index of the discharge. Discharge measurements made at such stations usually plot within 2 or 3 per cent of the mean-discharge curve, and the rating developed from that curve represents a very high degree of accuracy. For illustrative example of a station of this type see figure 1 and Water-Supply Paper 241.

Class 2 is confined mainly to stations on rough mountainous streams with steep slopes. The beds of such streams are, as a rule,

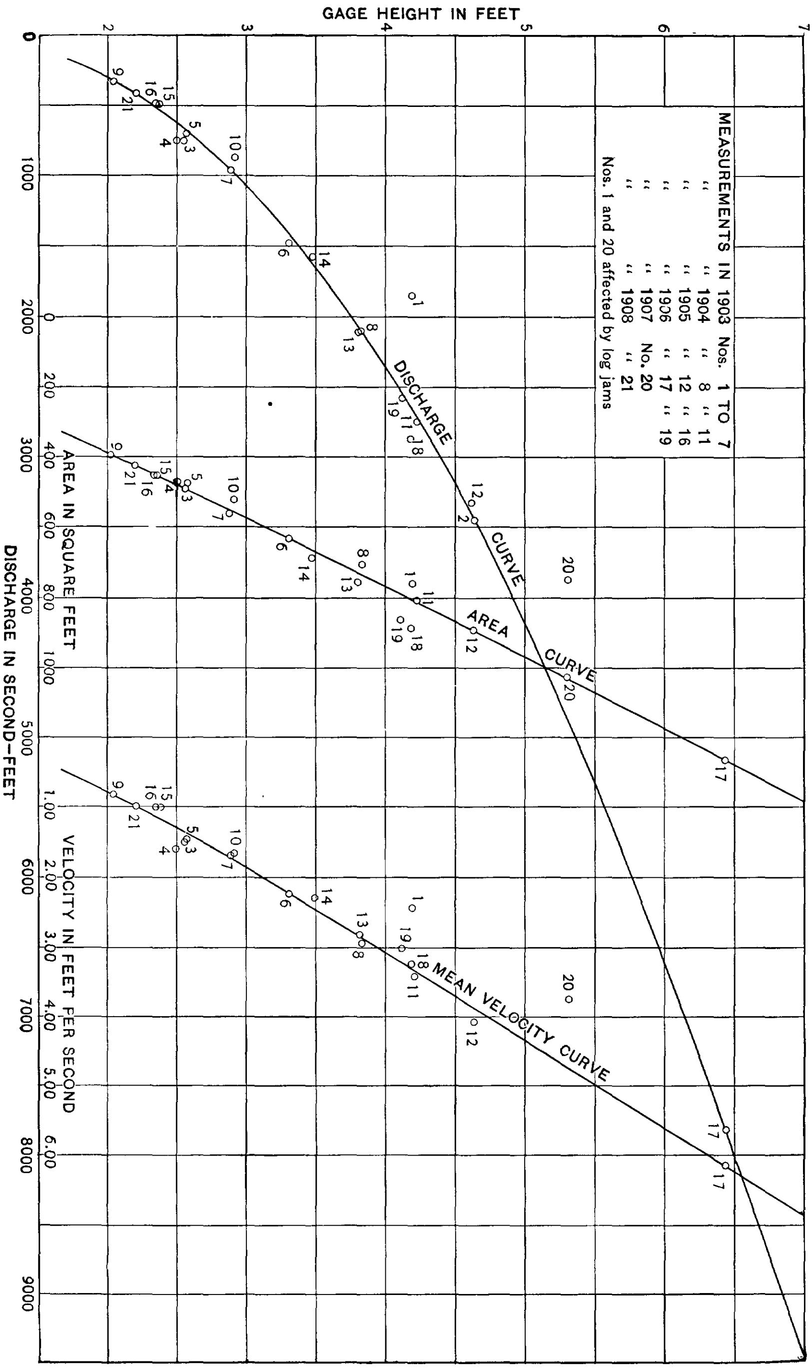


FIGURE 1.—Discharge, area, and mean velocity curves of Escanaba River near Escanaba, Mich.

comparatively permanent during low and medium stages, and when the flow is sufficiently well defined by an adequate number of discharge measurements before and after each flood the stations of this class give nearly as good results as those of class 1. As it is seldom possible to make measurements covering the time of change at flood stage, the assumption is often made that the curves before and after the flood converged to a common point at the highest gage height recorded during the flood. Hence the only uncertain period occurs during the few days of highest gage heights covering the period of actual change in conditions of flow. For illustrative examples of stations of this type see Water-Supply Paper 246.

Class 3 includes most of the current-meter gaging stations maintained by the United States Geological Survey. If sufficient measurements could be made at stations of this class results would be obtained nearly equaling those of class 1, but owing to the limited funds at the disposal of the Survey this is manifestly impossible, nor is it necessary for the uses to which discharge data are applied. The critical points are as a rule at relatively high or low stages. The percentage error, however, is greater at low stages. No absolute rule can be laid down for stations of this class. Each rating curve must be constructed mainly on the basis of the measurements of the current year, the engineer being guided largely by the past history of the station and the following general law: If all measurements ever made at a station of this class are plotted on cross-section paper, they will define a mean curve which may be called a standard curve. It has been found in practice that if after a change caused by high stage, a relatively constant condition of flow occurs at medium and low stages, all measurements made after the change will plot on a smooth curve which is practically parallel to the standard curve with respect to their ordinates, or gage heights. This law of the parallelism of ratings is the fundamental basis of all ratings and estimates at stations with semipermanent and shifting channels. It is not absolutely correct, but, with few exceptions, answers all the practical requirements of estimates made at low and medium stages after a change at a high stage. This law appears to hold equally true whether the change occurs at the measuring section or at some controlling point below. The change is of course fundamentally due to change in the channel caused by cut or fill, or both, at and near the measuring section. For all except small streams the changes in section usually occur at the bottom. The following simple but typical examples illustrate this law:

(*a*) If 0.5 foot of planking were to be nailed on the bottom of a well-rated wooden flume of rectangular section, there would result, other conditions of flow being equal, new curves of discharge, area, and velocity, each plotting 0.5 foot above the original curves when referred to the original gage. In other words, this condition would be analogous to a uniform fill or cut in a river channel which either reduces or increases all three values of discharge, area, and velocity for any gage height. In practice, however, such ideal conditions rarely exist.

(*b*) In the case of a cut or fill at the measuring section there is a marked tendency toward decrease or increase, respectively, of the velocity. In other words, the velocity has a compensating effect and if the compensation is exact at all stages, the discharge at a given stage will be the same under both the new and the old conditions.

(*c*) In the case of uniform change along the crest of a weir or rocky controlling point, the area curve will remain the same as before the change, and it can be shown that here again the change in velocity curve is such that it will produce a new discharge curve essentially parallel to the original discharge curve with respect to their ordinates.

Of course, in actual practice such simple changes of section do not occur. The changes are complicated and lack uniformity, a cut at one place being largely offset by a fill at another and vice versa. If these changes are very radical and involve large percentages of the total area—as, for example, on small streams—there may result a wide departure from the law of parallelism of ratings. In complicated changes of section the corresponding changes in velocity which tend to produce a new parallel discharge curve may interfere with each other materially, causing eddies, boils, backwater, and radical changes in slope. In such extreme conditions, however, the measuring section would more properly fall under class 4 and would require very frequent measurements of discharge. Special stress is laid on the fact that in the lack of other data to the contrary the utilization of this law will yield the most probable results.

Slight changes at low or medium stages of an oscillating character are usually averaged by a mean curve drawn among them parallel to the standard curve, and if the individual measurements do not vary more than 5 per cent from the rating curve the results are considered good for stations of this class. For illustrative example see Water-Supply Paper 242.

Class 4 comprises stations that have soft, muddy, or sandy beds. Good results can be obtained from such sections only by frequent discharge measurements, the frequency varying from a measurement every two or three weeks to a measurement every day, according to the rate of diurnal change in conditions of flow. These measurements are plotted and a mean or standard curve drawn among them. It is assumed that there is a different rating curve for every day of the year and that this rating is parallel to the standard curve with respect to their ordinates. On the day of a measurement the rating curve for that day passes through that measurement. For days between successive measurements it is assumed that the rate of change is uniform, and hence the ratings for the intervening days are equally spaced between the ratings passing through the two measurements. This method must be modified or abandoned altogether under special conditions. Personal judgment and a knowledge of the conditions involved can alone dictate the course to pursue in such cases. For illustrative example of a station of this type, showing the Bolster method of determining the daily discharge graphically, see Water-Supply Papers 247 and 249.

The computations have, as a rule, been carried to three significant figures. Computation machines, Crelle's tables, and the 20-inch slide rule have been generally used. All computations are carefully checked.

After the computations have been completed they are entered in tables and carefully studied and intercompared to eliminate or account for all gross errors so far as possible. Missing periods are filled in, so far as is feasible, by means of comparison with adjacent streams. The attempt is made to complete years or periods of discharge, thus eliminating fragmentary and disjointed records. Full notes accompanying such estimates follow the monthly discharge tables.

For most of the northern stations estimates have been made of the monthly discharge during frozen periods. These are based on measurements under ice conditions wherever available, daily records of temperature and precipitation obtained from the United States Weather Bureau climate and crop reports, observers' notes of conditions, and a careful and thorough intercomparison of results with adjacent streams. Although every care possible is used in making these estimates they are often very rough, the data for some of them being so poor that the estimates are liable to as much as 25 to 50 per cent error. It is believed, however, that estimates of this character are better than none at all, and serve the purpose of indicating in a relative way the proportionate amount of flow during the frozen period. These estimates are, as a rule, included in the annual discharge. The large error of the individual months has a relatively small effect on the annual total, and it is for many purposes desirable to have the yearly discharge computed even though some error is involved in doing so.

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

Practically all discharge measurements made under fair conditions are well within 5 per cent of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous tests and experiments have been made to test the accuracy of current-meter work. These show that it compares very favorably with the results from standard weirs, and, owing to simplicity of methods, usually gives results that are much more reliable than those from stations at dams, where uncertainty regarding the coefficient and complicated conditions of flow prevail.

The work is, of course, dependent on the reliability of the observers. With relatively few exceptions, the observers perform their work honestly. Care is taken, however, to watch them closely and to inquire into any discrepancies. It is, of course, obvious that one gage reading a day does not always give the mean height for that day. As an almost invariable rule, however, errors from this source are compensating and virtually negligible in a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added to the rating tables and an accuracy column is inserted in the monthly discharge table. In the rating tables "well defined" indicates in general that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined" or "approximate," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The accuracy column in the monthly discharge table does not apply to the maximum or minimum nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column, A indicates that the mean monthly flow is probably accurate within 5 per cent; B, within 10 per cent; C, within 15 per cent; D, within 25 per cent. Special conditions are covered by footnotes.

USE OF THE DATA.

In general, the policy is followed of making available for the public the base data which are collected in the field each year by the Survey engineers. This is done to comply with the law, but also for the express purpose of giving to any engineer the opportunity of examining the computed results and of changing and adjusting them as may seem best to him. Although it is believed that the rating tables and computed monthly discharges are as good as the base data up to and including the current year will warrant, it should always be borne in mind that the additional data collected at each station from year to year nearly always throw new light on data already collected and published, and hence allow more or less improvement in the computed results of earlier years. It is therefore expected that the engineer who makes serious use of the data given in these papers will verify all ratings and make such adjustments in earlier years as may seem necessary. The work of compiling, studying, revising, and republishing data for different drainage basins for five or ten year periods or more is carried on by the United States Geological Survey so far as the funds for such work are available.

The values in the table of monthly discharge are so arranged as to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates. This is particularly true of the maximum and minimum figures, which in the very nature of the method of collecting these data are liable to large errors. The maximum value should be increased considerably for many stations in considering designs for spillways, and the minimum value should be considered for a group of, say, seven days and not for one day.

The rating table, provided the engineer accepts it, is published primarily to allow him to apply it directly to the daily gage heights and rearrange the daily discharges in order of magnitude or by some other method.

COOPERATION AND ACKNOWLEDGMENTS.

LAKE MICHIGAN, LAKE HURON, AND LAKE ERIE DRAINAGES.

Assistance has been rendered or records furnished by the following persons, to whom special acknowledgment is due: D. W. Mead, Madison, Wis.; Gardiner S. Williams, Ann Arbor, Mich.; L. W. Anderson, city engineer, Grand Rapids, Mich.; Washtenaw Light and Power Company, Ann Arbor, Mich.; Fletcher Paper Company, Alpena, Mich.; Commonwealth Power Company, Jackson, Mich.; Flint Land Company, Flint, Mich.

LAKE HURON AND ST. LAWRENCE RIVER DRAINAGES.

Assistance has been rendered or records furnished by the following, to whom special acknowledgment is due: Fredrick Skene, state engineer, and William R. Hill, special deputy state engineer, representing New York state cooperation; State Water Supply Commission of New York, Hon. Henry H. Persons, president; E. A. Fisher, city engineer, and John F. Skinner, principal assistant city engineer, Rochester, N. Y.; West Virginia Pulp and Paper Company, Mechanicville, N. Y.; United States Army Engineers; Plattsburg Gas and Electric Company, Plattsburg, N. Y; Albany and Hudson Railroad Company, Albany, N. Y.; Charles H. Cooke, New York City; Consolidated Water Company, Utica, N. Y.; George Beebe, deputy city engineer, Syracuse, N.Y.

DIVISION OF WORK.

The field data in Lake Michigan, Lake Huron, and Lake Erie drainages were collected under the direction of L. S. Smith and A. H. Horton, district engineers, assisted by G. A. Gray, William M. O'Neill, and Max Chapman.

The ratings, special estimates, and studies of the completed data were made by A. H. Horton and R. H. Bolster. The computations and the preparation of the completed data for publication were made under the direction of R. H. Bolster, assistant engineer, assisted by H. D. Padgett, G. C. Stevens, G. L. Parker, R. C. Rice, J. G. Mathers, and M. I. Walters.

The field data for New York were collected under the direction of H. K. Barrows, district engineer, assisted by D. M. Wood, assistant engineer, and G. M. Brett, C. R. Adams, R. A. Mention, and H. F. French.

Except as otherwise stated in the descriptions, all ratings, computations, and special studies prepared in advance for the State Water Supply Commission of New York and some few other stations in New York were made by H. K. Barrows. All other ratings, ice estimates, special estimates, and computations for New York were made and prepared for publication by R. H. Bolster, assistant engineer, assisted by H. D. Padgett, G. C. Stevens, and M. I. Walters.

The completed manuscript for New York was reviewed by H. K. Barrows and C. C. Covert. The complete manuscript was edited by Mrs. B. D. Wood.

LAKE MICHIGAN DRAINAGE BASIN.

GENERAL FEATURES.

The Lake Michigan drainage basin comprises a comparatively narrow strip of flat or gently rolling land in eastern Wisconsin, on the west shore of the lake, and a much wider strip of nearly the same character in Michigan, on the east shore. The principal streams entering the lake from the west are Fox and Menominee rivers; from the east, St. Joseph, Kalamazoo, Grand, Muskegon, and Manistee rivers.

The following pages give the results of data collected during 1907 and 1908 in the Lake Michigan drainage basin.

ESCANABA RIVER DRAINAGE BASIN.

DESCRIPTION.

Escanaba River rises in the western part of Marquette County, near Lake Michigamme, and takes a generally southeasterly direction to Little Bay de Noquette, an arm of Lake Michigan, which it enters near Escanaba, Mich. Its length is about 90 miles, and its drainage area, which lies in the central part of the Northern Peninsula of Michigan, comprises about 890 square miles. The tributaries of the river are small, the West Branch being the only one of importance. The basin is long and narrow and comparatively regular in outline, the average width of its lower half being less than 10 miles, its extreme width about 25 miles, and its length about 70 miles.

In its upper course the river flows through an area of crystalline rocks, but farther down the rocks are sandstones and limestones. The headwaters of the river have an elevation of about 1,600 feet above sea level, and at its mouth the elevation is 580 feet, making a total descent of about 1,000 feet, or an average fall of over 10 feet to the mile.

The greater part of the best timber has been cut off, but lumbering is yet an active industry. The change in the forest conditions has probably not affected the run-off of the stream. The river is still used quite extensively for logging.

The mean annual rainfall in this part of Michigan is about 32 inches. The winters are severe; the snowfall is heavy and lasts for considerable periods, and ice covers the streams to a thickness of 2 feet from three to four months.

Storage possibilities have not been investigated, but suitable locations for reservoirs could doubtless be found in the drainage basin, as it contains some lakes and swamps.

Little is known of the water-power possibilities, but as the average fall is high favorable sites must be numerous. A few power sites not far from the mouth of the river have been developed, and at least one of these the plant is of recent installation.

ESCANABA RIVER NEAR ESCANABA, MICH.

The only station maintained in this river basin is that on the Escanaba, at Escanaba, Mich., 1903–1908, described below.

This station, which is located at a highway bridge between Escanaba, Mich., and Gladstone, Mich., about 9 miles north of Escanaba, Mich., and 4 miles above the mouth of the river, was established August 25, 1903, to obtain data applicable to water-power and water-supply problems, as well as general statistical and comparative data. Discharge measurements were made at this station in April, May, and July, 1903, but daily gage heights were not obtained until August 25, 1903.

Although the current is swift at the measuring section, gage heights are affected by ice, which in some years covers the stream to a depth of 2 feet for four months, and during the logging season the gage heights are sometimes affected by log jams.

The datum of the gage has remained unchanged. Except as noted above the records are reliable and accurate, and a good rating curve has been developed. (See fig. 1, p. 23.)

Discharge measurements of Escanaba River near Escanaba, Mich., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 7[a]	Horton and Gray	194	1,030	5.30	3,890
1908.					
July 16	G. A. Gray	194	426	2.20	416

[a] Discharge plots low; probably affected by log jam.

Daily gage height, in feet, of Escanaba River near Escanaba, Mich., for 1907 and 1908.

[Observer, Felix Beauchamp.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1				4.4	4.2	4.0	2.5	2.1	2.4	3.0	2.3	2.3
2				4.3	4.4	3.8	2.5	2.1	2.5	2.9	2.4	2.3
3				4.3	4.6	3.8	2.5	2.0	2.4	2.9	2.4	2.3
4				4.2	4.8	3.8	2.5	2.0	2.3	2.8	2.5	2.2
5				4.2	4.9	3.7	2.6	2.1	2.2	2.9	2.5	2.2
6				4.3	5.0	3.5	2.5	2.1	2.2	2.9	2.4	2.1
7				4.2	5.1	3.4	2.4	2.2	2.3	3.0	2.3	2.2
8				4.1	5.2	3.3	2.5	2.3	2.2	3.1	2.4	2.2
9				4.0	5.3	3.2	2.5	2.3	2.2	3.0	2.5	2.3
10				4.0	5.2	3.2	2.6	2.3	2.3	3.0	2.6	2.3
11				3.7	5.0	3.1	2.6	2.2	2.3	2.9	2.6	2.3
12				3.6	4.9	3.0	2.5	2.2	2.5	2.9	2.5	2.2
13				3.6	4.8	2.9	2.5	2.3	2.5	2.9	2.4	2.2
14				3.5	6.0	2.9	2.4	2.3	2.7	2.8	2.4	2.3
15				3.5	6.6	2.9	2.3	2.2	2.7	2.8	2.3	2.3
16				3.4	6.7	2.8	2.3	2.2	2.8	2.7	2.3	2.3
17				3.5	6.6	2.8	2.4	2.1	2.8	2.8	2.3	2.4
18				3.5	6.5	2.7	2.5	2.1	2.8	2.7	2.4	2.4
19				3.4	4.9	2.8	2.4	2.0	2.9	2.7	2.5	
20				3.5	5.0	2.8	2.4	2.2	2.9	2.6	2.4	2.7
21				3.7	5.1	2.7	2.3	2.1	3.0	2.6	2.3	
22				4.0	4.7	2.7	2.2	2.2	3.1	2.5	2.3	
23				4.2	4.7	2.6	2.3	2.2	3.2	2.5	2.2	
24				4.5	4.6	2.7	2.3	2.3	3.1	2.4	2.2	2.7
25				4.6	4.6	2.7	2.2	2.2	3.0	2.5	2.3	
26				4.7	4.5	2.6	2.2	2.3	3.0	2.6	2.4	
27				4.5	4.5	2.6	2.1	2.2	2.9	2.6	2.4	2.6
28				4.3	4.5	2.5	2.1	2.3	2.9	2.5	2.3	
29				4.2	4.4	2.6	2.1	2.3	2.8	2.5	2.4	
30				4.1	4.2	2.6	2.0	2.3	2.9	2.4	2.4	
31					4.1		2.0	2.4		2.3		2.7

NOTE.—Ice conditions prevailed January 1 to about March 31 and about December 17 to 31, 1907. Discharge during May, 1907, probably affected by log jams.

Daily gage height, in feet, of Escanaba River near Escanaba, Mich., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1					5.9	3.0	2.7	2.1	1.9	1.8	1.9	2.0
2					5.7	3.1	2.7	2.2	1.8	1.9	1.8	2.1
3	2.7		3.0		5.3	3.3	2.9	2.3	1.8	2.0	1.7	2.3
4		3.0			5.0	3.2	2.8	2.3	1.9	2.0	1.8	2.4
5					4.9	3.2	2.9	2.2	1.9	2.1	1.8	2.5
6			2.6		4.5	3.3	2.9	2.4	1.8	2.1	1.8	
7	2.8	3.1			4.3	3.4	3.0	2.2	1.8	2.1	1.7	
8					4.3	3.4	2.6	2.1	1.7	2.0	1.7	
9					4.2	3.5	2.7	2.0	1.7	2.0	1.7	
10	2.8		2.6		4.2	3.5	2.6	2.1	1.8	2.1	1.9	
11		3.2			3.9	3.4	2.4	2.2	1.8	2.0	1.9	
12				4.2	3.9	3.5	2.5	2.2	1.8	1.9	1.8	2.5
13			2.7	4.2	4.0	3.3	2.4	2.3	1.8	1.9	1.8	
14	2.9	3.2		4.4	3.9	3.3	2.4	2.4	1.7	1.8	1.8	
15				5.0	3.9	3.2	2.3	2.3	1.7	1.9	1.9	
16				5.2	3.8	3.2	2.2	2.2	1.8	1.9	2.0	
17	3.0		2.8	5.2	3.7	3.1	2.2	2.3	1.8	2.0	2.0	
18		3.3		5.3	3.5	3.0	2.3	2.4	1.9	2.1	2.0	
19				5.4	3.5	2.9	2.4	2.4	1.8	2.0	2.0	2.4
20			2.8	5.5	3.5	2.7	2.5	2.3	1.7	1.9	1.9	
21	2.9	3.3		5.5	3.4	2.6	2.4	2.3	1.8	2.0	1.9	
22				5.6	3.4	2.6	2.4	2.2	1.7	1.9	1.8	
23				5.8	3.5	2.5	2.3	2.3	1.8	1.9	1.9	
24	2.8		3.6	5.8	3.4	2.5	2.3	2.2	1.8	2.0	2.0	
25		3.3		5.9	3.3	2.4	2.4	2.1	1.9	2.0	2.0	
26				5.9	3.2	2.4	2.5	2.0	1.9	2.0	2.0	2.5
27			3.6	6.0	3.2	2.4	2.3	2.0	2.0	2.1	1.9	
28	2.9	3.3		6.1	3.2	2.5	2.2	1.9	2.1	2.1	2.0	
29				6.2	3.1	2.5	2.1	1.8	2.0	2.1	2.0	
30				6.2	3.1	2.4	2.2	1.9	2.0	2.0	2.0	
31	2.9		3.5		3.0		2.1	1.9		2.0		

NOTE.—Ice conditions prevailed from January 1 to about April 10 and from about December 5 to 31, 1908. Gage readings are to water surface in a hole in the ice during the frozen periods, 1907 and 1908.

Rating table for Escanaba River near Escanaba, Mich., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.70	165	2.80	880	3.90	2,230	5.00	4,210
1.80	205	2.90	970	4.00	2,380	5.20	4,650
1.90	250	3.00	1,070	4.10	2,530	5.40	5,120
2.00	300	3.10	1,180	4.20	2,690	5.60	5,610
2.10	350	3.20	1,300	4.30	2,860	5.80	6,120
2.20	410	3.30	1,420	4.40	3,030	6.00	6,640
2.30	480	3.40	1,550	4.50	3,210	6.20	7,180
2.40	550	3.50	1,680	4.60	3,400	6.40	7,730
2.50	630	3.60	1,810	4.70	3,590	6.60	8,290
2.60	710	3.70	1,950	4.80	3,790	6.80	8,870
2.70	790	3.80	2,090	4.90	4,000		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1903 to 1908, and is well defined above gage height 2.0 feet.

For illustration of this rating curve see figure 1, page 23.

Monthly discharge of Escanaba River near Escanaba, Mich., for 1907 and 1908.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
April	3,590	1,550	2,420	3.02	3.37	A.
May	8,580	2,530	4,390	5.49	6.33	B.
June	2,380	630	1,160	1.45	1.62	A.
July	710	300	531	.664	.77	A.
August	550	300	413	.516	.59	A.
September	1,300	410	779	.974	1.09	A.
October	1,180	480	829	1.04	1.20	A.
November	710	410	544	.680	.76	A.
December 1-16	480	350	446	.558	.33	B.
1908.						
April 12-30	7,180	2,690	5,320	6.65	4.70	A.
May	6,380	1,070	2,420	3.02	3.48	A.
June	1,680	550	1,100	1.38	1.54	A.
July	1,070	350	617	.771	.89	A.
August	550	205	406	.508	.59	A.
September	350	165	220	.275	.31	C.
October	350	205	294	.368	.42	B.
November	300	165	243	.304	.34	B.

NOTE.—Discharge during the log-driving season is liable to be affected by back water from jams. See measurement made May 7, 1907.

MENOMINEE RIVER DRAINAGE BASIN.

DESCRIPTION.

Menominee River, throughout its length of about 104 miles, forms part of the boundary line between northern Michigan and Wisconsin, and its drainage basin therefore lies in both Wisconsin and Michigan. The river is formed by the junction of Michigamme and Brule rivers and flows southeastward, emptying into Green Bay, an arm of Lake Michigan, near Menominee, Mich. Its total drainage area is about 4,000 square miles.

Michigamme River might well be called the main stream, as it is the largest and longest of the three tributaries that make up the main river. Downstream from the Michigamme, on the right or west bank, the following important tributaries enter: Paint River, which is called a tributary of Brule River, although it is much the larger stream of the two; and Brule, Pine, and Pemebonwon rivers; on the left or east bank are Sturgeon and Little Cedar rivers.

Michigamme River is said to rise in Lake Michigamme, the largest lake in the Menominee drainage basin, but the lake has a feeder which may be considered the continuation of the river and which rises within 12 miles of Lake Superior. The length of the Michigamme to its extreme source is about 72 miles; to Lake Michigamme about 51 miles. It is noteworthy that four of the largest tributaries enter the main stream above Iron Mountain, Mich., about six-tenths of the total drainage area being above this point. This characteristic increases the value of the stream for water-power development.

The drainage basin is fairly regular in outline, being narrow in its lower portion and widest at the sources of the tributaries which form the river. The surface is in general covered deeply by glacial drift, but the Menominee and all its tributaries flow over hard crystalline rocks as far south as the mouth of Pike River, or fully two-thirds its length. Below the mouth of the Pike the river flows over sandstones and limestones. Most of the rapids and falls occur in the area of crystalline rocks above the mouth of Pike River, although there are several rapids and falls below this point. The country through which the river flows is almost mountainous in character, many high ridges giving diversity to the surface.

The Wisconsin tributaries rise in a high, flat plateau, abounding in lakes and swamps, among which Flambeau and Wisconsin rivers also head. Some of these rivers head in lakes only a few rods apart, and even in the same swamps in which the tributaries of the Menominee head. These lakes and swamps have an elevation of nearly 1,600 feet above sea level, or about 1,000 feet above Lake Michigan. The Michigan branches flow from a similar region of equal or higher elevation. The numerous lakes and swamps make the flow of the river uniform and steady.

The elevation of the headwater streams is as stated, about 1,600 feet above sea level; at the junction of Brule and Michigamme rivers the elevation is about 1,300 feet; at the highway bridge near Iron Mountain, Mich., the elevation is about 1,050 feet; and at the mouth of the river it is 580 feet.

Forest conditions in this basin are similar to those in the other basins in Wisconsin and Michigan. Lumbering, while declining since 1892, is still active. Probably all the first-class timber has been cut, and that which is being cut at the present time is the smaller and less valuable timber that was left. The forest conditions, as far as their effect upon run-off conditions is concerned, are not greatly different from what they were originally, as the region is not thickly settled, and a second growth soon springs up after the lumbermen.

The mean annual rainfall is about 32 inches. The winters are severe, the snowfall being heavy and remaining on the ground for long periods, and the streams being ice-covered from three to four months.

Storage possibilities have not been fully investigated, but the large number of lakes and swamps must afford many excellent reservoir sites. At the present time lumbermen store water for running logs, and the enlargement of many of these dams would undoubtedly give good-sized reservoirs.

Some excellent water-power sites have been developed on the main stream and its tributaries, but many others, some of which have hardly been seen except by the lumbermen, are awaiting development. (See Pl. III.) With opportunities for storage with which to produce a uniform and increased low-water flow, and with the favorable arrangement of its drainage basin, this river will in time be one of the biggest power producers in this section.

This river is still used for running logs and the lumbermen's dams for holding water for flooding modify the normal flow of the stream considerably. Dams on the stream for power development should be so built as not to interfere with log running.

Iron is mined at many places in the upper two-thirds of the basin, and the section is fairly well covered with railroads.

The following gaging stations have been maintained in this drainage basin:

Menominee River near Iron Mountain, Mich., 1902 to 1908.
Menominee River at Lower Quinnesec Falls, Wis., 1898 to 1899.
Menominee River at Koss, Mich., 1907 to 1908.
Iron River at Riverton Mine, Mich., 1900 to 1905.

MENOMINEE RIVER NEAR IRON MOUNTAIN, MICH.

This station is located at the Homestead highway bridge across the Menominee River about 3½ miles south of Iron Mountain, Mich. It was established September 4, 1902, to obtain data for studying water power, water supply, and pollution problems, as well as general statistical and comparative data.

Pine River is tributary to the Menominee about 5 miles above the station. The gage was formerly located on the right abutment of the bridge, but on November 18, 1904, a chain gage was installed so as to obtain gage readings during the winter months, as ice formed at the gage on the abutment.

The winter conditions are severe in this locality, but as the current is swift the river is rarely entirely closed at this section. As is shown by the discharge measurements, however, there is backwater effect from ice below the station.

The stream is used extensively for logging and is subject to artificial control at times. Logs jams often occur below the station and produce backwater at the gage. Except as above stated the station is an excellent one.

The datum of the gage has remained unchanged. The observed records are accurate, but the discharge measurements and gage heights should be used with caution, so as to guard against possible backwater effects.

This station was last inspected July 15, 1908.

Discharge measurements of Menominee River near Iron Mountain, Mich., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 18	A. H. Horton	216	2,270	7.61	5,960
May 8	do	220	2,820	10.01	9,020
June 20[a]	G. A. Gray	205	1,210	2.98	1,940
August 22[a]	do	208	1,460	4.00	2,490
October 16	do	207	1,280	3.18	2,280
Do	do	207	1,280	3.18	2,280
December 17[b]	do	195	995	2.20	1,270
1908.					
July 15	G. A. Gray	203	1,000	2.00	1,520

[a] Affected by log jams. [b] Affected by ice conditions.

Daily gage height, in feet, of Menominee River near Iron Mountain, Mich., for 1907 and 1908.

[Observer, Alfred J. St. Arnauld.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	......	......	......	7.3	7.6	8.5	5.9	1.3	1.6	3.4	2.4	1.8
2	......	......	......	7.3	7.8	8.0	1.9	1.6	1.25	3.3	2.4	1.8
3	......	......	......	7.3	8.4	7.8	6.1	1.5	1.35	3.2	2.6	1.9
4	......	......	......	7.7	9.6	7.6	5.8	1.5	1.6	3.3	2.8	1.9
5	......	......	......	7.6	9.6	8.3	5.3	1.2	1.6	3.3	2.5	2.1
6	......	......	......	7.3	9.8	7.6	4.5	1.1	2.0	3.3	2.45	2.2
7	......	......	......	7.5	9.8	5.2	4.5	1.3	2.0	3.3	2.5	3.0
8	......	......	......	7.6	10.2	5.3	4.2	1.4	1.9	3.1	2.5	3.0
9	......	......	......	7.3	10.4	5.3	4.1	1.4	1.8	3.6	2.5	2.8
10	......	......	......	6.9	8.5	5.4	3.7	1.8	1.7	3.5	......	2.5
11	......	......	......	6.6	9.4	5.8	3.6	1.7	1.7	3.4	......	2.1
12	......	......	......	6.5	9.5	4.7	2.2	1.6	1.9	3.5	2.1	2.1
13	......	......	......	6.3	9.7	3.2	4.7	1.9	1.9	3.5	1.9	2.2
14	......	......	......	6.1	10.3	2.9	4.7	1.7	1.8	3.6	1.6	2.3
15	......	......	......	6.0	13.3	4.0	4.6	1.6	2.0	3.2	1.7	2.3
16	......	......	......	5.9	14.1	3.2	3.5	1.5	2.0	3.2	1.8	2.3
17	......	......	......	5.8	14.7	2.6	2.6	1.6	2.3	3.3	2.0	2.3
18	......	......	......	5.8	14.3	2.9	3.7	1.6	2.3	3.0	2.4	2.4
19	......	......	......	5.7	12.7	3.6	2.1	1.8	3.8	2.8	2.2	2.5
20	......	......	......	5.6	13.0	3.0	1.9	1.8	4.6	2.8	2.1	2.3
21	......	......	......	5.8	11.8	3.5	1.9	2.8	4.8	2.9	2.2	2.3
22	......	......	......	6.1	10.9	3.8	2.1	2.6	4.8	2.5	2.4	2.3
23	......	......	......	7.3	12.6	3.9	1.4	2.05	5.0	2.5	2.2	2.5
24	......	......	3.8	8.3	11.3	3.2	1.6	3.2	5.3	2.6	2.5	2.5
25	......	......	4.3	8.5	10.0	4.5	1.3	1.7	5.3	2.6	2.9	2.4
26	......	......	4.8	8.6	10.0	4.8	1.2	3.1	5.2	2.4	2.7	2.3
27	......	......	5.25	8.9	10.0	5.6	1.6	2.95	5.0	2.8	1.8	2.3
28	......	......	6.65	8.8	9.8	6.8	1.4	2.8	4.9	3.0	1.9	2.3
29	......	......	7.2	8.6	9.7	6.2	1.4	2.6	4.4	2.4	1.8	2.3
30	......	......	7.5	7.6	9.0	6.0	1.6	2.55	3.7	2.45	1.8	2.3
31	......	......	7.5	......	8.5	......	1.3	1.8	......	2.4	......	2.3
1908.[a]												
1	......	2.4	2.5	2.8	11.1	8.2	2.7	4.0	1.1	4.2	1.5	2.8
2	......	2.4	2.4	2.8	9.9	7.8	1.5	3.6	1.1	4.0	1.4	2.0
3	......	2.4	2.4	2.9	9.5	7.5	1.4	3.0	1.2	4.0	1.2	2.0
4	......	2.4	2.5	2.9	9.1	7.8	1.8	2.5	1.2	3.8	1.1	2.4
5	3.0	2.4	2.5	3.6	8.9	9.0	1.6	2.4	1.3	3.8	1.2	2.5
6	2.6	2.4	2.5	4.2	7.4	8.1	2.5	1.9	1.3	3.8	1.5	2.3
7	2.6	2.4	2.5	4.1	7.4	11.0	2.4	1.9	1.2	3.4	1.5	2.1
8	2.3	2.5	2.5	3.9	7.6	8.2	4.8	1.8	1.2	2.8	1.6	2.1
9	2.3	2.6	2.5	3.8	7.0	8.0	3.2	1.8	1.2	2.6	1.7	2.1
10	2.3	2.8	2.5	4.4	6.8	8.5	2.8	1.6	1.1	2.0	1.6	2.0

[a] See note at end of table, next page.

LOWER QUINNESEC FALLS, MENOMINEE RIVER, MICHIGAN.

Daily gage height, in feet, of Menominee River near Iron Mountain, Mich., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
11	2.3	2.9	2.5	6.4	6.1	8.7	2.6	1.4	1.1	2.0	1.2	2.0
12	2.3	2.9	2.6	6.2	5.3	8.4	2.3	1.4	1.1	1.8	1.0	2.0
13	2.3	2.7	2.7	6.0	4.4	8.6	2.1	1.3	1.1	1.6	1.4	2.0
14	2.3	2.7	3.0	6.8	3.3	4.1	1.6	1.4	.9	1.7	1.6	2.0
15	2.3	2.9	3.0	8.5	4.8	3.4	2.0	1.5	.9	1.8	1.6	2.0
16	2.4	2.9	3.0	9.9	4.9	3.9	2.0	1.5	.9	1.8	1.2	2.0
17	2.4	2.8	2.8	10.1	6.3	3.3	2.5	1.5	.9	1.7	1.2	1.9
18	2.4	2.8	2.8	9.4	4.6	2.8	3.7	1.5	1.4	1.7	1.3	1.9
19	2.5	2.5	2.7	9.1	5.2	1.9	3.0	1.5	1.0	1.6	1.8	1.9
20	2.5	2.5	2.8	8.9	6.5	1.9	3.3	1.4	1.0	1.4	1.6	1.9
21	2.4	2.5	2.8	9.2	6.2	1.8	3.0	1.2	.5	1.1	1.8	1.9
22	2.4	2.5	2.8	9.2	6.0	1.8	2.5	1.2	.6	1.5	1.8	1.9
23	2.4	2.5	2.8	9.4	5.6	1.4	2.4	1.3	.6	1.5	1.8	1.9
24	2.4	2.5	2.8	9.4	7.1	1.9	2.5	1.2	.6	1.7	1.8	1.9
25	2.4	2.5	2.8	8.9	5.4	1.4	2.7	1.3	.9	1.7	1.8	1.9
26	2.4	2.6	2.8	9.6	5.4	1.5	2.7	1.3	.9	1.7	2.4	1.9
27	2.4	2.5	2.7	11.1	5.6	1.4	2.4	1.4	1.5	1.7	2.8	1.9
28	2.3	2.5	2.6	12.8	5.6	1.2	2.4	1.5	2.0	1.6	2.8	1.9
29	2.3	2.5	2.6	12.8	5.4	1.1	1.9	1.3	3.3	1.7	2.8	1.9
30	2.4	....	2.6	12.6	6.4	.9	2.9	1.3	4.2	1.6	2.8	1.8
31	2.4	....	2.7	....	6.2	....	4.0	1.3	....	1.5	....	1.8

NOTE.—The discharge was affected by ice conditions from about January 1 to March 23 and December 7 to 31, 1907, and by log jams from about June to August, 1907.

Discharge affected by ice conditions from about January 1 to April 13, 1908. Discharge probably not materially affected by ice conditions during December, 1908. Discharge affected by log jams June 1 to 13, and probably also for short intervals at other times during 1908.

Rating table for Menominee River near Iron Mountain, Mich., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	700	2.00	1,515	3.50	2,540	6.00	4,680
0.60	745	2.10	1,575	3.60	2,615	6.20	4,870
0.70	795	2.20	1,640	3.70	2,690	6.40	5,060
0.80	845	2.30	1,705	3.80	2,765	6.60	5,260
0.90	895	2.40	1,770	3.90	2,840	6.80	5,460
1.00	950	2.50	1,835	4.00	2,920	7.00	5,660
1.10	1,005	2.60	1,900	4.20	3,080	8.00	6,740
1.20	1,060	2.70	1,970	4.40	3,240	9.00	7,890
1.30	1,115	2.80	2,040	4.60	3,405	10.00	9,070
1.40	1,170	2.90	2,110	4.80	3,575	11.00	10,300
1.50	1,225	3.00	2,180	5.00	3,750	12.00	11,540
1.60	1,280	3.10	2,250	5.20	3,930	13.00	12,800
1.70	1,335	3.20	2,320	5.40	4,110	14.00	14,080
1.80	1,395	3.30	2,390	4.60	4,300	15.00	15,380
1.90	1,455	3.40	2,465	5.80	4,490		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on discharge measurements made during 1903 to 1908 and is well defined above gage height 2.0 feet.

Monthly discharge of Menominee River near Iron Mountain, Mich., for 1907 and 1908.

[Drainage area, 2,420 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
March 24-31	6,180	2,760	4,630	1.91	0.57	B.
April	7,680	4,300	5,780	2.39	2.67	B.
May	15,000	6,300	9,750	4.03	4.65	B.
June	7,220	1,900	3,980	1.64	1.83	B.
July	4,780	1,060	2,360	.975	1.12	C.
August	2,320	1,000	1,480	.612	.71	C.
September	4,680	1,090	2,290	.946	1,06	B.
October	2,620	1,770	2,210	.913	1.05	B.
November	2,110	1,280	1,680	.694	.77	B.
December	1,640	....	1,320	.545	.63	D.
1908.						
January	....	....	1,100	.455	.52	D.
February	....	....	1,000	.413	.45	D.
March	....	....	1,000	.413	.48	D.
April	12,500	....	5,710	2.36	2.63	C.
May	10,400	2,390	5,250	2.17	2.50	B.
June	....	895	2,870	1.19	1.33	C.
July	3,580	1,170	1,900	.785	.90	B.
August	2,920	1,060	1,370	.566	.65	B.
September	3,080	700	1,100	.455	.51	B.
October	3,080	1,000	1,690	.698	.80	B.
November	2,040	950	1,350	.558	.62	B.
December	2,040	1,400	1,530	.632	.73	B.
The year	12,500	....	2,160	.891	12.12	

NOTE.—Discharge during the frozen periods and during the period of log jam, June 1 to 13, 1908, estimated on the basis of the discharge at Koss and one measurement made under ice conditions, December 17, 1907. Discharge December 7 to 31, 1907, 1,280 second-feet; April 1 to 13, 1908, 1,500 second-feet; June 1 to 13, 1908, 4,500 second-feet.

MENOMINEE RIVER AT KOSS, MICH.

This station, which is located at the Wisconsin and Michigan Railroad bridge at Koss, Mich., was established July 21, 1907, to obtain data for studying water power, water supply, and pollution problems, and for general statistical and comparative uses.

This stream is used for logging and log jams occur frequently at the station and immediately below. The winter conditions are severe, ice forming about 2 feet thick at times. The records are reliable and accurate except as affected by the above conditions.

The datum of the gage has remained unchanged.

Discharge measurements of Menominee River at Koss, Mich., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.	Thickness of ice.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*	*Feet.*
June 21	G. A. Gray	246	1,590	8.04	3,870	....
July 19	.....do	242	1,380	7.27	2,650	....
August 23	.....do	235	1,150	6.15	1,080	....
October 15	.....do	280	1,540	7.35	2,950	....
November 12	.....do	278	1,460	7.10	2,640	....
1908.						
January 21[a]	G. A. Gray	258	1,360	7.15	1,900	1.1
February 11[a]	.....do	274	1,490	7.70	1,830	1.2
March 10[a]	.....do	283	1,380	7.85	1,800	1.8
Do[a]	.....do	283	1,380	7.85	1,790	1.8
April 15	.....do	298	2,480	10.40	8,430	....
April 16	.....do	299	2,630	10.90	9,130	....
Do[b]	.....do	299	2,650	11.00	8,800	....
July 14	.....do	261	1,560	7.95	3,160	....
September 19	.....do	269	1,180	6.30	1,460	....

[a] Discharge made under ice conditions.
[b] Measurement approximate; velocity determined by means of floats.

Daily gage height, in feet, of Menominee River at Koss, Mich., for 1907 and 1908.

[Observers, W. D. Flynn and G. H. Bronoel.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	......	......	......	......	......	......	8.0	7.3	7.35	8.1	6.9	6.95
2	......	......	......	......	......	......	8.4	6.6	6.1	7.9	6.9	6.8
3	......	......	......	......	......	......	8.0	6.9	7.2	7.6	6.9	6.8
4	......	......	......	......	......	......	7.9	6.85	6.6	7.55	7.0	7.1
5	......	......	......	......	......	......	8.2	6.95	7.5	7.4	7.1	7.0
6	......	......	......	......	......	......	8.15	7.75	6.5	7.2	7.15	7.0
7	......	......	......	......	......	......	8.35	7.0	7.9	6.85	7.05	7.0
8	......	......	......	......	......	......	7.7	6.75	6.7	6.95	7.0	7.0
9	......	......	......	......	......	......	7.9	7.1	7.95	7.05	7.0	7.0
10	......	......	......	......	......	......	8.15	6.75	6.6	7.0	7.0	7.1
11	......	......	......	......	......	......	7.75	7.0	8.25	7.05	7.0	7.1
12	......	......	......	......	......	......	7.4	6.75	8.35	7.1	7.1	7.1
13	......	......	......	......	......	......	6.95	7.0	8.6	7.05	6.95	7.0
14	......	......	......	......	......	......	7.55	7.75	8.25	7.05	6.7	6.9
15	......	......	......	......	......	......	8.0	6.55	7.7	7.4	6.7	6.9
16	......	......	......	......	......	......	7.85	6.75	7.55	8.0	6.95	6.9
17	......	......	......	......	......	......	7.7	6.7	7.85	7.45	6.9	7.15
18	......	......	......	......	......	......	7.6	6.7	8.2	7.4	6.9	7.0
19	......	......	......	......	......	......	7.3	6.75	8.8	7.4	7.1	6.9
20	......	......	......	......	......	......	7.6	6.5	9.6	7.3	7.1	6.9
21	......	......	......	......	......	8.25	7.65	6.7	9.6	7.3	7.1	6.9
22	......	......	......	......	......	8.35	7.0	7.1	9.75	7.3	7.1	6.9
23	......	......	......	......	......	8.45	7.8	7.55	9.65	7.3	7.2	6.9
24	......	......	......	......	......	9.1	7.65	6.8	9.6	7.25	7.2	6.9
25	......	......	......	......	......	8.25	6.75	7.15	9.45	7.15	7.1	6.9
26	......	......	......	......	......	8.6	7.35	7.5	8.95	7.0	7.0	6.9
27	......	......	......	......	......	8.6	7.45	6.4	9.0	6.95	7.0	6.9
28	......	......	......	......	......	8.5	7.6	7.35	8.55	6.9	6.9	7.0
29	......	......	......	......	......	8.3	6.7	6.55	8.55	7.15	6.8	7.0
30	......	......	......	......	......	8.25	7.25	7.45	8.2	7.10	6.8	7.0
31	......	......	......	......	......	......	6.95	6.45	......	7.05	......	7.0
1908.												
1	7.2	......	......	7.9	13.4	9.05	7.15	6.1	5.6	7.45	6.5	7.2
2	......	......	7.5	7.9	13.25	9.65	7.45	8.7	5.65	7.6	6.5	7.05
3	6.9	7.4	......	8.05	12.8	10.05	8.1	8.25	6.55	7.6	6.5	6.9
4	......	......	......	8.0	12.2	10.2	7.95	7.6	6.95	7.6	6.5	6.8
5	......	......	......	8.05	11.9	9.4	6.85	6.1	6.45	7.5	6.55	6.7
6	6.4	......	7.5	8.1	11.5	8.7	7.05	8.05	6.35	7.25	6.4	6.7
7	......	7.5	......	8.55	10.8	8.75	8.2	5.9	6.3	7.1	6.5	6.75
8	......	......	......	9.2	10.55	9.0	8.7	7.85	6.2	7.0	6.5	6.7
9	......	......	......	9.35	10.2	9.25	9.1	5.85	6.35	6.9	6.5	6.7
10	6.9	7.5	7.85	9.4	9.7	9.7	9.05	7.7	6.4	6.9	6.55	6.9
11	......	7.7	......	9.5	9.6	9.85	8.55	5.85	6.35	6.8	6.7	6.7
12	......	......	......	9.5	9.6	9.75	8.0	7.75	6.2	6.7	6.5	7.05
13	6.9	......	8.0	10.2	9.6	9.55	7.9	5.9	6.15	6.7	6.5	6.85
14	......	7.6	......	10.35	9.55	9.2	7.9	7.5	6.1	6.6	6.5	6.8
15	......	......	......	10.5	9.45	8.9	6.4	5.8	6.25	6.75	6.5	6.8
16	......	......	8.0	11.0	9.5	8.7	8.45	5.6	6.4	6.7	6.4	6.8
17	......	7.8	......	11.35	9.7	8.25	6.35	7.5	6.35	6.6	6.1	6.85
18	6.9	......	......	11.75	9.45	7.8	8.3	5.75	6.3	6.6	6.4	6.8
19	......	......	......	11.75	9.55	7.75	8.25	7.45	6.2	6.6	6.6	7.0
20	6.9	......	7.9	11.25	9.5	7.3	8.7	5.75	6.25	6.6	6.6	7.25
21	7.15	7.5	......	10.95	9.9	8.2	8.35	7.3	6.15	6.5	6.6	6.8
22	......	......	......	11.1	9.85	7.85	8.15	5.7	6.2	6.4	6.4	6.8
23	......	......	7.9	11.0	9.85	7.45	7.95	5.75	6.2	6.4	6.35	7.0
24	6.9	7.5	......	11.0	9.45	7.3	7.8	7.65	6.2	6.4	6.55	7.0
25	......	......	......	11.0	9.4	7.6	7.95	5.65	6.2	6.4	6.8	6.9
26	......	......	......	11.0	9.55	7.9	6.0	6.75	6.2	6.5	6.9	6.9
29	6.9	......	7.9	12.35	9.25	7.8	8.2	5.7	6.2	6.7	6.85	7.0
28	......	7.5	......	12.9	9.1	8.0	6.35	6.0	6.2	6.7	7.1	6.9
29	......	......	......	13.15	8.55	6.65	8.2	7.05	6.3	6.6	7.2	6.9
30	......	......	7.8	13.25	8.75	7.4	6.0	5.65	6.55	6.5	7.3	7.0
31	6.9	......	......	......	8.8	......	7.95	6.5	......	6.6	......	7.0

NOTE.—Ice conditions prevailed from December 22 to 31, 1907. Gage readings during this period were to the top of the ice. Discharge affected by log jams at times during 1907.

Ice conditions prevailed January 1 to about April 13, 1908. Gage readings during this period are to water surface, except April 1 to 4. Ice conditions prevailed November 17 and December 30 to 31, 1908. Gage readings on these days were to the top of the ice. Discharge affected by log jams during July and the first part of August, 1908.

Rating tables for Menominee River at Koss, Mich.

JUNE 21 TO SEPTEMBER 18, 1907.

Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
6.10	1,045	6.90	2,085	7.70	3,295	8.50	4,650
6.20	1,165	7.00	2,230	7.80	3,460	8.60	4,825
6.30	1,285	7.10	2,375	7.90	3,630	8.70	5,000
6.40	1,405	7.20	2,525	8.00	3,800	8.80	5,175
6.50	1,530	7.30	2,675	8.10	3,970	8.90	5,350
6.60	1,665	7.40	2,825	8.20	4,140	9.00	5,525
6.70	1,800	7.50	2,980	8.30	4,310	9.10	5,705
6.80	1,940	7.60	3,135	8.40	4,480		

NOTE.—The above table is not applicable for obstructed-channel conditions. It is based on three discharge measurements made during 1907 and the form of the 1908 curve. It is fairly well defined.

SEPTEMBER 19, 1907, TO DECEMBER 31, 1908.

5.60	688	6.90	2,305	8.20	4,360	10.00	7,580
5.70	790	7.00	2,450	8.30	4,530	10.20	7,950
5.80	895	7.10	2,600	8.40	4,700	10.40	8,330
5.90	1,005	7.20	2,750	8.50	4,875	10.60	8,715
6.00	1,120	7.30	2,900	8.60	5,050	10.80	9,105
6.10	1,240	7.40	3,055	8.70	5,225	11.00	9,495
6.20	1,360	7.50	3,210	8.80	5,400	11.20	9,890
6.30	1,485	7.60	3,370	8.90	5,580	11.40	10,290
6.40	1,610	7.70	3,530	9.00	5,760	11.60	10,690
6.50	1,740	7.80	3,695	9.20	6,120	11.80	11,100
6.60	1,875	7.90	3,860	9.40	6,480	12.00	11,510
6.70	2,015	8.00	4,025	9.60	6,840	13.00	13,670
6.80	2,160	8.10	4,190	9.80	7,210	13.50	14,800

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on five discharge measurements made during 1907 and 1908 and is fairly well defined between gage heights 6 feet and 11 feet.

Monthly discharge of Menominee River at Koss, Mich., for 1907 and 1908.

[Drainage area, 3,780 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
June 21-30	5,700	4,220	4,590	1.21	0.45	B.
July	4,480	1,800	3,220	.852	.98	B.
August	3,380	1,400	2,170	.574	.66	B.
September	7,120	1,040	4,240	1.12	1.25	B.
October	4,190	2,230	2,860	.757	.87	B.
November	2,750	2,020	2,430	.643	.72	B.
December	2,680	2,160	2,350	.622	.72	B.
1908.						
January			1,980	.524	.60	C.
February			1,800	.476	.51	C.
March			1,800	.476	.55	C.
April	14,200		7,050	1.87	2.09	B.
May	14,600	4,960	7,920	2.10	2.42	B.
June	7,950	1,940	5,040	1.33	1.48	B.
July [a]	5,940	1,120	3,740	.989	1.14	B.
August [a]	5,220	688	2,100	.556	.64	B.
September	2,380	688	1,440	.381	.43	B.
October	3,370	1,610	2,200	.582	.67	B.
November	2,900	1,240	1,880	.497	.55	B.
December	2,820	2,020	2,270	.601	.69	B.
The year	14,600	688	3,270	.865	11.77	

[a] Results slightly too high on account of log jams.

NOTE.—Discharge during the frozen periods 1907 and 1908 based on four measurements made under ice conditions which showed a fairly uniform rate of flow.

Discharge December 22 to 31, 1907, 2,200 second-feet; April 1 to 13, 1908, 2,470 second-feet; November 17, 1908, open-channel rating used; December 30 to 31, 1908, 2,150 second-feet.

PESHTIGO RIVER DRAINAGE BASIN.

DESCRIPTION.

Peshtigo River rises in the western part of Forest County, northeastern Wisconsin, flows southeastward across the southwestern part of Marinette County, and empties into Green Bay, an arm of Lake Michigan, at the extreme southeast corner of Marinette County, about 7 miles south of Marinette. The drainage area measured above the mouth comprises about 1,123 square miles.

The drainage basin is narrow and fairly regular in outline, being about 80 miles long and 14 miles in average width. The river itself is about 150 miles long. Its tributaries are small. Among the larger ones are Rat, Thunder, and Little rivers, entering on the west or right bank, and Eagle Nest and Noque Bay rivers, entering on the east or left bank. In the upper two-thirds of its course the river flows through an area of ancient crystalline rocks; in the lower third it crosses successively beds of sandstone and limestone. The most important falls and rapids are in the crystalline area.

The river rises in the highest land in northern Wisconsin. At North Grandon railroad crossing, near its sources, the elevation of the river is 1,620 feet above sea level, at the mouth the elevation is 580 feet, making a total fall of 1,040 feet in about 140 miles, or an average fall of about 7 feet to the mile. This high average gradient gives rise to more and larger rapids than in any other river in Wisconsin, and, together with the high and rocky banks, insures numerous water powers.

As in other parts of Wisconsin, practically all the original growth of timber has been cut off and has been replaced by second growth and brush. A considerable area is being brought under cultivation. It is not thought that these changes in forestry conditions have appreciably altered the flow of the streams, but a marked effect upon the run-off may be expected to follow the draining of the numerous swamps and lakes at the sources of the river.

The mean annual rainfall is about 32 inches. Winter conditions are severe, the river being icebound for about three months of each year.

The opportunities for storage have not been investigated, but excellent sites for reservoirs must be afforded by the numerous lakes and swamps in the basin.

The stream presents numerous opportunities for water-power users. It has been estimated that about 32,000 horsepower await development on this river at various points.

The stream is still used to some extent for logging, but the run of logs is small. A good share of the timber is being used for pulp.

The following gaging stations have been maintained in this drainage basin:

Peshtigo River near Crivitz, Wis., 1906 to 1908.
Peshtigo River at Crivitz, Wis., 1906.

PESHTIGO RIVER SURVEY.

In order to point out the power possibilities along Peshtigo River, a survey was made during 1906 from the mouth to Rat River. From the data collected on this survey sheets have been prepared showing a profile of the water surface, a plan of the river, contour along the bank, and prominent natural or artificial features.

The results of this survey have been published on separate sheets and may be had upon application to the Director of the Geological Survey.

PESHTIGO RIVER NEAR CRIVITZ, WIS.

This station is located at Herman's farm, in the SE. ¼ NW. ¼ sec. 26, T. 32 N., R. 19 E., about 4½ miles west of Crivitz, Wis. It was established September 7, 1906, to obtain data for studying water-power problems.

No important tributaries enter near the station. The drainage area above the section is about 670 square miles.

Winter conditions are severe, ice forming to a thickness of 1 to 2 feet and lasting about three months. The gage heights may also be affected to a slight extent by logging operations.

The datum of the gage has remained unchanged and the records are reliable and accurate.

The gage heights at this station were furnished by D. W. Mead.

Information in regard to this station prior to 1908 is contained in Bulletin No. 20 of the Wisconsin Geological and Natural History Survey, entitled "The water powers of Wisconsin," by Leonard S. Smith.

Daily gage height, in feet, of Peshtigo River near Crivitz, Wis., for 1907 and 1908.

[Observer, Rose Herman.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	3.2	3.3	2.9	4.6	4.7	3.8	3.85	2.7	2.5	2.95	2.6	2.55
2	3.1	3.15	2.9	4.65	4.6	3.7	3.95	2.65	2.5	2.95	2.6	2.55
3	3.1	3.2	2.95	4.5	4.6	3.8	3.7	2.6	2.4	2.9	2.6	2.5
4	3.1	3.3	3.0	4.55	4.8	3.7	3.0	2.6	2.5	2.9	2.6	2.5
5	3.2	3.3	2.95	4.5	4.8	2.7	3.25	2.65	2.5	2.9	2.6	2.5
6	3.1	3.45	3.0	4.35	4.9	3.0	3.75	2.65	2.55	2.8	2.6	2.5
7	3.1	3.45	3.0	4.35	5.0	3.2	3.0	2.65	2.6	2.8	2.55	2.6
8	3.05	3.25	2.9	4.2	5.1	3.5	3.65	2.65	2.7	2.75	2.55	2.5
9	2.75	3.2	2.95	4.2	5.15	3.35	2.8	2.6	2.8	2.7	2.55	2.6
10	3.2	3.05	3.0	4.0	4.1	4.25	3.15	2.6	2.8	2.7	2.5	2.6
11	3.2	3.1	3.0	4.0	5.2	3.9	2.5	2.6	2.9	2.7	2.5	2.55
12	3.25	3.05	2.9	4.0	4.4	3.75	2.45	2.7	3.0	2.7	2.45	2.5
13	3.3	3.05	2.8	3.95	4.3	4.45	2.3	2.65	3.1	2.7	2.6	2.45
14	3.2	3.1	2.8	2.7	4.0	4.0	2.3	2.6	3.05	2.7	2.25	2.4
15	3.25	3.1	2.75	3.8	5.55	4.0	2.2	2.55	3.0	2.75	2.25	2.5
16	3.3	3.15	2.85	3.5	5.7	2.9	2.3	2.55	2.95	2.8	2.25	2.5
17	3.3	3.1	2.8	2.7	5.8	3.25	2.9	2.5	2.95	2.75	2.6	2.5
18	3.0	3.05	2.75	2.8	5.75	2.5	2.85	2.5	2.95	2.75	2.55	2.5
19	3.0	3.05	3.0	2.8	5.6	2.9	2.85	2.55	3.65	2.7	2.55	2.5
20	2.95	3.1	2.85	2.8	5.3	3.95	2.8	2.6	3.85	2.7	2.5	2.55
21	3.1	3.0	3.0	2.8	4.9	4.0	2.75	2.65	4.0	2.65	2.6	2.45
22	3.0	3.0	3.05	2.85	5.1	3.5	2.7	2.7	3.95	2.6	2.65	2.55
23	3.0	2.9	3.3	2.9	5.0	3.05	2.7	2.7	3.8	2.6	2.65	2.5
24	3.1	2.9	3.5	3.0	4.65	3.0	2.7	2.7	3.65	2.6	2.6	2.45
25	3.15	2.9	3.7	3.0	4.85	2.75	2.7	2.7	3.55	2.85	2.6	2.45
26	3.15	2.9	3.95	3.0	4.55	2.75	2.8	2.65	3.35	2.75	2.6	2.45
27	3.2	3.0	3.9	3.0	4.3	2.7	2.7	2.6	3.2	2.65	2.6	2.45
28	3.25	2.9	4.4	3.2	4.25	3.0	2.7	2.6	3.05	2.6	2.6	2.5
29	3.3	......	4.65	4.4	4.2	2.6	2.7	2.6	3.0	2.6	2.55	......
30	3.3	......	4.8	4.7	4.05	2.6	2.6	2.55	2.95	2.6	2.55	......
31	3.25	......	4.65	......	4.0	......	2.6	2.55	......	2.6	......	......
1908.												
1	2.5	2.7	3.05	2.6	5.7	3.4	2.8	2.4	2.25	2.7	2.3	2.35
2	2.5	2.9	3.1	2.6	5.6	2.4	2.7	2.4	2.2	2.7	2.3	2.6
3	2.5	2.9	3.1	2.55	5.4	3.3	3.0	2.4	2.2	2.65	2.3	2.6
4	2.45	2.85	3.1	2.6	4.6	3.25	3.15	2.35	2.2	2.55	2.3	2.4
5	2.45	2.9	3.1	2.8	4.25	3.2	2.45	2.35	2.2	2.5	2.3	2.4
6	2.4	2.9	3.3	2.9	3.8	2.6	3.0	2.35	2.2	2.0	2.3	2.6
7	2.4	2.9	3.3	3.05	3.65	3.25	3.95	2.3	2.2	2.0	2.3	2.5
8	2.4	2.95	3.2	3.1	3.2	2.7	3.8	2.3	2.15	2.0	2.3	2.5
9	2.4	2.95	3.2	3.05	3.0	3.7	3.75	2.3	2.15	2.0	2.3	2.6
10	2.6	2.9	3.25	3.3	3.2	3.65	3.85	2.3	1.85	3.0	2.3	2.5
11	2.5	2.9	3.3	3.55	3.8	3.65	3.2	2.25	1.9	2.4	2.15	2.5
12	2.5	3.0	3.25	3.7	3.2	2.7	2.7	2.25	2.0	2.35	2.25	2.5
13	2.55	3.05	3.0	3.9	4.0	2.7	3.0	2.3	2.0	2.2	2.2	2.5
14	2.5	3.05	2.75	3.5	3.3	3.25	2.45	2.3	2.0	2.2	2.2	2.5
15	2.5	3.05	2.6	4.4	3.8	3.2	2.6	2.25	2.8	2.2	2.2	2.5
16	2.5	3.0	2.6	4.35	3.9	3.4	2.4	2.3	2.3	3.0	2.2	2.5
17	2.6	2.95	2.5	4.35	3.8	3.25	3.3	2.3	2.25	2.5	2.0	2.5
18	2.6	2.95	2.45	4.3	4.0	3.0	2.7	2.3	2.15	2.1	2.4	2.5
19	2.5	2.95	2.4	4.2	4.0	2.9	2.7	2.3	2.15	2.1	2.35	2.6
20	2.5	2.95	2.4	3.2	4.0	2.8	3.3	2.3	2.15	2.1	2.2	2.6
21	2.5	3.05	2.45	3.0	4.75	2.3	2.8	2.5	2.15	2.1	2.2	2.6
22	2.5	3.05	2.45	2.8	5.0	2.4	3.75	2.3	2.15	3.3	2.3	2.6
23	2.45	3.05	2.6	2.9	4.65	3.2	2.4	2.3	2.2	2.6	2.3	2.6
24	2.65	3.05	2.5	3.0	4.7	3.3	3.5	2.25	2.2	2.55	2.4	2.6
25	2.6	3.0	2.5	3.6	4.1	2.9	2.95	2.25	2.2	2.4	2.85	2.6
26	2.5	3.0	2.5	4.65	3.85	3.2	2.8	2.25	2.2	2.4	2.85	2.6
27	2.5	3.05	2.5	4.8	3.75	2.3	2.75	2.25	2.2	2.4	2.95	2.6
28	2.5	3.05	2.5	5.3	3.7	2.4	2.7	2.25	2.4	2.4	2.9	2.6
29	2.6	3.05	2.5	5.8	3.55	3.8	2.65	2.3	2.35	2.4	2.75	2.55
30	2.6	......	2.5	5.8	3.5	2.5	2.5	2.3	2.6	2.4	2.7	2.6
31	2.7	......	2.75	......	3.4	......	2.5	2.25	......	2.3	......	2.5

NOTE.—Ice conditions prevailed from about January 1 until the latter part of March and during the greater portion of December, 1907, and from about January 1 to the first part of April and during December, 1908.

OCONTO RIVER DRAINAGE BASIN.

DESCRIPTION.

Oconto River rises in the plateau region of northeastern Wisconsin in a number of small lakes and swamps in the southern part of Forest County, flows in a slight southeasterly direction across Oconto County until it passes the southern boundary of that county, then turns abruptly to the east and flows into Green Bay at Oconto, Wis. Its mouth is about 10 miles southwest of the mouth of Peshtigo River.

Its drainage basin which is somewhat irregular in outline is about 70 miles long, following the general course of the river, and has an average width of about 15 miles. The total drainage area is about 950 square miles. The total length of the river is about 90 miles. The important tributaries are as follows: South Branch of the Oconto, and Peshtigo Brook and Little River on the left or east bank. The elevation of the headwaters is about 1,530 feet above sea level; at the mouth the elevation is 580 feet; the total fall therefore is 950 feet, or an average fall of over 10 feet to the mile. In the upper 35 miles of its course the river flows over crystalline rocks, and in this stretch is found about two-thirds of the total fall. On leaving the crystalline rocks the river flows nearly due south for 20 miles over sandstones and in its eastward stretch it crosses limestones. As in other parts of Wisconsin, the original forest growth has almost been all lumbered and a second growth is taking its place on those areas that are not being brought under cultivation. It is doubtful if the change in the forestry conditions has had any harmful effect on the run-off at the present time.

The mean annual rainfall is about 32 inches. The winter conditions are severe. The snowfall is comparatively heavy and remains on the ground for long periods. Ice forms from a foot to 2 feet in thickness and lasts for about three months.

Storage possibilities have not yet been investigated, but as lakes and swamps are numerous, excellent sites for reservoirs must exist.

The stream affords many valuable water-power sites whose development is only awaiting a demand for power.

The river is used to some extent for running logs, but the runs are small, and the timber is not large; a great deal of it is used for manufacturing pulp.

The following gaging stations have been maintained in this drainage basin:

Oconto River near Gillett, Wis., 1906-1908.
Oconto River at Stiles, Wis., 1906.

OCONTO RIVER NEAR GILLETT, WIS.

This station, which is located at a highway bridge about 2½ miles south of Gillett, Wis., was established June 27, 1906, to obtain data for studying water power, water supply, and pollution problems, and for general statistical data and comparative purposes.

No tributaries of any importance enter near the gaging station.

The winter conditions are severe, ice forming to a thickness of about 2 feet and lasting for about three months. The gage heights may also be affected for short periods by logging operations.

The datum of the gage has remained unchanged; the records, except as noted above, are reliable and accurate.

Information in regard to this station prior to 1908, is contained in Bulletin No. 20 of the Wisconsin Geological and Natural History Survey, entitled "The water powers of Wisconsin," by Leonard S. Smith.

Discharge measurements of Oconto River near Gillett, Wis., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.	Thickness of ice.
1907.		*Feet.*	*Sq.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*
April 10	A. H. Horton	72	354	6.10	940	....
May 11	.....do	87	407	[a] 6.75	1,530	....
June 24	G. A. Gray	76	327	5.67	685	....
July 22	.....do	76	283	5.20	421	....
August 26	.....do	55	246	5.00	329	....
Do	.....do	55	246	4.90	326	....
October 11	.....do	55	254	5.00	341	....
Do	.....do	55	255	5.00	354	....
November 8	.....do	56	262	5.15	405	....
December 13 [b]	.....do	58	311	6.10	334	....
1908.						
January 17 [c]	G. T. Gray	58	231	6.30	303	1.3
February 10 [c]	.....do	70	243	6.50	327	1.6
Do. [c]	.....do	70	243	6.50	324	1.6
March 9 [c]	.....do	70	240	6.75	390	1.9
Do. [c]	.....do	70	240	6.75	388	1.9
April 17	.....do	92	379	6.70	1,210	....
Do	.....do	92	379	6.70	1,210	....
April 20	.....do	90	364	6.50	1,130	....
Do	.....do	90	364	6.50	1,120	....
July 10	.....do	95	429	7.10	1,530	....
September 18	.....do	56	251	5.05	322	....

[a] Gage height doubtful; rise in stage of more than 1 foot during the measurement.
[b] Discharge under half frozen and half open conditions.
[c] Discharge made under ice conditions.

Daily gage height, in feet, of Oconto River near Gillett, Wis., for 1907 and 1908.

[Observer, Hattie Gilbertsen.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1				7.1	6.3	7.3	6.65	5.05	4.9	5.8	6.0	5.0
2				7.2	7.1	4.45	5.5	5.1	4.9	5.85	5.2	5.4
3				6.1	6.5	4.1	5.6	5.25	4.8	5.8	5.0	5.1
4				6.5	6.7	5.05	5.7	5.0	4.7	5.7	5.2	5.2
5				6.75	6.5	5.0	5.2	4.9	4.5	5.7	5.2	6.1
6				6.7	5.9	4.1	5.1	5.6	4.9	5.4	5.2	6.5
7				6.55	6.35	4.8	5.1	5.5	4.8	5.65	5.2	5.8
8				6.9	6.2	5.1	4.9	5.0	4.8	4.8	5.15	5.3
9				6.8	7.3	4.5	5.3	4.5	5.0	5.3	5.2	5.2
10				6.1	5.8	7.1	4.8	4.5	5.1	5.2	5.1	5.3
11				6.6	7.2	5.0	4.65	4.6	5.5	5.0	5.15	5.7
12				6.3	7.45	5.2	6.0	4.6	5.4	5.05	5.2	5.9
13				6.0	5.7	6.1	7.0	4.3	5.5	5.5	5.1	6.3
14				6.6	6.1	6.2	4.5	4.35	5.7	5.3	4.7	6.6
15				6.1	7.4	6.4	5.9	4.4	5.6	5.15	4.7	7.2
16				5.6	6.2	5.9	5.0	5.2	5.6	5.0	5.1	7.0
17				5.85	7.5	5.7	5.0	4.3	5.4	5.3	5.2	7.15
18				6.05	6.2	6.0	6.05	4.75	5.55	5.0	5.4	
19				6.25	7.1	5.9	5.0	4.65	5.2	5.2	5.4	
20				6.25	7.4	5.1	5.3	4.6	6.35	5.3	5.9	
21				6.1	6.75	6.2	5.45	4.7	6.5	5.3	5.4	
22				7.1	6.5	7.35	5.2	4.85	6.8	5.25	5.6	
23			6.9	6.1	7.0	6.25	5.2	4.3	6.8	4.95	5.6	
24			6.6	6.5	7.4	5.65	5.1	4.9	7.0	5.05	5.45	6.4
25			7.5	5.45	5.9	5.5	5.0	4.6	6.15	5.15	5.4	
26			7.5	6.0	8.0	6.05	5.2	4.7	6.1	5.1	5.4	
27			7.5	6.3	5.45	7.3	5.2	4.8	5.9	5.2	5.4	
28			7.75	6.4	5.0	7.4	5.1	4.8	6.0	5.0	5.4	
29			7.35	7.5	4.8	4.6	5.0	5.0	6.0	5.2	5.3	
30			7.25	6.1	4.7	7.9	5.1	5.05	6.1	5 1	5.2	
31			7.1		4.8		5.1	5.0		5.15		6.6
1908.												
1		6.5		5.7	8.6	6.0	5.4	5.0	4.7	5.1	5.5	5.5
2				6.0	8.3	5.9	5.4	4.9	4.9	5.2	5.0	5.0
3				6.1	8.2	5.7	5.6	5.1	5.1	5.2	5.1	5.7
4				5.7	8.1	5.7	5.6	5.1	5.0	5.3	5.05	4.8
5			6.6	5.8	7.9	5.7	5.4	5.8	4.8	5.2	5.1	5.6
6				6.1	6.7	5.3	6.2	5.0	4.9	5.1	5.1	7.0
7				6.0	7.3	5.4	6.1	4.5	5.1	5.1	4.7	8.6
8	6.6			6.0	7.5	6.0	7.1	4.7	5 1	5.1	5.1	8.0
9			6.75	5.5	7.5	6.0	7.1	4.5	4.8	5.0	5.1	
10		6.5		5.5	7.6	5.5	7.1	4.3	4.8	5.0	5.0	
11			6.9	6.0	7.7	5.7	7.05	4.4	5.0	5.0	5.0	
12				6.5	7.6	5.7	6.7	4.5	5.0	5.0	5.0	
13				6.4	7.5	5.7	6.6	4.3	4.9	5.1	5.0	
14	6.6			6.5	6.6	5.7	6.3	4.6	4.9	5.0	5.0	
15				6.3	6.5	5.7	5.8	4.4	5.0	4.9	5.0	7.0
16				6.6	6.6	5.6	5.8	4.5	4.9	5.1	5.2	
17	6.3			6.5	6.8	5.7	5.4	4.5	4.8	5.1	5.4	
18		6.7		6.6	6.7	5.5	5.05	4.8	4.9	5.3	4.8	
19				6.6	6.7	5.5	5.3	5.1	5.0	5.2	4.8	
20				6.5	6.7	5.4	5.8	5.0	4.9	4.8	5.3	
21			6.8	6.5	6.7	5.2	6.0	5.0	4.9	4.9	5.2	
22				6.1	6.8	5.2	5.8	5.0	5.2	5.2	5.0	7.3
23	6.6			6.6	6.3	5.3	5.6	5.0	4.9	5.2	5.0	
24				6.3	6.5	5.9	5.6	5.1	4.8	5.0	5.2	
25			5.8	6.3	6.6	5.9	5.4	4.9	4.9	5.1	5.3	
26			5.8	6.5	6.4	5.9	5.5	5.0	4.9	5.2	5.4	
27			6.5	6.9	6.4	5.4	5.6	5.0	4.9	5.2	5.4	
28			6.7	7.2	6.3	5.0	5.6	4.9	4.9	5.15	5.5	
29		6.7	5.7	8.4	6.0	5.5	5.4	5.0	5.1	5.2	5.5	6.8
30			6.5	8.5	6.1	5.5	5.3	5.1	5.1	5.2	5.5	
31			5.7		6.0		5.1	4.9		5.2		

NOTE.—Ice conditions prevailed from January 1 to about March 22 and during December, 1907, and from January 1 to about March 25 and during practically the whole of December, 1908. Gage readings to water surface in a hole in the ice during the frozen periods.

Rating tables for Oconto River near Gillett, Wis.

FOR 1906 AND 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.00	78	4.90	312	5.80	760	6.70	1,370
4.10	95	5.00	346	5.90	820	6.80	1,445
4.20	115	5.10	382	6.00	885	6.90	1,520
4.30	137	5.20	424	6.10	950	7.00	1,595
4.40	161	5.30	472	6.20	1,015	7.20	1,750
4.50	188	5.40	525	6.30	1,085	7.40	1,910
4.60	217	5.50	580	6.40	1,155	7.60	2,070
4.70	247	5.60	640	6.50	1,225	7.80	2,230
4.80	279	5.70	700	6.60	1,295	8.00	2,400

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 10 discharge measurements made during 1906 and 1907 and the form of the 1908 curve. It is well defined between gage heights 4.8 feet and 6 feet.

FOR 1908.

4.30	105	5.40	468	6.50	1,090	7.60	1,865
4.40	129	5.50	515	6.60	1,155	7.70	1,940
4.50	155	5.60	565	6.70	1,220	7.80	2,015
4.60	181	5.70	615	6.80	1,290	7.90	2,090
4.70	209	5.80	670	6.90	1,360	8.00	2,165
4.80	239	5.90	725	7.00	1,430	8.20	2,315
4.90	271	6.00	780	7.10	1,500	8.40	2,470
5.00	305	6.10	840	7.20	1,570	8.60	2,630
5.10	342	6.20	900	7.30	1,640		
5.20	382	6.30	960	7.40	1,715		
5.30	424	6.40	1,025	7.50	1,790		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 6 discharge measurements made during 1908 and the 1906 and 1907 curve. It is fairly well defined between gage heights 5 feet and 7.5 feet.

Monthly discharge of Oconto River near Gillett, Wis., for 1906, 1907, and 1908.

[Drainage area, 814 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1906.						
June 7-30	1,020	346	776	0.953	0.85	A.
July	982	161	504	.619	.71	A.
August	1,080	115	501	.615	.71	A.
September	982	312	570	.700	.78	A.
October	1,370	137	682	.838	.97	A.
November	1,870	217	957	1.18	1.32	A.
1907.						
March 23-31	2,190	1,300	1,810	2.22	.74	A.
April	1,990	552	1,160	1.43	1.60	A.
May	2,400	247	1,230	1.51	1.74	A.
June	2,320	95	844	1.04	1.16	A.
July	1,600	188	520	.639	.74	A.
August	640	137	291	.357	.41	B.
September	1,600	188	682	.838	.94	A.
October	790	279	474	.582	.67	A.
November	885	247	476	.585	.65	A.
December			331	.407	.47	D.
1908.						
January			317	.389	.45	D.
February			337	.414	.45	D.
March	1,220		486	.597	.69	D.
April	2,550	515	1,050	1.29	1.44	A.
May	2,630	780	1,450	1.78	2.05	A.
June	780	305	575	.706	.79	A.
July	1,500	324	733	.900	1.04	A.
August	670	105	261	.321	.37	B.
September	382	209	285	.350	.39	B.
October	424	239	347	.426	.49	A.
November	515	209	364	.447	.50	A.
December			275	.338	.39	D.
The year	2,630	105	540	.663	9.05	

NOTE.—Ice conditions beginning about December 1, 1906. Discharge December, 1907, based on a measurement made December 13 under ice conditions. Discharge during the frozen period, January to March, 1908, based on five measurements made under ice conditions, which showed a relatively constant flow. Discharge December, 1908, is only a rough approximation.

WOLF RIVER DRAINAGE BASIN.

DESCRIPTION.

Wolf River rises in a number of small lakes in the western part of Forest County in northeastern Wisconsin, flows in a generally southerly direction, and empties into upper Fox River at a point about 10 miles west of Lake Winnebago. Though nominally a branch of Fox River, it is really the master stream, as it has over three times the discharge of the Fox. (See Pl. IV.)

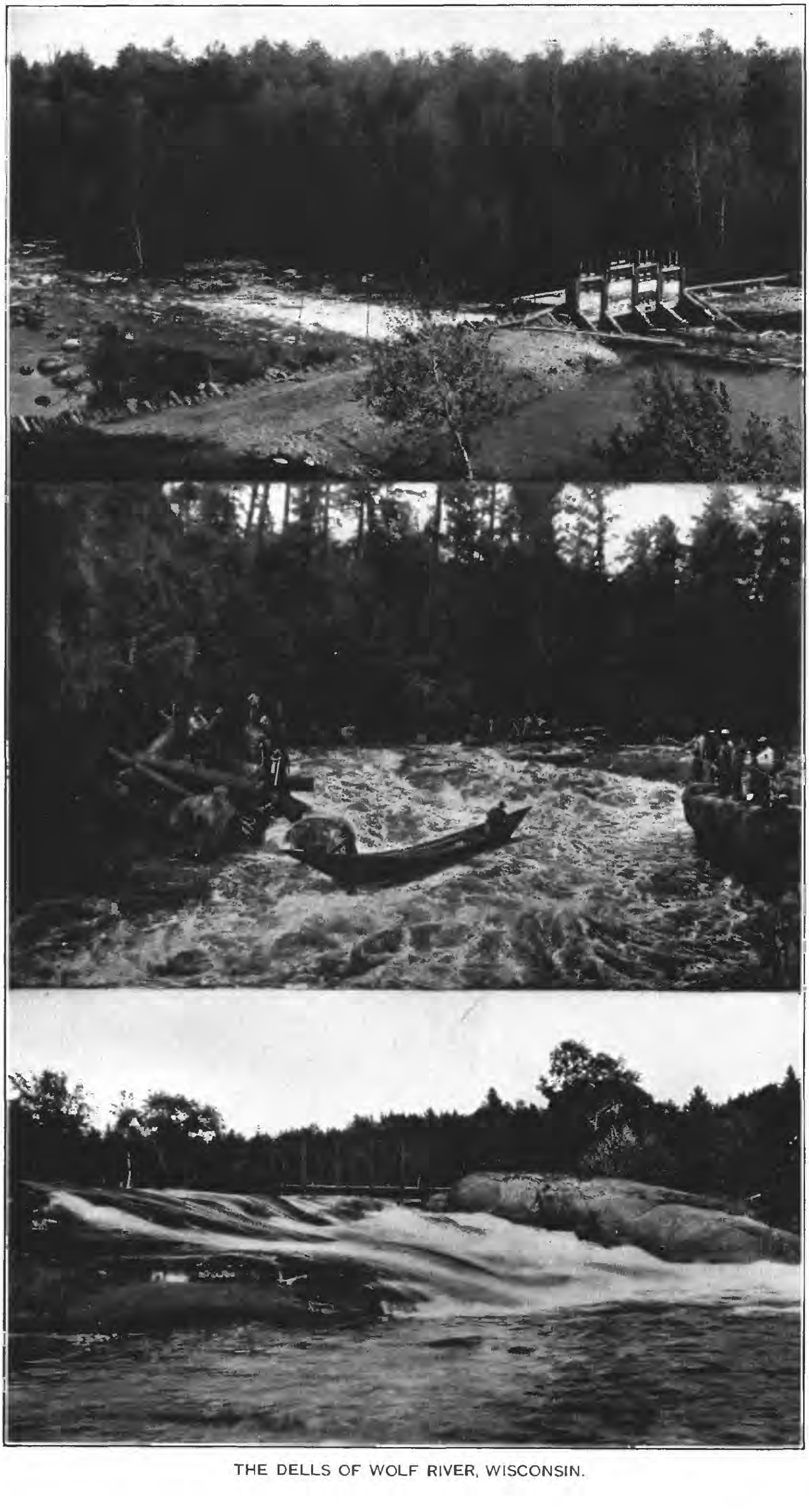
The river is about 180 miles long and its drainage area comprises about 3,600 square miles. All the largest tributaries are from the west, the more important ones (beginning at the source) being West Wolf, Red, Embarrass, Little Wolf, and Waupaca rivers.

The drainage basin is somewhat regular in outline—about 110 miles long with an average width of about 35 miles. Glacial action has modified the basins of many of the streams of northern Wisconsin, and the basin of Wolf River shows very prominently the effect of this action, as there is considerable evidence that formerly this river flowed westward and joined Mississippi River through the present Wisconsin River Valley between Portage and Prairie du Chien. In the upper half of its course the river flows over crystalline rocks and its descent is very rapid. At the Chicago and Northwestern Railroad crossing, 2 miles west of Lenox, the river has an elevation of 1,560 feet; in the 80 miles between this point and Shawano the river descends about 770 feet, or nearly 10 feet to the mile. This steep slope causes many rapids and falls. Shawano marks the point of transition from ancient crystalline rocks to sandstones, and here the river also crosses the old coast line of Lake Michigan and enters the region of red clay. Below Shawano, which is the head of navigation, the stream is sluggish, its descent being only 42 feet to Lake Winnebago, a distance of 80 miles. The banks are low, and in high water the adjoining flats are covered with water for several miles from the river.

The forestry conditions are similar to those elsewhere in Wisconsin. Lumbering has been carried on very extensively in the past and all the best timber has been cut off. At the present time the run of logs is small, and a great proportion of the timber is used for making paper pulp. Above Shawano the drainage basin is thinly settled, and the forestry conditions, as far as they affect the run-off of the river, are little changed, as a second growth has sprung up after the operations of the lumbermen.

The mean annual rainfall in this part of Wisconsin is about 32 inches. The winter conditions are severe; snowfall is comparatively heavy and lasts for considerable periods. Ice forms on the river from 1 to 2 feet in thickness and remains for about three months.

Storage possibilities have not been investigated, but the lakes and swamps in the basin must afford opportunities for making



THE DELLS OF WOLF RIVER, WISCONSIN.

reservoirs. The lumbermen have built numerous dams for holding water for flooding logs, and by increasing the height of these dams large reservoirs could undoubtedly be created.

Excellent sites for water power are numerous and their development awaits only a demand for power. A few power plants have already been put in operation. (Pl. V, *B*.)

The following stations have been maintained in this drainage basin:

Wolf River at Keshena, Wis., 1907 to 1908.
Wolf River at White House Bridge, near Shawano, Wis., 1906 to 1907.
Wolf River at Darrows Bridge, near Shawano, Wis., 1906.
Wolf River at Northport, Wis., 1905.
Wolf River at Winneconne, Wis., 1902 to 1903.
Little Wolf River near Northport, Wis., 1907 to 1908.

WOLF RIVER AT KESHENA, WIS.

This station, which is located at the highway bridge at Keshena, Wis., was established May 9, 1907, to obtain data for studying water power, water supply, and pollution problems, and for general statistical and comparative purposes.

West Wolf River enters about 3 miles above the station.

The winter conditions are severe, ice forming about 2 feet thick near the section. The stream is used considerably for logging, and there is a power plant above the station that may modify the flow in extreme low water.

The datum of the gage has remained unchanged. The records, except as noted above, are reliable and accurate.

Information in regard to this station prior to 1908, is contained in Bulletin No. 20 of the Wisconsin Geological and Natural History Survey, entitled "The water powers of Wisconsin," by Leonard S. Smith.

Discharge measurements of Wolf River at Keshena, Wis., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.	Thickness of ice.
1907.		Feet.	Sq. ft.	Feet.	Sec.-ft.	Feet.
May 10	A. H. Horton	102	472	3.75	1,750	
June 22	G. A. Gray	105	308	1.82	666	
July 20	do	104	461	3.32	1,490	
August 24	do	107	277	1.48	568	
October 12	do	109	320	1.90	737	
Do	do	109	320	1.90	737	
November 8	do	109	385	2.50	1,010	
December 14 [a]	do	109	368	2.50	694	
1908.						
January 18 [b]	G. A. Gray	101	285	3.32	508	1.5
February 8 [b]	do	103	217	3.05	384	1.7
March 7 [b]	do	103	260	3.20	530	1.9
Do. [b]	do	103	260	3.20	528	1.9
April 21	do	103	520	4.02	1,920	
July 9	do	104	468	3.50	1,580	
September 17	do	108	243	1.10	414	

[a] Ice conditions; river half open and half frozen. [b] Dischage under ice conditions.

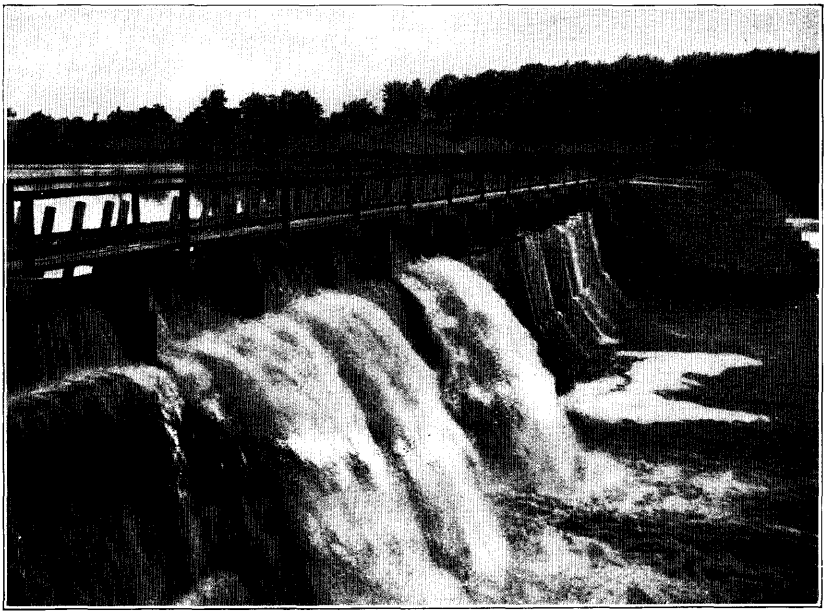
Daily gage height, in feet, of Wolf River at Keshena, Wis., for 1907 and 1908.

[Observer, Neil Gauthier.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1						2.85	1.95	1.4	1.15	1.7	1.6	1.6
2						3.35	2.25	1.6	2.0	1.6	1.6	1.6
3						1.4	1.85	1.05	1.4	1.8	1.65	2.65
4						2.85	2.05	3.8	2.25	2.35	1.8	2.4
5						2.4	1.5	2.1	1.2	1.95	1.8	2.2
6						2.55	2.6	1.6	2.35	2.2	1.6	2.2
7						2.65	1.95	1.75	2.35	1.95	1.6	2.2
8						2.3	2.5	1.45	1.3	2.0	1.6	2.2
9						2.55	2.75	1.5	3.1	1.9	1.6	2.25
10					3.0	1.0	1.1	1.5	3.25	1.9	1.6	2.2
11					3.32	2.0	2.55	1.55	2.6	1.95	1.7	1.95
12					3.7	2.25	1.15	1.9	2.4	1.9	1.65	1.85
13					1.78	1.9	1.25	1.8	2.15	1.85	1.65	2.25
14					3.75	1.6	1.4	1.85	1.9	1.8	1.65	2.5
15					4.22	1.9	3.15	1.85	1.7	1.8	1.55	2.55
16					4.45	1.85	2.95	1.85	1.8	1.8	1.5	2.55
17					4.65	1.45	1.0	1.75	1.8	1.8	1.6	2.7
18					4.35	2.2	3.1	1.95	1.8	1.75	1.65	3.0
19					4.25	1.7	1.05	1.85	2.8	1.7	1.6	2.95
20					3.7	1.6	2.9	1.45	4.25	1.7	1.6	3.0
21					3.85	1.85	1.1	2.0	4.3	1.7	1.85	3.35
22					3.8	2.0	2.5	2.0	3.65	1.65	1.9	3.4
23					3.55	1.85	2.45	1.3	3.25	1.8	1.8	3.4
24					3.5	1.7	1.15	1.45	3.05	1.55	1.7	3.4
25					3.45	1.9	2.55	1.2	2.5	1.7	1.7	3.45
26					3.4	2.2	1.4	1.95	2.4	1.7	1.7	3.4
27					3.05	1.55	2.7	2.35	2.3	1.65	1.7	3.45
28					3.45	1.7	1.05	1.8	2.15	1.65	1.7	3.4
29					3.3	1.55	2.55	1.9	2.1	1.7	1.7	3.4
30					3.15	1.65	1.0	1.1	1.75	1.6	1.6	3.5
31					2.9		2.8	2.2		1.6		3.65
1908.												
1	3.75	3.00		2.60	4.38	2.80	2.30	1.70	1.48	2.48	1.60	1.72
2	3.80			2.58	3.95	2.67	2.15	1.62	1.42	2.50	1.42	1.85
3	3.80		3.00	2.52	3.75	2.62	2.12	1.65	1.38	1.78	1.62	1.70
4	3.80	3.00		2.40	3.10	2.70	2.05	1.45	1.38	1.75	1.48	2.05
5	3.80			2.60	2.90	2.40	2.30	1.50	1.32	1.72	1.50	1.18
6	3.80			2.42	2.40	2.40	2.35	1.45	1.45	1.68	1.40	1.85
7	3.75		3.20	2.50	2.55	1.85	2.67	1.45	1.32	1.70	1.30	2.08
8	3.70	3.05		2.47	2.75	2.70	4.00	1.58	1.28	1.58	1.35	1.18
9	3.70			2.52	2.90	2.57	4.15	1.50	1.28	1.55	1.45	1.28
10	3.70		3.20	2.50	2.25	2.70	3.45	1.45	1.25	1.50	1.42	2.15
11	3.65	3.10		2.70	2.55	2.55	3.15	1.42	1.25	1.65	1.35	2.18
12	3.65			2.65	2.55	2.55	2.82	1.48	1.25	1.52	1.38	2.12
13	3.60			2.45	2.30	2.45	2.50	1.45	1.30	1.42	1.45	2.22
14	3.55		3.40	2.60	2.10	3.65	2.35	1.42	1.28	1.32	1.50	2.20
15	3.55	3.30		2.95	2.32	2.72	2.35	1.35	1.25	1.38	1.55	2.22
16	3.45			2.63	2.95	2.40	1.85	1.42	1.28	1.32	1.35	2.18
17	3.45		3.20	3.30	2.80	1.60	1.90	1.60	1.08	.78	1.60	2.12
18	3.35	3.10		3.05	2.40	1.50	2.05	1.52	1.02	.82	1.45	2.10
19				3.35	3.05	1.70	2.02	1.45	1.30	1.32	1.78	2.12
20				2.60	3.02	1.75	2.02	1.48	1.30	1.22	1.75	2.12
21	3.30		3.00	3.50	2.97	1.67	2.05	1.42	1.25	1.15	1.65	2.10
22		3.00		3.06	3.32	1.70	1.95	1.40	1.22	1.20	1.50	2.18
23				2.80	3.40	2.00	1.95	1.42	1.00	1.52	1.55	2.20
24			3.10	2.85	3.55	2.00	2.00	1.45	1.10	1.78	1.68	2.10
25	3.20	3.00		3.30	3.35	2.00	1.95	1.35	.75	1.80	1.05	2.15
26				3.82	3.80	2.00	1.90	1.38	.70	1.60	1.15	2.18
27				4.20	3.15	1.90	2.00	1.32	.85	1.72	1.10	2.12
28	3.10		2.70	5.50	3.22	1.95	1.90	1.38	1.05	1.68	1.90	2.12
29		2.90		5.08	3.30	2.17	1.70	1.55	1.62	2.10	1.92	2.00
30			2.65	4.95	3.20	2.17	1.70	1.55	1.55	1.72	1.90	1.90
31			2.6		2.95		1.78	1.45		1.80		1.82

NOTE.—Ice conditions prevailed from about December 3 to 31, 1907, and from about January 1 to the end of March, 1903, and probably during the whole of December, 1908. Gage heights during the frozen periods are to water surface.

A. WINTER CONDITIONS AT INDIAN RAPIDS DAM ON SARANAC RIVER, NEAR PLATTSBURG, N. Y.



B. COMBINED LOCKS DAM, FOX RIVER, WISCONSIN.

Rating table for Wolf River at Keshena, Wis., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.70	275	1.80	695	2.90	1,222	3.90	1,853
.80	310	1.90	737	3.00	1,280	4.00	1,920
.90	346	2.00	780	3.10	1,340	4.20	2,055
1.00	383	2.10	824	3.20	1,401	4.40	2,191
1.10	421	2.20	869	3.30	1,463	4.60	2,330
1.20	459	2.30	915	3.40	1,526	4.80	2,474
1.30	497	2.40	962	3.50	1,590	5.00	2,620
1.40	536	2.50	1,010	3.60	1,655	5.20	2,767
1.50	575	2.60	1,060	3.70	1,721	5.40	2,915
1.60	614	2.70	1,112	3.80	1,787	5.50	2,990
1.70	654	2.80	1,166				

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on ten discharge measurements made during 1907 and 1908, and is well defined between gage heights 1.0 foot and 4 feet.

Monthly discharge of Wolf River at Keshena, Wis., for 1907 and 1908.

[Drainage area, 797 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
May 10-31	2,370	687	1,650	2.07	1.69	A.
June	1,490	383	798	1.00	1.12	A.
July	1,370	383	811	1.02	1.18	A.
August	1,790	402	694	.871	1.00	A.
September	2,120	440	988	1.24	1.38	A.
October	938	594	695	.872	1.01	A.
November	737	575	640	.803	.90	A.
December			600	.753	.87	C.
1908.						
January			510	.640	.74	D.
February			399	.501	.54	D.
March	1,090		608	.763	.88	D.
April	2,990	962	1,360	1.71	1.91	A.
May	2,180	824	1,300	1.63	1.88	A.
June	1,690	575	911	1.14	1.27	A.
July	2,020	654	942	1.18	1.36	A.
August	654	505	564	.708	.82	A.
September	622	275	472	.592	.66	A.
October	1,010	303	612	.768	.89	A.
November	746	402	578	.725	.81	A.
December			450	.565	.65	D.
The year	2,990	275	726	.910	12.41	

NOTE.—Discharge during the frozen period 1907 and 1908, estimated on the basis of five measurements made under ice conditions and climatological reports. Discharge December, 1908, is only a rough approximation.

WOLF RIVER NEAR SHAWANO, WIS.

This station, which is located at the highway bridge known as the White House bridge, about 3½ miles north of Shawano, was established to obtain data for use in studying water power, water supply, and navigation problems.

The station is one-fourth mile above the mouth of Red River. The drainage area above the section is about 810 square miles.

The winter conditions are severe in this locality, ice forming of considerable thickness and lasting three to four months.

Backwater from Red River and from a dam about 4 miles below the station may affect the gage heights, otherwise the records are reliable and accurate.

The datum of the gage has remained unchanged.

This station was discontinued May 31, 1907, as it was concluded that backwater from the dam affected the gage heights, the station at Keshena taking its place.

Information in regard to this station is contained in Bulletin No. 20 of the Wisconsin Geological and Natural History Survey, entitled "The water powers of Wisconsin," by Leonard S. Smith.

Daily gage height, in feet, of Wolf River near Shawano, Wis., for 1907.

[Observer, Albert Utke.]

Day.	Mar.	Apr.	May.	Day.	Mar.	Apr.	May.	Day.	Mar.	Apr.	May.
1		7.0	6.8	11		6.7	7.1	21		6.5	7.3
2		7.0	6.5	12		6.9	7.1	22		6.1	6.9
3		7.0	7.4	13		7.0	5.6	23		6.0	6.8
4		7.0	6.8	14		7.0	7.5	24		6.6	7.0
5		6.9	6.8	15		7.1	7.2	25	7.5	6.8	7.0
6		7.1	5.9	16		6.7	7.2	26	7.7	6.6	7.0
7		7.1	7.1	17		6.6	7.0	27	7.6	6.6	6.7
8		6.8	7.1	18		6.8	6.6	28	7.7	6.6	7.4
9		6.4	7.0	19		6.6	6.6	29	8.0	6.6	7.5
10		6.2	6.7	20		6.5	6.5	30	7.9	6.6	6.8
								31	7.9		6.8

LITTLE WOLF RIVER NEAR NORTHPORT, WIS.

This station, which is located at the highway bridge known as Phillips bridge, about 3 miles southwest of Northport, Wis., in the southeastern part of sec. 8, T. 22 N., R. 14 E., was established October 13, 1907, to obtain data for use in studying water power problems.

The station is about 3 miles from Wolf River.

The drainage area above the section is about 460 square miles.

The ice conditions are those that prevail generally throughout the basin, the stream being covered with ice 1 to 2 feet in thickness for a period of about three months.

The datum of the gage has remained unchanged. The records are reliable and accurate.

The station was established and is maintained by D. W. Mead, who furnishes the records.

Information in regard to this stream is contained in Bulletin No. 20 of the Wisconsin Geological and Natural History Survey, entitled "The water powers of Wisconsin," by Leonard S. Smith.

Discharge measurements of Little Wolf River near Northport, Wis., in 1907 and 1908.

Date.	Hydrographer.	Gage height.	Discharge.
1907.		*Feet.*	*Sec.-ft.*
October 13	V. H. Reineking	1.40	214
October 16	Henry J. Hunt	1.54	215
October 27	....do	1.45	217
1908.			
March 20 [a]	V. H. Reineking	5.00	930
March 21 [a]	....do	4.20	617
March 22 [a]	....do	4.90	869
March 23 [a]	....do	4.90	881
March 24	....do	4.30	805

[a] Measurement made under ice conditions.

Daily gage height, in feet, of Little Wolf River near Northport, Wis., for 1907 and 1908.

[Observer, A. N. Garrow.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1907.				1907.				1907.			
1		1.4	2.0	11		2.0	3.0	21	3.2	1.7	2.0
2		1.6	2.1	12		1.4	3.1	22	1.3	1.7	2.6
3		1.6	1.8	13	1.5	1.6	2.8	23	1.4	1.8	2.7
4		1.7	1.8	14	2.0	1.6	2.7	24	1.3	2.0	2.6
5		1.5	2.0	15	1.4	1.5	1.9	25	1.3	1.7	1.9
6		1.9	1.7	16	1.4	1.7	2.0	26	1.5	1.8	1.8
7		1.3	1.9	17	1.5	1.5	1.9	27	1.3	1.9	1.7
8		1.5	1.8	18	1.4	1.5	1.8	28	1.6	1.8	1.8
9		1.8	2.4	19	1.4	1.6	1.7	29	1.4	1.8	1.9
10		1.4	3.0	20	1.4	1.4	1.8	30	1.3	1.7	2.0
								31	1.5		2.0

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	2.2	2.3	2.8	3.2	4.6	2.5	1.5	2.5	1.3	1.5	1.2	1.1
2	2.4	2.1	2.9	2.9	4.3	2.2	1.4	1.3	1.2	1.3	1.3	2.1
3	2.5	2.1	2.7	2.8	4.0	2.2	1.5	1.4	1.3	1.4	1.2	2.4
4	2.4	2.1	2.7	2.9	3.8	2.0	1.4	1.4	1.3	1.3	1.4	2.2
5	2.0	2.2	2.8	2.7	3.5	1.7	1.8	1.3	1.2	1.4	1.2	2.2
6	1.9	2.2	3.0	3.2	3.5	1.6	3.5	1.4	1.2	1.2	1.1	2.3
7	1.8	2.3	3.4	3.1	3.4	1.5	4.4	1.3	1.2	1.2	1.2	2.1
8	1.6	2.4	3.9	3.0	3.3	1.7	4.7	1.4	1.1	1.2	1.2	2.0
9	1.7	2.4	3.7	3.1	3.0	1.7	5.3	1.4	1.1	1.2	1.1	1.9
10	1.7	2.4	4.5	3.0	2.8	1.6	4.7	1.3	1.1	1.3	1.7	2.0
11	1.6	2.5	5.0	3.0	2.8	1.7	4.0	1.3	1.1	1.1	1.5	1.9
12	2.0	2.6	5.7	3.0	2.7	1.8	2.8	1.3	1.1	1.1	1.2	1.9
13	2.0	2.7	6.6	3.2	2.8	1.8	3.1	1.3	1.0	1.4	1.2	1.9
14	1.9	2.7	6.4	3.0	2.9	1.6	3.0	1.3	1.0	1.3	1.1	2.0
15	2.2	3.1	6.1	3.0	3.4	1.5	2.6	1.2	1.1	1.3	1.7	2.0
16	2.1	3.2	5.8	3.0	3.5	1.4	2.5	1.3	1.1	1.2	1.8	2.0
17	2.0	3.1	5.9	3.0	2.7	1.4	2.4	1.5	1.0	1.1	1.8	2.0
18	2.1	3.0	5.6	2.9	2.4	1.4	2.0	1.4	1.0	1.1	1.7	2.1
19	2.0	2.7	5.3	2.7	3.0	1.4	2.8	1.4	1.0	1.1	1.4	2.0
20	2.0	2.7	5.0	2.5	3.0	1.3	2.7	1.4	1.1	1.1	1.1	2.1
21	2.3	2.6	4.1	3.0	2.8	1.3	2.9	1.4	1.1	1.5	1.3	2.1
22	2.2	2.7	3.8	2.8	2.7	1.3	1.6	1.4	1.1	1.1	1.1	2.0
23	1.9	2.7	4.9	2.5	3.0	1.5	1.7	1.4	1.1	1.1	1.2	2.0
24	1.8	2.7	4.8	2.6	2.8	1.6	1.6	1.3	1.1	1.1	1.2	2.0
25	1.8	2.8	3.8	3.0	3.0	1.4	1.5	1.3	1.1	1.2	1.3	2.0
26	2.0	3.0	3.5	2.9	2.8	1.3	2.5	1.3	1.1	1.8	2.1	2.0
27	2.1	2.7	3.3	4.6	2.7	1.5	2.5	1.2	1.1	1.7	2.0	2.0
28	2.1	2.6	3.2	4.9	2.7	1.3	2.4	1.2	1.1	1.4	1.4	1.9
29	2.1	2.5	3.2	5.0	2.6	1.4	2.5	1.2	1.2	1.2	1.9	2.0
30	2.1		3.4	4.9	3.0	1.3	2.4	1.1	1.3	1.6	1.8	2.0
31	2.2		3.2		2.6		2.4	1.1		1.4		2.0

NOTE.—Ice conditions probably prevailed during the greater part of December, 1907.
Ice conditions prevailed from about January 1 to March 23 and probably during the greater part of December, 1908.

KALAMAZOO RIVER DRAINAGE BASIN.

DESCRIPTION.

Kalamazoo River is formed by the junction of the North and South branches at Albion, in the eastern part of Calhoun County, in south-central Michigan. The two branches are each about 20 miles in length. The river flows in a general northwesterly direction into Lake Michigan.

There are no important tributaries. The length of the river below Albion is 101 miles. The total drainage area is about 2,000 square miles.

The drainage basin is overlain with glacial deposits which are thinnest near the sources of the river. The surface formations are distributed as follows: Morainal ridge and glacial drift cover between 25 and 45 per cent of the drainage area; clay-loam till plains, 25 to 35 per cent; overwash valley train deposits of the ice drainage, 35 to 45 per cent. The surface of the drainage basin is rolling. Prairie, swamp, and hilly stretches alternate at short intervals. The current of the river is swift, averaging about 3 miles an hour, and its slope uniform, there being no waterfalls and no considerable rapids except at two points, at each of which there occurs a descent of 3 or 4 feet within a distance of a few rods. The river flows through a rich agricultural region, in a valley from one-fourth of a mile to 2 or 3 miles in width, backed by low hills or sloping gently to the upland. The flat lands in the valley through which the river winds in a tortuous manner are often flooded. There are within the drainage basin a large number of small lakes and spring hollows, in which water stands part or all of the time. Many of these have no surface outlets and feed the stream only through seepage or ground flow.

The elevation of the river at Albion is 919 feet; at Battle Creek, about 800 feet; at the mouth the elevation, 581 feet.

Only about 10 per cent of the drainage basin is forested. The mean annual rainfall is about 34 inches. The winter conditions are comparatively mild; snowfall is not heavy; ice forms on the streams about 1 foot in thickness.

Some opportunities for storage are found in this basin, but the high value of land for agricultural purposes prohibits the construction of reservoirs.

On account of the uniform flow this stream is of great value for water-power development (Pl. VI, *A*). All of the better power sites have been developed, one company alone having developed about 9,500 horsepower at six dams. Springs issuing from galcial moraines or breaking through the underlying sandstone from the great artesian basin of the State supply the river with a considerable body of water.

A. TROWBRIDGE DAM AND POWER HOUSE, KALAMAZOO RIVER, ALLEGAN, MICH

B. FLETCHER DAM, THUNDER BAY RIVER, ALPENA, MICH, IN 1902.

The following gaging stations have been maintained in this drainage basin:

Kalamazoo River at Kalamazoo, Mich., 1900 to 1901.
Kalamazoo River near Allegan, Mich., 1901 to 1908.
Reed's Spring at Albion, Mich., 1904 to 1906.

KALAMAZOO RIVER NEAR ALLEGAN, MICH.

This station, which is located at the power plant of the Commonwealth Power Company, 6 miles upstream by the river from Allegan, Mich., was established April 4, 1901, to obtain data for use in studying water power, water supply, and pollution problems.

There are no tributaries of any size near the station.

The entire flow of the river at this point passes through the turbines except in times of high water, when the extra flow is released by means of Taintor gates. The discharge is computed from a record kept of the run of the turbines and of the Taintor gate openings. The computed data, if the records are accurately and carefully taken, and if the flow through the wheels as they are set up agrees with the manufacturer's rating, should be excellent, as the records and computations are simple. Ice does not affect the computation of the discharge, although it forms a foot or so in thickness on the pond above the dam. The records at this station have been furnished by employees[a] of the Commonwealth Power Company. The 1908 data were not computed owing to repairs and alterations to the Taintor flood gates.

Daily discharge, in second-feet, of Kalamazoo River near Allegan, Mich., for 1907.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,570	1,510	1,300	3,520	2,320	1,400	774	1,030	[b]370	1,270	726	[b]900
2	1,380	1,560	1,190	3,440	2,170	[b]1,640	963	719	717	1,060	1,100	900
3	1,700	[b]1,270	[b]1,560	2,940	2,310	1,220	963	592	409	1,270	[b]1,280	924
4	1,570	1,470	1,310	2,580	2,480	1,190	879	[b]477	562	1,460	1,280	1,100
5	1,630	1,300	1,750	2,350	2,670	1,260	801	1,100	655	1,340	1,630	338
6	[b]1,610	1,130	1,420	1,090	2,270	1,450	1,210	683	501	[b]1,200	1,240	612
7	1,670	1,200	1,600	[b]882	1,800	1,160	[b]719	790	578	1,330	997	719
8	2,430	1,160	1,280	1,620	1,630	1,370	1,080	971	[b]489	1,100	785	[b]712
9	2,080	1,280	1,400	1,940	1,710	[b]1,150	1,130	933	1,330	998	785	1,160
10	1,780	[b]1,090	[b]845	1,570	1,260	1,190	780	716	1,220	1,250	[b]616	1,780
11	1,710	1,360	1,320	1,810	1,410	1,190	876	(b)	1,120	1,030	1,240	1,670
12	1,990	1,300	1,260	1,540	[b]1,340	1,300	900	588	414	725	997	1,510
13	[b]2,020	1,250	1,450	1,580	1,380	1,250	1,250	635	490	[b]1,060	1,060	1,600
14	1,600	1,000	1,620	[b]1,410	1,020	1,060	[b]1,120	889	545	1,220	1,100	1,460
15	1,700	1,240	1,440	1,210	1,220	859	1,380	1,030	[b]288	918	568	[b]1,380
16	1,450	1,240	1,820	1,310	1,190	[b]954	1,250	714	718	800	1,020	1,300
17	1,270	[b]1,410	[b]1,800	1,380	1,080	1,130	1,300	684	1,030	763	[b]819	1,270
18	1,350	1,470	1,590	1,260	911	1,240	1,160	(b)	1,330	900	963	1,100
19	1,610	1,870	1,680	1,180	[b]1,220	1,190	1,410	909	735	1,100	726	1,190
20	[b]3,520	1,870	1,600	1,170	859	1,000	1,060	970	1,050	[b]578	924	734
21	2,200	1,380	1,520	[b]1,170	1,250	731	[b]182	840	1,220	1,220	971	757
22	2,330	1,300	1,640	1,010	1,300	529	1,030	361	[b]1,060	879	1,320	[b]1,060
23	1,790	1,300	1,640	1,290	1,220	[b]932	1,160	493	988	879	1,250	1,120
24	1,910	[b]866	[b]2,450	1,130	1,190	1,210	1,220	531	1,100	1,100	[b]733	997
25	2,080	1,310	1,820	1,430	1,410	1,270	765	[b]687	719	918	1,150	851
26	1,940	1,270	1,940	1,130	[b]1,510	1,100	1,250	1,080	699	1,050	1,080	1,380
27	[b]1,440	1,330	2,040	1,050	1,800	971	1,220	323	836	[b]848	1,100	2,080
28	1,600	1,300	2,570	[b]888	1,740	1,270	[b]634	670	1,160	900	984	3,400
29	1,480	....	2,980	918	1,710	900	660	687	[b]1,190	972	1,030	[b]2,770
30	1,530	....	3,340	2,200	820	[b]856	1,030	361	1,320	862	1,240	2,360
31	1,590	....	[b]3,240	....	1,370	....	647	874	....	854	....	2,370

[a] Danner and Harrington.

[b] Sunday.

Monthly discharge of Kalamazoo River near Allegan, Mich., for 1907.

[Drainage area, 1,470 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
January	3,520	1,270	1,820	1.24	1.43
February	1,870	866	1,320	.898	.94
March	3,340	845	1,760	1.20	1.38
April	3,520	882	1,630	1.11	1.24
May	2,670	820	1,530	1.04	1.20
June	1,450	529	1,110	.755	.84
July	1,410	182	994	.676	.78
August (29 days)	1,100	323	736	.501	.54
September	1,330	288	828	.563	.63
October	1,460	578	1,030	.701	.81
November	1,630	568	1,020	.694	.77
December	3,400	338	1,340	.912	1.05

GRAND RIVER DRAINAGE BASIN.

DESCRIPTION.

Grand River rises in the southern part of Jackson County, in the southeast-central part of Michigan, flows northward to Lansing, thence northwestward to the central part of Ionia County, and finally westward to Grand Haven, Mich., where it enters Lake Michigan. Its length, not following the bends and angles, is about 200 miles, and its total length is at least 300 miles. The important tributaries are as follows, beginning at the source: From the right, Portage, Red Cedar, Lookingglass, Maple, Flat, and Rogue rivers; from the left there is only one of any size—Thornapple River. The total drainage area is about 5,570 square miles, which makes it the largest stream in Michigan.

The drainage basin is fairly regular in outline and shape. It lies in the southern border of the pine belt and is for the most part cleared, and is now thickly settled, having become a rich agricultural region. The drainage area is comparatively flat, being overlain with glacial drift with outcroppings of rock at rare intervals. At Grand Rapids the stream passes over a limestone ledge, making a considerable fall at Grand Ledge. About 12 miles west of Lansing a similar descent occurs over sandstone. Below Grand Rapids the flow is very sluggish. In the upper half of this stretch the immediate banks of the river are high in places forming natural levees. Below Lamont bayous and swamps are common between the river banks and the foothills bordering the valley. The valley of the river proper is narrow; gravel bluffs from 50 to 60 feet high stand close to the stream in some places. The northwestern and southeastern portions of the drainage basin are thickly interspersed with small lakes, a number of which have no surface outlet. The elevation of the sources of the river is about 1,000 feet; at Lansing the elevation is about 820 feet; at Grand Rapids it is about 590 feet; at the mouth of the river the elevation is 581 feet; the total descent is therefore about 400 feet, which produces a rather low average fall.

There are no forested areas of any extent in this drainage basin, all timber having been cut off some time ago.

The mean annual rainfall is from 30 to 35 inches. The winter conditions are comparatively mild; in general the snowfall is not heavy, and ice does not form very thick.

Storage possibilities have not been investigated, but it is thought that some of the lakes and swamps may make good-sized reservoirs by means of dams of ordinary height.

At the present time there is about 5,000 horsepower developed on the main stream and tributaries, counting only power plants of some size. The stream is therefore of considerable value for water power, and there are power sites still undeveloped.

Grand Rapids is at the head of navigation on the Grand River.

The following gaging stations have been maintained in this drainage basin:

Grand River at North Lansing, Mich., 1901–1906.
Grand River at Grand Rapids, Mich., 1901–1908.[a]
Red Cedar River at Agricultural College, Mich., 1902–3.
Crockery Creek at Slocums Grove, Mich., 1902–3.

GRAND RIVER AT GRAND RAPIDS, MICH.

This station, which is located at the Fulton Street Bridge in the city of Grand Rapids, Mich., was installed March 12, 1901, to obtain data for studying water supply, flood control, pollution, and navigation problems, and for general statistical and comparative studies.

The drainage area above the station is about 4,900 square miles.

Ice forms in winter and changes the relationship between gage heights and discharge. Power plants above the section modify the low-water flow.

In November, 1907, a new staff gage was installed whose zero corresponded with the city datum. Readings taken on this gage were first reported in December, 1907. The zero of the gage in use prior to November, 1907, was 0.55 foot below the city datum; all gage readings, however, have been corrected to the city datum, and all published gage heights are therefore referred to the same datum. The records are reliable and accurate. Only two or three measurements have been taken at this station since 1905. These measurements appear to indicate that the 1905 discharge table does not hold after that year and therefore estimates of the flow have not been computed for later years.

[a] Also gage-height records on the Grand River at the Chicago and West Michigan Railroad bridge, Grand Rapids, Mich., 1897–1900.

The following discharge measurement was made October 21, 1908: Width, 481 feet; area, 675 square feet; gage height, —0.64 foot; discharge, 1,500 second-feet.

Daily gage height, in feet, of Grand River at Grand Rapids, Mich., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	2.95	9.95	3.25	7.75	5.10	1.85	0.12	0.10	......	0.75	......	......
2	3.00	9.65	5.75	7.70	6.30	......	-.05	.12	......	.75	......	0.15
3	3.50	......	......	7.00	7.10	1.23	-.05	.05	-0.40	.85	......	.42
4	3.80	9.25	6.20	8.05	7.50	1.35	-.12	......	.10	1.10	......	-.02
5	3.70	8.95	6.25	4.75	......	1.20	-.15	-.22	-.18	.85	......	-.18
6	......	8.75	5.85	3.90	7.03	1.15	-.20	-.30	-.35	......	......	-.06
7	3.75	8.25	5.30	......	6.30	1.25	......	-.20	-.30	.85	......	.08
8	5.30	7.95	4.90	3.40	5.40	.97	-.12	-.22	......	.90	......	......
9	6.30	7.55	4.40	3.45	4.57	......	-.15	-.05	-.28	.85	......	.10
10	6.35	......	......	3.20	3.75	.87	-.25	-.32	-.12	.45	......	1.10
11	6.45	7.00	3.25	3.10	3.25	.90	-.10	......	-.05	.30	......	1.68
12	6.55	6.70	4.35	2.80	......	.90	-.12	-.40	.00	.05	......	1.92
13	......	6.35	6.00	2.75	2.45	.80	-.10	-.32	.08	......	......	1.75
14	5.40	6.00	6.50	......	2.35	.75	......	-.40	-.20	.40	......	.65
15	4.70	5.85	7.05	2.50	2.00	.70	.15	-.45	......	.05	......	......
16	4.20	5.60	7.50	2.55	1.65	......	.68	-.28	-.40	-.05	......	.45
17	3.10	......	......	2.50	1.60	.40	.45	.35	-.05	-.20	......	.90
18	2.95	5.50	6.55	2.37	1.45	.40	.72	......	.30	-.05	......	.82
19	6.40	5.90	6.60	2.35	......	.37	.15	-.38	.55	-.35	......	1.18
20	......	6.15	6.65	2.10	1.15	.33	.10	-.35	.65	......	......	.82
21	9.90	6.15	6.50	......	1.15	.35	......	-.35	.50	-.10	......	.50
22	10.30	6.05	6.50	1.87	1.23	.35	1.82	-.10	......	.30	......	.75
23	12.90	5.65	6.20	1.77	1.15	......	2.28	-.35	-.05	.05	......	.92
24	15.10	......	......	1.33	1.15	.33	2.30	-.38	-.18	......	......	.50
25	12.65	5.00	6.70	1.25	.90	.50	2.12	......	-.20	......	......	......
26	11.45	4.60	7.60	1.23	......	.93	2.02	-.40	-.22	......	......	.50
27	10.15	4.00	8.05	1.35	1.35	1.20	1.72	-.38	-.35	......	......	1.55
28	10.00	3.35	8.10	......	2.15	.95	......	-.40	.10	......	......	3.20
29	9.70	......	7.90	1.35	2.37	.55	.42	-.38	......	......	......	......
30	9.65	......	7.60	3.13	2.10	......	.35	-.42	.40	......	......	4.95
31	9.65	......	......	......	1.95	......	.28	-.50	......	......	......	5.10
1908.												
1	5.35	2.50	......	10.20	3.62	7.40	-0.22	-0.58	-0.55	-0.50	......	0.58
2	5.00	......	4.10	9.75	2.82	7.32	-.22	......	-.60	-.60	-0.60	.43
3	4.77	2.75	3.90	9.10	......	6.95	-.80	-.78	-.62	-.55	-.65	.10
4	......	2.38	3.60	8.40	2.45	5.75	......	-.62	-.62	......	-.55	.10
5	......	2.25	3.35	......	2.20	4.50	......	-.65	-.65	-.60	-.55	.00
6	3.60	2.15	3.65	6.90	2.00	4.00	-.10	-.55	......	-.62	-.58	......
7	3.42	2.25	7.28	6.15	2.05	......	-.25	-.55	......	-.55	-.58	-.40
8	3.38	2.22	8.40	6.35	3.85	2.65	-.20	-.55	-.70	-.62	......	-.50
9	2.72	......	9.02	6.55	5.00	2.32	-.38	......	-.70	-.62	-.55	-.40
10	2.32	2.00	9.90	6.70	......	1.70	-.35	-.60	-.75	-.58	-.68	-.40
11	2.30	1.38	11.65	6.58	5.45	1.30	-.38	-.65	-.75	......	-.50	-.55
12	......	1.70	13.80	......	6.20	1.10	......	-.65	-.78	-.65	-.50	-.60
13	2.05	2.70	14.35	......	6.35	.95	-.52	-.72	......	-.62	-.45	......
14	1.60	3.50	14.80	......	7.10	......	-.38	-.75	-.85	-.52	-.55	-.60
15	1.30	4.75	15.30	......	8.00	1.25	-.40	-.75	-.85	-.55	......	-.35
16	1.15	......	15.30	......	......	1.02	-.60	......	-.90	-.55	-.68	-.45
17	1.15	5.85	14.82	3.30	......	.70	-.55	1.30	-.85	-.60	-.50	-.40
18	1.05	6.05	13.95	3.20	10.22	.50	-.55	1.10	-.75	......	-.52	-.30
19	......	6.50	12.90	......	10.25	.40	......	1.00	-.75	-.60	-.45	-.05
20	1.00	6.40	11.90	3.40	9.72	.35	-.50	.80	-.70	-.60	-.50	......
21	1.28	6.30	10.75	3.10	9.00	......	-.25	.48	-.70	-.60	-.50	-.35
22	1.20	......	......	2.95	7.90	.05	-.40	.28	-.72	-.50	......	-.50
23	1.10	......	9.05	2.50	7.30	-.12	-.50	......	-.78	-.35	-.58	-.60
24	.90	5.10	8.33	3.25	......	.02	-.45	.05	-.75	-.50	-.45	-.40
25	1.60	4.95	7.62	3.25	5.30	-.20	-.40	-.12	-.82	......	-.25	......
26	......	4.90	7.12	......	5.35	-.15	......	-.35	-.78	-.50	-.40	-.40
27	1.60	4.60	6.55	3.60	5.70	-.20	-.50	-.52	......	-.45	-.20	......
28	1.75	4.60	7.30	4.35	5.85	......	-.45	-.38	-.70	-.42	-.18	-.50
29	1.75	4.32	......	4.35	6.20	-.25	-.50	-.60	-.70	-.55	......	-.50
30	1.38	......	9.10	4.00	......	-.12	-.60	......	-.60	-.55	-.13	-.45
31	1.20	......	10.00	......	......	......	-.65	-.60	......	......	......	-.55

MANISTEE RIVER DRAINAGE BASIN.

DESCRIPTION.

Manistee River rises in several lakes along the boundary line between Antrim and Otsego counties in the north-central part of Michigan, flows southwestward across Kalkaska, Wexford, and Manistee counties, and empties into Lake Michigan at Manistee, Mich. It has but two important tributaries, both of which enter in the lower part of the river—Big Bear on the right bank, and the South Branch of the Manistee on the left bank. The length of the river is about 110 miles, not taking into account the numerous bends and angles; but following its windings, its total length must be about 200 miles, for it is very crooked. The total drainage area is about 2,120 square miles.

The drainage basin is somewhat irregular in shape, the upper part being narrow, the widest portion being found in the lower third of the basin. The soil of the drainage basin is sandy and the stream receives a large proportion of its supply from springs along the banks of the main river and its tributaries. The country is flat or rolling. The elevation of the sources of the river is about 1,200 feet, the elevation of the mouth is 581 feet, a total fall of 620 feet.

Practically all the better timber has been cut off this drainage basin, although lumbering is still carried on to some extent.

The mean annual rainfall is about 35 inches. The winter conditions are not severe; there is a fairly heavy fall of snow, ice forms on the river about 1 foot in thickness during severe cold spells. The large amount of spring water helps to keep the river open.

Storage possibilities have not been investigated, but as the basin contains numerous lakes, it must afford conditions for creating reservoirs to conserve and regulate the flow.

The opportunities for water power have not been fully investigated. Good sites, however, must be available at various places, as the fall of the river is considerable and the flow is well sustained during dry spells by the numerous springs.

The stream is used considerably for logging, but the lumber interests are becoming less every year.

One gaging station has been maintained in this drainage basin: Manistee River near Sherman, Mich., established July 10, 1903, and maintained to date.

MANISTEE RIVER NEAR SHERMAN, MICH.

This station, which is located at North Bridge, about 1 mile from Sherman, Mich., was established July 10, 1903, to obtain data for studying water power, water supply, and pollution problems.

Wheeler Creek enters immediately below the station.

The river freezes over in winter, making necessary special studies to determine the winter flow. The constancy of flow of this stream, as shown by the tables given below, is remarkable and is due to springs and ground-water flow. The maximum recorded mean flow for any month from 1903 to 1908 is only 2½ times the minimum recorded mean flow. It has consequently been possible to estimate the discharge during the frozen periods fairly closely by taking advantage of these facts and by utilizing climatologic data. The stream is used for logging, and at times there are sunken logs in the bed of the stream which may affect the gage heights slightly.

The datum of the gage has remained unchanged; the records are reliable and accurate except as conditions noted above may affect the readings.

Discharge measurements of Manistee River near Sherman, Mich., in 1903-1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1903.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 4	W. M. Gregory		344		935
July 10	do		368	2.45	1,040
July 24	do		358	2.55	1,060
Do	Horton and Gregory		354	2.49	1,050
August 26	W. M. Gregory		347	2.30	994
1904.					
June 2	C. C. Covert		538	3.62	1,510
September 13	H. R. Beebe		335	2.05	921
September 16	do		359	2.05	912
Do	do		359	2.06	907
December 14	C. C. Covert		362	1.76	860
1905.					
June 4	H. R. Beebe	67	441	2.65	1,130
November 8	E. F. Weeks	67	456	2.70	1,230
1906.					
June 20	Horton and Covert	68	409	2.36	988
1907.					
April 23	A. H. Horton	66	454	3.02	1,240
1908.					
October 23	O'Neill and Chapman	68	368	1.90	831

Daily gage height, in feet, of Manistee River near Sherman, Mich., for 1907 and 1908.

[Observer, F. J. Bullock.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	2.42	4.30	6.00	4.65	3.92	3.65	2.40	2.00	1.92	2.50	2.10	2.40
2	2.48	4.00	......	4.40	3.92	3.40	2.40	2.08	1.98	2.45	2.25	2.35
3	2.60	......	......	4.15	3.72	3.35	2.40	2.12	2.08	2.42	2.40	2.28
4	2.58	......	......	3.87	3.50	3.32	2.30	2.20	2.10	2.40	2.55	2.25
5	2.52	......	......	3.65	3.38	3.40	2.28	2.08	2.10	2.35	2.70	2.15
6	2.50	......	......	3.58	3.30	3.40	2.22	2.00	2.10	2.35	2.70	2.10
7	2.50	......	......	3.52	3.25	3.38	2.20	2.00	2.05	2.30	2.68	2.12
8	2.50	......	......	3.50	3.12	3.25	2.20	2.02	2.05	2.30	2.58	2.30
9	2.45	......	......	3.48	3.15	3.08	2.15	2.00	2.10	2.28	2.52	2.50
10	2.45	......	......	3.42	3.10	3.00	2.10	1.95	2.12	2.25	2.45	2.70
11	2.40	......	......	3.35	3.00	2.88	2.10	2.10	2.18	2.48	2.42	2.70
12	2.40	......	......	3.38	3.00	2.82	2.15	2.48	2.20	2.90	2.38	2.55
13	2.40	......	2.40	3.40	2.92	2.75	2.15	2.28	2.28	3.15	2.32	2.40
14	2.40	......	2.40	3.40	2.95	2.75	2.15	2.18	2.30	3.05	2.28	2.40
15	2.45	......	2.42	3.35	3.15	2.70	2.18	2.15	2.20	2.80	2.20	2.40
16	2.50	......	2.48	3.32	3.30	2.68	2.20	2.25	2.20	2.68	2.20	2.40
17	2.68	......	2.78	3.28	3.28	2.65	2.15	2.28	2.25	2.58	2.20	2.35
18	2.98	......	3.30	3.18	3.20	2.62	2.20	2.20	2.30	2.52	2.20	2.35
19	3.32	......	3.35	3.15	3.20	2.60	2.28	2.18	2.28	2.42	2.18	2.25
20	3.38	......	3.30	3.10	3.12	2.68	2.30	2.12	2.30	2.38	2.22	2.20
21	3.22	......	3.35	3.10	3.02	2.78	2.25	2.10	2.35	2.32	2.45	2.20
22	3.20	......	3.55	3.02	2.95	2.95	2.25	2.10	2.40	2.30	2.62	2.20
23	3.25	......	3.88	3.00	2.88	3.02	2.25	2.10	2.40	2.30	2.65	2.20
24	3.30	......	4.22	3.08	2.80	3.08	2.25	2.05	2.45	2.28	2.58	2.20
25	3.65	......	4.50	3.12	2.92	3.05	2.22	2.00	2.45	2.20	2.50	2.25
26	5.28	......	4.90	3.20	2.95	2.92	2.30	2.00	2.48	2.10	2.50	2.28
27	5.90	......	5.12	3.32	3.20	2.78	2.18	2.00	2.50	2.10	2.50	2.55
28	5.90	......	5.05	3.50	3.65	2.65	2.10	2.00	2.50	2.10	2.45	2.65
29	5.75	......	5.02	3.70	3.95	2.48	2.10	1.92	2.50	2.10	2.45	2.60
30	5.40	......	5.10	3.82	3.92	2.40	2.10	1.90	2.50	2.10	2.45	2.50
31	4.88	......	4.92	......	3.70	......	2.10	1.90	......	2.10	......	2.40
1908.												
1	2.30	......	2.40	3.95	4.10	3.10	2.20	2.05	1.85	2.20	1.90	2.40
2	2.25	......	2.40	4.05	3.90	3.10	2.20	2.00	1.85	2.20	1.85	2.40
3	2.20	......	2.55	3.82	3.70	2.98	2.20	2.00	1.85	2.20	1.85	2.40
4	2.55	......	2.40	3.55	3.40	2.90	2.30	1.90	1.85	2.20	1.90	2.40
5	2.55	......	2.60	3.52	3.35	2.80	2.30	1.80	1.85	2.15	1.90	2.30
6	2.30	......	2.70	3.60	3.20	2.70	2.35	2.10	1.85	2.10	1.90	2.30
7	2.30	......	2.70	3.88	3.40	2.60	2.35	2.00	1.85	2.00	1.90	2.30
8	2.30	......	2.70	4.15	3.70	2.50	2.40	2.00	1.85	2.00	1.90	2.30
9	2.20	......	2.60	4.35	3.90	2.50	2.40	2.00	1.85	2.00	1.90	2.20
10	2.05	......	2.45	4.50	3.88	2.50	2.50	1.90	1.85	2.00	1.90	2.10
11	2.20	......	2.55	4.50	3.72	2.50	2.70	2.12	1.85	1.95	1.90	2.10
12	2.25	2.75	2.78	4.50	3.62	2.45	2.48	2.30	1.85	1.95	1.90	2.15
13	2.20	2.85	2.95	4.48	3.62	2.45	2.35	2.40	1.85	1.95	1.90	2.15
14	2.10	2.90	2.95	4.35	3.65	2.50	2.25	2.60	1.85	1.95	1.90	2.15
15	2.15	3.00	2.95	4.25	3.68	2.60	2.25	2.60	1.85	1.95	1.90	2.15
16	2.15	2.80	2.90	4.18	3.60	2.65	2.30	2.35	1.85	1.95	1.85	2.15
17	2.15	2.50	2.80	4.20	3.50	2.60	2.50	2.25	1.85	1.95	1.90	2.15
18	2.15	2.50	2.80	4.12	3.40	2.50	2.50	2.05	1.85	1.95	2.00	2.15
19	2.10	2.40	2.72	4.10	3.30	2.45	3.00	2.05	1.85	1.95	2.35	2.15
20	2.20	2.50	2.50	4.00	3.20	2.35	3.20	1.90	1.85	1.95	2.20	2.10
21	2.25	2.40	2.40	3.78	3.10	2.30	3.10	1.85	1.85	1.95	2.05	2.10
22	2.25	2.50	2.60	3.72	2.90	2.30	2.80	1.80	1.85	1.95	2.05	2.10
23	2.25	2.30	2.98	3.62	2.90	2.30	2.70	1.85	1.85	1.95	2.20	2.10
24	2.10	2.30	3.42	3.60	2.80	2.40	2.60	1.85	1.85	1.95	2.40	2.10
25	2.05	2.30	3.40	3.55	2.80	2.60	2.40	1.85	1.85	2.05	2.50	2.10
26	2.00	2.30	3.40	3.65	2.70	2.60	2.25	1.85	1.85	2.05	2.50	2.10
27	2.00	2.40	3.52	3.80	2.58	2.40	2.25	1.85	1.85	2.05	2.50	2.10
28	2.00	2.60	3.90	4.05	2.62	2.40	2.15	1.85	2.10	2.00	2.40	2.10
29	2.00	2.40	4.05	4.25	2.90	2.35	2.10	1.85	2.10	2.00	2.40	2.10
30	......	......	3.85	4.25	3.05	2.35	2.10	1.85	2.20	1.95	2.40	2.10
31	......	......	3.95	......	3.10	......	2.05	1.80	......	1.95	......	2.10

NOTE.—Ice conditions prevailed January 25 to about March 12, 1907. To what extent the remainder of January, March, and December, 1907, were affected by ice conditions is not known. The effect on the discharge was, however, probably slight.

River frozen January 30 to February 11, 1908 To what extent January, February, March, and December, 1908, may have been affected by backwater from ice conditions is not known. It could not, however, have been excessive.

Rating table for Manistee River near Sherman, Mich., for 1903-1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	760	2.70	1,135	3.80	1,591	4.90	2,110
1.70	789	2.80	1,174	3.90	1,635	5.00	2,160
1.80	819	2.90	1,213	4.00	1,680	5.20	2,260
1.90	850	3.00	1,253	4.10	1,726	5.40	2,362
2.00	883	3.10	1,293	4.20	1,772	5.60	2,466
2.10	917	3.20	1,334	4.30	1,818	5.80	2,572
2.20	952	3.30	1,376	4.40	1,866	6.00	2,680
2.30	987	3.40	1,418	4.50	1,914	6.20	2,788
2.40	1,023	3.50	1,461	4.60	1,962	6.40	2,900
2.50	1,060	3.60	1,504	4.70	2,010		
2.60	1,097	3.70	1,547	4.80	2,060		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 14 discharge measurements made during 1903-1908, and is well defined between gage heights 1.6 feet and 4 feet.

Monthly discharge of Manistee River near Sherman, Mich., for 1903-1908.

[Drainage area, 900 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1903.						
July 10-31	1,170	934	1,040	1.16	0.95	A.
August	1,800	970	1,200	1.33	1.53	A.
September	1,330	1,080	1,200	1.33	1.48	A.
October	1,330	1,050	1,150	1.28	1.48	A.
November	1,240	991	1,100	1.22	1.36	A.
December	1,930	966	1,210	1.34	1.54	A.
1904.						
January	1,470	842	1,100	1.22	1.41	A.
February	1,060	934	1,000	1.11	1.20	A.
March	1,580	945	1,100	1.22	1.41	A.
April	2,780	1,730	2,100	2.33	2.60	A.
May	2,080	1,480	1,740	1.93	2.22	A.
June	1,600	1,050	1,240	1.38	1.54	A.
July	1,190	987	1,050	1.17	1.35	A.
August [a]	1,110	876	999	1.11	1.28	A.
September	1,080	866	942	1.05	1.17	A.
October	1,150	952	1,010	1.12	1.29	A.
November	1,020	819	926	1.03	1.15	A.
December	1,000	813	910	1.01	1.16	A.
The year	2,780	813	1,180	1.31	17.78	
1905.[b]						
January	1,020	774	901	1.00	1.15	B.
February	987	....	855	.950	.99	B.
March	2,870	789	1,300	1.44	1.66	A.
April	2,840	1,210	1,580	1.76	1.96	A.
May	1,440	1,170	1,310	1.46	1.68	A.
June	1,330	952	1,120	1.24	1.38	A.
July	1,360	917	1,110	1.23	1.42	A.
August	1,040	883	952	1.06	1.22	A.
September	1,100	883	954	1.06	1.18	A.
October	1,120	866	963	1.07	1.23	A.
November	1,170	970	1,060	1.18	1.32	A.
December	1,070	952	1,000	1.11	1.28	A.
The year	2,870	....	1,090	1.21	16.47	

[a] Discharge affected by log jam August 26-27, 1904. Discharge estimated 900 second-feet.
[b] See footnote at end of table, next page.

NOTE.—The winter periods, 1903 and 1904, were assumed unaffected by ice and the open-channel rating applied.

Monthly discharge of Manistee River near Sherman, Mich., for 1903–1908—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1906.						
January			1,200	1.33	1.53	C.
February	1,550		1,030	1.14	1.19	C.
March	1,440	910	1,110	1.23	1.42	A.
April	2,240	1,380	1,840	2.04	2.28	A.
May	1,670	1,120	1,320	1.47	1.70	A.
June	1,140	987	1,060	1.18	1.32	A.
July	1,250	959	1,050	1.17	1.35	A.
August	1,000	857	920	1.02	1.18	A.
September	952	850	878	.976	1.09	A.
October	945	866	905	1.01	1.16	A.
November	1,580	883	1,060	1.18	1.32	A.
December	1,530	959	1,060	1.18	1.36	A.
The year	2,240		1,120	1.24	16.90	
1907.						
January	1,410	1,020	1,140	1.27	1.46	B.
February			900	1.00	1.04	C.
March	2,220		1,340	1.49	1.72	B.
April	1,990	1,250	1,450	1.61	1.80	A.
May	1,660	1,170	1,370	1.52	1.75	A.
June	1,530	1,020	1,240	1.38	1.54	A.
July	1,020	917	956	1.06	1.22	A.
August	1,050	850	914	1.02	1.18	A.
September	1,060	857	971	1.08	1.20	A.
October	1,310	917	1,030	1.14	1.31	A.
November	1,140	917	1,030	1.14	1.27	A.
December	1,140	917	1,000	1.11	1.28	A.
The year	2,220		1,110	1.24	16.77	
1908.						
January	1,080		943	1.05	1.21	A.
February	1,250		970	1.08	1.16	B.
March	1,700	1,020	1,230	1.37	1.58	A.
April	1,910	1,470	1,690	1.88	2.10	A.
May	1.730	1,090	1,390	1.54	1.78	A.
June	1,290	987	1,080	1.20	1.34	A.
July	1,330	900	1,030	1.14	1.31	A.
August	1,100	819	892	.991	1.14	A.
September	952	834	843	.937	1.05	A.
October	952	866	888	.987	1.14	A.
November	1,060	834	908	1.01	1.13	A.
December	1,020	917	945	1.05	1.21	A.
The year	1,910		1,070	1.19	16.15	

NOTE.—River frozen across January 25 to February 22, 1905, and ice conditions prevailed during the latter part of January and February 1 to 16, 1906. Remainder of 1905 and 1906 assumed unaffected by ice and open-channel rating applied except January 1–19, 1906, when there was no record. Discharge January 25 to 31, 1905, 890 second-feet; February 1 to 22, 1905, 825 second-feet; February 1 to 16, 1906, 800 second-feet. Discharge estimated January 25 to March 12, 1907. Discharge assumed unaffected by ice January 1 to 24, March 13 to 31, and during December, 1907. Discharge during 1908 assumed unaffected by ice except January 30 to February 11, when the discharge was estimated. Discharge January 25 to 31, 1907, 1,130 second-feet; March 1 to 12, 1907, 900 second-feet; January 30 to 31, 1908, 850 second-feet; February 1 to 11, 1908, 800 second-feet.

MISCELLANEOUS MEASUREMENTS IN LAKE MICHIGAN DRAINAGE.

The following miscellaneous discharge measurements were made in Lake Michigan drainage basin during 1908:

Date.	Stream.	Locality.	Width.	Area of section.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Feet.*	*Sec. ft.*
October 16	St. Joseph River	South Bend Ind	235	1,470	2.60	2,200
October 16	do	do	250	1,010	2.58	2,040
November 3	do	do	244	669	1.45	812
October 20	Kalamazoo River	Allegan, Mich	123	822		864
October 22	Muskegon River	Bridgeton, Mich	252	701		943

LAKE HURON DRAINAGE BASIN.

GENERAL FEATURES.

The area tributary to Lake Huron in the United States comprises the eastern part of the southern peninsula of Michigan. South of Saginaw Bay the Lake Huron slope is very narrow and the brooks and runnels by which it is drained are only a few miles in length. The so-called Thumb of the Mitten is drained chiefly by three short northward-flowing streams known as Willow, Pinnepog, and Pigeon rivers, which lie in a flat, marshy region. The Saginaw River system is tributary to the bay at its head, while northward from the bay are Rifle, Au Sable, and Thunder Bay rivers, streams having considerable fall, excellent ground storage, and well-sustained flow. Cheboygan River also belongs in the Lake Huron drainage.

THUNDER BAY RIVER DRAINAGE BASIN.

DESCRIPTION.

Thunder Bay River rises in the southern part of Montmorency County, in the northeastern part of the lower peninsula of Michigan, and flows in a generally northeasterly direction to within about 15 miles of its mouth, where it turns and flows southwestward, joining Lake Huron in Thunder Bay at Alpena. The important tributaries on the right or south bank, beginning at the sources are: Upper South Branch and South Branch. Nenelon River is a tributary of the South Branch. On the left or north bank there is only one tributary, the North Branch. The total length of the river, not following the bends, is about 50 miles.

The drainage basin is regular in outline and shape. Thunder Bay River proper may be said to be about 8 miles in length, for at this distance above the mouth it receives a large tributary, and 2 miles above this tributary another large stream enters. Both the main river and these two tributaries further subdivide at short distances above, so that the river is relatively small except at the lower end.

The upper portions of the drainage basin are in general level or undulating, the central part is rolling and hilly, and the lower portion is level with shallow sand ridges.

The predominating rocks of this drainage basin are shales, but these have been covered more or less deeply with glacial drift. An outcrop of the shales crosses the drainage basin in a northeast-southwest direction, crossing the river channel a few miles west of Alpena. The surface above the line of this outcrop is almost continuous lime stone composed of nearly pure calcium carbonate, a small area being covered with sand or thin drift deposits. This limestone area contains numerous sink-holes, in many places deep and precipitous. Surface water entering these pits disappears by finding outlets to a lower level through limestone fissures. Such a pocket, known as Sunken Lake, absorbed the entire flow of the North Branch until 1900, when a puddle dam was built so as to turn the water down its original channel. The drainage basin contains about 30 lakes, averaging 1 square mile in area. In addition to these is Hubbard Lake, whose area is 13.4 square miles. The elevation of the sources of the river is approximately 1,200 feet; the elevation of the mouth is 581 feet.

This drainage basin was formerly heavily timbered with Michigan pine. Most of the pine has been cut, but a large number of conifers, hard woods, white birch, and cedar remains, so that this area may be said to be forested rather than cleared.

The mean annual rainfall is 30 to 35 inches. The winter conditions are severe; the snowfall is heavy. Ice forms from 1 to 2 feet in thickness and lasts for three or four months.

The basin affords excellent opportunities for storage. A dam at the foot of Hubbard Lake produces a storage depth of 5 feet with an aggregate storage capacity of nearly 2,000,000,000 cubic feet of water. Beaver Lake is also used for storage. Undoubtedly the storage capacity of these two lakes could be so increased that a very material addition to the low-water flow could be obtained. There are probably other lakes capable of producing reservoirs of good capacity.

There are a few opportunities for water power in this drainage basin. The most important are in the stretch of the river below the junction of the tributaries, where there are two developments of about 2,000 and 900 horsepower. Other power sites are found elsewhere on the river and tributaries. By developing the storage capacity of the lakes the low-water flow could be considerably increased, thereby increasing the value of the water-power sites.

The stream is still used for running logs, and the storage and releasing of water for flooding modifies the normal flow of the river considerably. Owing to the pervious nature of the rock strata the effective and apparent boundaries of the drainage basin may differ materially.

One gaging station has been maintained in this drainage basin: Thunder Bay River near Alpena, Mich., established April 4, 1901, and maintained to date.

THUNDER BAY RIVER NEAR ALPENA, MICH.

This station, which is located 4 miles above Alpena at the dam and power plant (Pl. VI, *B*) of the Fletcher Paper Company, was established April 4, 1901, to obtain data for studies of water-power problems. It is below all tributaries. The South Branch of Thunder Bay River enters a few miles above the station.

The discharge at this station is obtained by computing the flow through the water wheels, over spillways, log slides, and over the headrace overflow, the proper coefficients to be applied being assumed from experiments with model dams of nearly or the same shape. Measurements of the flow through the turbines, made in April, 1906, indicated that the manufacturer's rating was 20 per cent in error. All published data previous to 1906 is therefore in error by 20 per cent or less, depending upon how much of the entire flow was taken by the wheels. The discharge at this station is effected by the following factors: The dam has settled, trash and drift lodge on the crest, ice forms on the lower side of the dam, changing the shape of the crest as well as restricting the length of the spillways, and there is some leakage. For these reasons the data obtained are not considered very accurate.

The winter conditions are severe. The stream is used for logging, and the normal flow is modified by storage of water for power and logging purposes.

D. W. Mead has furnished the computations of the discharge at this station for 1906, 1907, and 1908.

The Fletcher Paper Company has furnished the observed records at this station.

Daily discharge, in second-feet, of Thunder Bay River near Alpena, Mich., for 1906, 1907, and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.												
1	731	1,026	1,603	[a]3,167	1,630	1,050	[a]1,087	640	467	929	797	2,719
2	697	947	1,344	3,153	1,426	1,147	1,712	675	[a]369	812	760	[a]2,322
3	690	791	1,135	3,637	1,607	[a]545	2,002	650	97	686	717	1,172
4	680	[a]1,336	[a]1,050	4,094	2,105	700	1,669	709	43	639	[a]697	1,137
5	728	785	962	4,352	2,033	692	1,093	[a]915	172	613	800	1,103
6	717	787	818	4,465	[a]1,766	714	908	648	98	580	691	796
7	[a]524	754	922	4,158	1,363	710	991	610	160	[a]64	696	684
8	583	751	933	[a]3,907	1,196	835	[a]756	554	133	781	696	756
9	563	725	927	3,748	1,217	985	749	446	[a]311	569	740	[a]606
10	629	675	5,849	4,094	1,701	[a]999	678	499	211	670	720	1,007
11	660	[a]574	[a]2,021	4,604	1,496	1,079	661	585	205	610	[a]862	1,088
12	653	665	917	4,787	1,448	699	642	[a]1,044	183	610	801	1,174
13	616	642	859	4,217	[a]914	612	653	523	211	569	723	1,168
14	[a]528	634	806	4,036	1,427	676	688	466	191	[a]64	694	1,112
15	667	612	930	[a]3,784	1,470	621	[a]608	430	183	797	661	1,039
16	744	612	770	4,715	1,351	616	745	531	[a]110	589	612	[a]814
17	708	576	2,876	3,748	1,247	[a]68	700	293	191	589	604	996
18	810	[a]632	[a]1,621	3,637	2,102	710	678	280	200	557	[a]697	978
19	796	582	1,295	2,533	2,702	697	652	[a]229	191	577	830	887
20	758	662	806	3,808	[a]2,679	648	650	230	183	611	784	792
21	[a]461	752	772	2,500	2,170	688	613	180	175	[a]64	822	792
22	1,213	1,017	747	[a]2,591	1,761	669	[a]608	44	245	1,043	1,141	753
23	1,455	933	716	2,556	1,277	781	753	126	[a]112	517	1,443	[a]524
24	2,021	1,000	763	2,047	1,232	[a]101	678	126	401	676	1,712	399
25	2,134	[a]1,335	[a]966	1,896	1,188	752	626	239	432	668	[a]1,717	789
26	1,885	1,734	788	2,274	1,215	755	601	[a]98	432	732	1,852	954
27	1,682	2,030	903	1,826	[a]834	651	575	379	432	741	2,063	746
28	[a]1,550	2,181	1,235	1,682	1,602	690	586	159	687	[a]64	2,706	792
29	1,355	....	1,343	[a]1,293	1,667	693	[a]408	307	508	1,375	2,884	758
30	1,253	....	1,823	1,611	1,154	1,111	755	204	[a]68	918	2,831	[a]578
31	1,154	....	2,531	....	1,113	....	633	235	....	839	....	1,007

[a] Sunday.

Daily discharge, in second-feet, of Thunder Bay River near Alpena, Mich., for 1906, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1,181	905	655	3,376	1,937	2,740	569	364	[a]304	416	738	[a]468
2	1,420	846	666	2,851	2,506	[a]2,408	635	441	350	463	521	584
3	1,614	[a]1,482	[a]459	2,062	2,512	2,131	633	588	508	381	[a]574	484
4	1,651	882	737	2,344	2,274	1,506	246	[a]304	450	390	1,131	528
5	1,620	833	737	2,166	[a]1,759	1,599	636	570	536	501	787	575
6	[a]1,694	817	719	1,832	2,069	2,068	570	502	529	[a]246	660	610
7	1,614	772	709	[a]1,830	2,001	1,993	[a]165	514	523	519	688	661
8	1,472	760	703	1,081	1,501	1,949	642	446	[a]409	458	601	[a]576
9	1,268	720	682	1,230	1,507	[a]1,504	599	439	493	485	918	883
10	1,297	[a]1,094	[a]821	1,760	1,391	1,332	642	465	413	716	[a]98	787
11	1,170	761	708	1,474	1,423	1,253	604	[a]350	434	389	731	732
12	1,035	721	740	1,717	[a]1,109	1,204	578	489	452	318	412	615
13	[a]998	745	860	1,991	1,240	1,159	619	313	434	[a]612	412	367
14	1,128	650	813	[a]1,633	1,240	1,098	[a]246	444	467	481	227	613
15	1,086	1,830	842	1,417	1,230	1,084	673	435	[a]547	358	415	[a]453
16	1,015	721	810	1,398	1,234	[a]479	620	445	531	406	531	712
17	914	[a]940	[a]1,890	1,486	1,180	606	612	503	473	413	[a]408	728
18	982	749	1,564	1,232	1,248	593	594	[a]474	462	425	524	763
19	1,008	757	1,685	1,242	[a]1,109	634	604	522	535	473	604	780
20	[a]1,437	757	1,685	1,184	1,603	642	599	465	546	[a]209	597	763
21	1,656	757	1,685	[a]689	1,272	609	[a]428	458	472	577	597	736
22	1,735	705	1,764	1,270	1,597	599	604	476	[a]547	485	748	[a]488
23	1,828	656	1,818	1,198	1,632	[a]476	610	440	255	474	927	708
24	1,759	[a]757	[a]2,894	1,129	979	719	554	479	530	450	[a]542	541
25	1,661	684	3,362	1,186	1,131	689	452	[a]408	445	424	752	961
26	1,431	686	4,212	1,180	[a]1,188	689	452	508	475	445	752	755
27	[a]1,209	674	4,614	1,337	1,864	689	450	424	556	[a]141	777	673
28	1,085	654	4,789	[a]1,627	2,209	637	[a]246	429	475	528	782	709
29	1,075	......	4,989	2,403	2,800	708	578	433	[a]304	492	752	[a]961
30	1,003	......	4,277	1,562	2,863	[a]305	461	412	537	555	803	753
31	914	......	[a]4,141	......	2,753	......	315	451	......	569	......	767
1908.												
1	732	489	[a]2,731	2,248	2,930	1,071	560	315	145	469	[a]465	837
2	660	[a]1,350	1,226	2,342	2,678	2,286	560	[a]68	154	525	626	739
3	626	1,580	638	2,342	[a]2,656	1,448	980	236	137	476	577	587
4	487	510	628	2,913	2,282	1,087	547	175	145	[a]253	570	558
5	[a]573	510	628	[a]2,913	1,122	858	[a]476	261	120	635	576	627
6	515	510	628	2,964	2,007	1,010	849	229	[a]24	514	547	[a]733
7	518	515	581	2,248	2,240	[a]541	1,396	147	145	464	531	709
8	513	491	[a]2,314	2,725	2,530	817	864	125	145	464	[a]115	762
9	512	[a]1,116	977	3,254	3,016	703	1,133	[a]68	137	486	620	694
10	483	631	537	3,725	[a]3,212	670	1,484	92	137	495	532	691
11	477	510	530	3,917	3,913	674	2,089	174	131	[a]253	516	738
12	[a]660	510	561	[a]4,335	3,242	625	[a]1,703	204	272	670	549	728
13	525	539	639	3,986	3,032	642	1,396	318	[a]198	464	510	[a]1,041
14	510	615	664	4,468	2,808	[a]166	769	202	155	484	520	808
15	513	707	[a]2,431	4,433	2,596	692	781	336	168	423	[a]446	737
16	513	[a]1,672	1,213	4,648	2,550	601	618	[a]413	145	295	644	737
17	513	887	737	4,468	[a]2,069	608	614	319	155	257	516	711
18	487	647	737	3,917	2,204	569	385	264	98	[a]849	555	640
19	[a]995	625	716	[a]3,887	1,600	567	[a]351	228	122	490	553	616
20	634	414	728	3,430	2,834	610	627	237	[a]122	483	536	[a]416
21	517	414	732	3,255	1,283	[a]68	523	198	115	483	575	693
22	530	419	[a]2,314	2,965	1,004	696	416	249	115	483	[a]2,443	1,061
23	518	[a]854	1,687	2,965	1,367	669	600	[a]316	115	484	683	628
24	506	954	1,174	2,919	[a]1,236	1,961	486	245	166	493	625	318
25	492	497	1,418	2,784	1,600	1,588	371	245	204	[a]474	720	747
26	[a]843	494	1,728	[a]2,656	1,066	1,858	[a]141	218	474	814	798	731
27	602	506	1,905	2,724	988	1,858	494	233	[a]542	795	846	[a]748
28	506	661	2,222	2,730	1,139	[a]1,817	427	229	298	642	851	743
29	509	646	[a]2,775	2,937	1,109	1,225	330	232	383	591	[a]882	676
30	509	......	2,818	3,151	1,044	840	288	[a]68	388	591	914	676
31	509	......	2,005	......	[a]296	......	266	246	......	611	......	650

[a] Sunday.

Monthly discharge of Thunder Bay River near Alpena, Mich., for 1906, 1907, and 1908.

[Drainage area 1,260 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1906.					
January	2,134	[a] 461	956	0.76	0.871
February	2,181	[a] 574	919	.73	.757
March	5,849	716	1,323	1.05	1.195
April	4,787	[a] 1,293	3,297	2.61	2.905
May	2,702	[a] 834	1,551	1.23	1.418
June	1,147	[a] 68	723	.574	.640
July	2,002	[a] 408	812	.644	.740
August	1,044	[b] 44	409	.325	.372
September	687	[b] 43	247	.196	.218
October	1,375	[a] 64	631	.501	.575
November	2,884	604	1,125	.892	.995
December	2,719	399	982	.779	.898
The year	5,849	[b] 43	1,081	.858	11.584
1907.					
January	1,828	914	1,321	1.048	1.206
February	1,830	654	833	.661	.686
March	4,989	[a] 459	1,840	1.460	1.680
April	3,376	[a] 689	1,629	1.292	1.440
May	2,863	979	1,686	1.338	1.535
June	2,740	[a] 305	1,136	.900	1.003
July	673	[a] 165	523	.415	.477
August	588	[a] 304	451	.358	.411
September	556	255	466	.370	.413
October	716	[a] 141	442	.351	.403
November	1,131	[a] 98	633	.502	.559
December	961	367	669	.530	.610
The year	4,989	98	969	.769	10.423
1908.					
January	995	477	564	.447	.514
February	1,672	414	699	.554	.597
March	2,818	530	1,310	1.040	1.193
April	4,648	2,248	3,275	2.600	2.890
May	3,913	[a] 296	2,053	1.626	1.870
June	2,286	[a] 68	961	.764	.850
July	2,089	[a] 141	727	.577	.664
August	413	[a] 68	222	.176	.202
September	542	[a] 24	183	.145	.162
October	849	[a] 253	513	.407	.467
November	2,443	[a] 115	661	.525	.586
December	1,061	318	703	.558	.643
The year	4,648	24	989	.785	10.638

[a] Sunday. [b] Not reliable; error in reading gage.

AU SABLE RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of Au Sable River lies in the northeastern part of Michigan. The river rises in the heart of the plateau region in the central part of northern Michigan, in the southern part of Otsego County, flows southward along the western side of Crawford County to Grayling, then turns and flows eastward across Crawford and Oscoda counties, thence southeastward, and joins Lake Huron at Au Sable. The South Branch and the North Branch are the principal tributaries. The river is about 100 miles in length, not following the bends, and its total drainage area comprises about 2,010 square miles.

Along the lower 20 miles of the river the drainage basin is narrow, having an average width of about 5 miles; but farther up it is somewhat regular in shape, being about 40 miles long by about 30 miles wide. The drainage basin is underlain by shales which have been so deeply covered with glacial drift that rock outcrops are very rare. The upper end of the narrow part of the basin is rolling and hilly; the lower part is level and undulating. In its wider portion the basin consists chiefly of sand and gravel plains with undrained hollows. The elevation of the sources of the river is about 1,250 feet; at Bamfield, about 40 miles from the mouth, following the river, the elevation is about 850 feet; the elevation of the mouth is 581 feet.

This district was at one time noted for its white pine, but the area is now almost entirely cleared of its valuable native timber and is in great part covered with scrub conifers. The mean annual rainfall is about 30 to 35 inches. It is possible that deforestation has increased the flow of this stream by allowing the rainfall to be entirely absorbed by the sand and gravel soil. The water thus absorbed reappears as springs. The springs, which occur wherever the streams have cut down through the sand and gravel to the underlying clay, help maintain the flow of the stream in dry periods, and have a tendency to keep the river open during the winter months, although the winter conditions are severe, snowfall being comparatively heavy, and ice of considerable thickness forming on the streams.

The arrangement of this basin is very favorable for water-power developments, as three-fourths of the drainage area lies above the narrow portion in which the opportunities are found. Along this section the bed of the stream is of firm clay and in many places the river is flanked by high terraced clay cliffs rising 60 to 100 feet above it. Extensive investigations are now being made preparatory to developing the power.

The river is still used for logging, but the run of logs is small.

One gaging station has been maintained in this drainage basin: Au Sable River at Bamfield, Mich., established August 27, 1902, and maintained to date.

AU SABLE RIVER AT BAMFIELD, MICH.

This station, which is located at the steel highway bridge at Bamfield, Mich., was established August 27, 1902, to obtain data for use in water-power studies.

The measuring section was formerly located at a wooden bridge about 400 feet above the new steel bridge from which measurements are now made. The steel bridge was begun in March, 1907, and finished in July, 1907. The gage, which is fastened to a pier of the old bridge, is unchanged, and the section at the gage has not been altered in any way. It is probable that the river is used for log driving only in the spring of the year, for during the summer and fall the gage heights are fairly uniform. As sunken logs are removed from the river twice each year, they have little if any effect on the gage readings. Winters are severe in this locality; the river generally freezes over, but does not remain closed longer than one or two months. Any increase in gage height during the winter months, unless caused by a thaw, is generally caused by backwater from ice jams formed by anchor ice.

Except as stated above the records are reliable and accurate. The datum of the gage has remained unchanged.

Discharge measurements of Au Sable River at Bamfield, Mich., in 1907 and 1908.

Date	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 19[a]	A. H. Horton	98	586	2.13	1,540
April 20	do		577	2.01	1,630
1908.					
October 26	O'Neill and Chapman	81.5	401	1.25	1,170

[a] Discharge probably affected by log jam.

Daily gage height, in feet, of Au Sable River at Bamfield, Mich., for 1907 and 1908.

[Observer, Mrs. W. H. Bamfield.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	2.8			4.8	2.45	2.95	2.5	1.3	0.9	1.4	1.1	1.25
2	2.8			4.9	2.55	2.55	2.4	1.3	.9	1.4	1.1	1.2
3	2.7			4.85	2.7	3.2	2.2	1.1	.9	1.4	1.0	1.2
4	2.65			4.75	2.8	3.4	2.25	1.1	.9	1.3	1.1	1.15
5	2.7			4.7	2.8	3.45	2.2	1.1	.9	1.3	1.15	1.15
6	2.7			4.6	2.5	3.4	2.1	1.1	1.0	1.4	1.05	1.15
7	2.7			4.45	2.9	3.15	2.2	1.1	1.0	1.5	1.1	1.1
8	2.6			4.2	2.5	3.75	1.3	1.1	1.0	1.5	1.15	1.1
9	2.6			4.05	3.45	3.75	1.25	1.0	1.05	1.6	1.1	1.1
10	2.6			4.1	3.45	3.8	1.25	1.0	1.1	1.7	1.2	1.1
11	2.7			4.0	3.45	3.7	1.1	1.0	1.2	1.8	1.1	1.1
12	2.65			3.7	3.35	3.6	1.2	1.0	1.2	1.65	1.1	1.1
13	2.6			3.55	3.15	3.6	1.3	1.0	1.3	1.5	1.1	1.0
14	2.55			3.2	3.3	3.5	1.3	1.0	1.3	1.45	1.1	1.0
15	2.5			3.0	3.3	3.4	1.3	1.0	1.25	1.4	1.1	1.1
16	2.6			2.8	3.35	3.35	1.3	1.1	1.2	1.35	1.2	1.15
17	2.7			2.35	3.15	3.35	1.3	1.1	1.2	1.3	1.2	1.25
18	2.75			2.3	3.15	3.25	1.3	1.1	1.25	1.3	1.2	1.4
19	2.9			2.05	3.0	3.15	1.4	1.1	1.2	1.25	1.4	1.3
20			4.50	2.1	3.05	3.2	1.4	1.0	1.3	1.2	1.45	1.3
21			4.6	2.0	2.85	3.15	1.4	1.0	1.3	1.2	1.5	1.2
22			5.0	1.9	2.75	2.95	1.3	1.0	1.4	1.15	1.55	1.15
23			5.0	2.05	2.65	2.75	1.3	1.1	1.4	1.15	1.5	1.1
24			5.1	2.25	2.7	2.65	1.3	1.1	1.5	1.1	1.4	1.1
25			5.0	2.35	2.25	2.5	1.35	1.3	1.5	1.1	1.4	1.05
26			4.9	2.15	2.65	2.15	1.35	1.3	1.4	1.1	1.2	1.2
27			5.0	2.15	2.6	2.1	1.4	1.3	1.5	1.15	1.2	1.2
28			5.0	2.35	2.85	2.55	1.4	1.0	1.5	1.15	1.2	1.15
29			5.2	2.45	3.0	2.8	1.35	1.0	1.6	1.2	1.3	1.1
30			5.1	2.4	3.0	2.9	1.3	1.0	1.6	1.2	1.3	1.1
31			5.05		2.95		1.3	.95		1.15		1.1
1908.												
1	1.0			2.55	3.0	2.45	1.45	1.1	0.95	1.2	0.91	1.85
2	1.0			2.6	2.9	2.45	1.45	1.1	.9	1.05	.9	1.87
3	1.0			2.85	2.8	2.35	1.35	1.1	.9	1.2	.9	1.9
4	1.0			3.0	2.6	2.35	1.45	1.0	.9	1.1	.95	2.0
5	1.1			2.75	2.4	2.4	1.45	1.0	1.0	1.0	.95	1.95
6	1.1			2.75	2.25	2.5	1.35	1.0	1.0	1.0	1.0	1.7
7	1.1			3.15	2.25	2.6	1.35	1.0	1.0	1.05	1.0	1.5
8	1.1			3.3	2.75	2.65	1.35	1.1	.95	1.05	1.0	1.4
9	1.1			3.35	3.05	2.55	1.45	1.2	.9	1.0	1.0	1.4
10	1.15			3.55	3.0	2.55	1.45	1.2	.9	1.0	1.0	1.4
11	1.25			3.95	2.75	2.35	1.35	1.2	.9	1.0	1.0	1.2
12	1.45			3.75	2.75	2.25	1.45	1.1	.9	1.1	.95	1.1
13	1.5			3.55	2.75	2.1	1.45	1.2	.9	1.1	.95	1.1
14	1.3			3.5	2.85	2.05	1.45	1.4	.9	1.1	.95	1.1
15	1.25			3.5	2.6	2.1	1.45	1.6	.9	1.05	.95	1.0
16	1.2		1.1	3.5	2.5	2.15	1.35	1.15	.9	1.0	1.05	1.1
17	1.2		1.1	3.45	2.5	2.0	1.35	1.4	1.0	1.0	1.2	1.2
18	1.3		1.2	3.3	2.5	1.9	1.65	1.3	1.0	1.0	1.1	1.2
19	1.4		1.1	3.15	2.4	1.85	1.55	1.2	.9	.9	1.05	1.05
20	1.25		1.1	2.95	2.4	1.75	1.7	1.1	.9	.9	1.05	1.05
21	1.2		1.1	2.8	2.4	1.55	1.6	1.0	.9	.9	1.05	1.2
22	1.1		1.2	2.7	2.3	1.75	1.5	1.0	.8	.9	1.0	1.1
23	1.1		1.2	2.65	2.2	1.7	1.45	1.0	.8	1.0	1.1	1.15
24	1.1		1.4	2.5	2.1	1.6	1.45	1.0	.8	1.1	1.2	1.15
25	1.15		1.4	2.6	2.1	1.5	1.4	1.0	.9	1.35	1.3	1.2
26	1.25		1.5	2.85	2.05	1.5	1.3	1.0	.9	1.2	1.5	1.2
27	1.15		1.5	3.1	2.0	1.5	1.2	1.0	.9	1.1	1.65	1.1
28			1.65	3.4	1.9	1.4	1.2	1.0	.9	1.0	1.6	1.5
29			1.85	3.45	1.9	1.5	1.15	.9	1.0	.9	1.4	1.3
30			2.1	3.25	2.0	1.45	1.15	.9	1.3	.95	1.55	1.0
31			2.4		2.45		1.2	.9		.95		1.0

NOTE.—Ice conditions prevailed from about January 20 to March 20, 1907, and from about January 28 to March 15, 1908.

Rating table for Au Sable River at Bamfield, Mich., for 1902-1908.

Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	1,050	1.90	1,570	2.90	2,260	3.90	3,050
1.00	1,100	2.00	1,630	3.00	2,340	4.00	3,130
1.10	1,140	2.10	1,700	3.10	2,410	4.20	3,300
1.20	1,200	2.20	1,760	3.20	2,490	4.40	3,480
1.30	1,240	2.30	1,830	3.30	2,570	4.60	3,650
1.40	1,300	2.40	1,900	3.40	2,650	4.80	3,840
1.50	1,340	2.50	1,960	3.50	2,730	5.00	4,020
1.60	1,400	2.60	2,040	3.60	2,810	5.20	4,220
1.70	1,460	2.70	2,110	3.70	2,890		
1.80	1,520	2.80	2,190	3.80	2,970		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on discharge measurements made in 1902-1908, and is well defined below gage height 3.5 feet.

Monthly discharge of Au Sable River at Bamfield, Mich., for 1907 and 1908.

[Drainage area, 1,420 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
January 1-19	2,260	1,960	2,090	1.47	1.04	B.
March 20-31	4,220	3,560	3,980	2.80	1.25	B.
April	3,930	1,570	2,550	1.80	2.01	A.
May	2,690	1,800	2,280	1.61	1.86	A.
June	2,970	1,700	2,450	1.73	1.93	A.
July	1,960	1,140	1,370	.965	1.11	A.
August	1,240	1,070	1,140	.803	.93	A.
September	1,400	1,050	1,210	.852	.95	A.
October	1,520	1,140	1,260	.887	1.02	A.
November	1,370	1,100	1,200	.845	.94	A.
December	1,300	1,100	1,170	.824	.95	A.
1908.						
January 1-27	1,340	1,100	1,180	.831	.83	B.
March 16-31	1,900	1,140	1,320	.930	.55	A.
April	3,090	1,960	2,440	1.72	1.92	A.
May	2,370	1,570	1,950	1.37	1.58	A.
June	2,080	1,300	1,660	1.17	1.30	A.
July	1,460	1,170	1,300	.915	1.05	A.
August	1,400	1,050	1,150	.810	.93	A.
September	1,240	1,000	1,060	746	.83	A.
October	1,270	1,050	1,120	789	.91	A.
November	1,430	1,050	1,150	.810	.90	A.
December	1,630	1,100	1,260	.887	1.02	A.

RIFLE RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage of Rifle River lies in the northeastern part of Michigan, its headwaters draining the southeastern slopes of the plateau region. The river rises in the northern part of Ogemaw County, flows southward to the vicinity of Sterling, in Arenac County, and thence southeastward, joining Lake Huron in Saginaw Bay. Its length, not following the bends in the river, is about 45 miles. It has but one important tributary—the West Branch.

The drainage basin is comparatively long and narrow, being less than 20 miles across at its widest point, and is heavily overlain with glacial deposits—sand, overwash gravel, and till. A considerable portion of the area is composed of so-called "jack pine" lands, which are covered with a light growth of scrub pine. The basin contains numerous small glacial lakes, but there is no controlled storage. The lower portion of the basin is flat, with shallow sand ridges; the upper part is composed of sand and gravel plains with undrained hollows; the central portion is rolling and hilly, with a section along the river similar to that of the upper part. The sources of the river are about 1,000 feet above sea level; at the mouth the elevation is 581 feet.

Much of the timber has been cut off from this basin and extensive fires have occurred. A considerable area is being cultivated, but some section of the stream are still wild and undeveloped and are still covered with trees.

The mean annual rainfall is about 30 to 35 inches. The winters are severe, the snowfall is heavy and ice forms from 1 to 2 feet in thickness.

Storage possibilities have not been investigated, but it is thought that some of the lakes near the sources of the river might be utilized.

The stream offers good opportunities for water-power developments. In some sections the river flows for miles between high clay bluffs, and at one place in Ogemaw County sandstone ledges appear in the river bottom for over a mile. The Flint Land Company, of Flint, Mich., control most of the power sites along the river.

The river is still used to some extent for logging. As much of the soil of the area is composed of sand and gravel, the rainfall is quickly absorbed, and where the river has cut its bed down to rock numerous springs occur. These springs keep the river from freezing during the winter months, and also help maintain the flow during dry periods.

The following gaging stations have been maintained in this river basin:

Rifle River at Sterling, Mich., 1905–1908.
Rifle River at Omer, Mich., 1902–3.

RIFLE RIVER NEAR STERLING, MICH.

This station is located in sec. 5, T. 19 N., R. 5 E., at the highway bridge known as Meeker's bridge, near Sterling, Mich. It was established November 14, 1905, to obtain data for use in studying water-power problems, and was discontinued December 31, 1908.

The winter conditions are somewhat severe, the fall of snow is considerable, and ice at times modifies the relations between discharge and gage heights.

The datum of the gage has remained unchanged and the records have been accurately kept. The stream bed at the measuring section is composed of sand and shifts considerably, especially during floods. Sufficient discharge measurements have not been made to determine the discharge curve or to establish definitely the changes in the section. The gage heights should therefore be used with caution, if at all.

The salary of the gage reader at this station has been paid by the Flint Land Company, of Flint, Mich.

The following discharge measurement was made April 22, 1907: Width, 48 feet; area, 165 square feet; gage height, 1.21 feet; discharge, 412 second-feet.

Daily gage height, in feet, of Rifle River near Sterling, Mich., for 1907 and 1908.

[Observer, Myron Meeker.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	5.52	3.05	2.62	2.98	3.80	1.40	0.81	0.02	0.08	0.46	0.12	0.39
2	4.50	3.08	3.30	2.65	3.72	1.20	.77	.15	-.01	.30	.32	.30
3	4.12	3.00	3.20	2.45	3.15	1.08	.70	.15	-.02	.22	.65	.25
4	4.05	3.21	3.05	2.30	2.70	1.15	.69	.08	.05	.20	.45	.28
5	3.77	3.36	3.12	2.22	2.35	1.56	.60	.10	.18	.12	.50	.95
6	3.66	3.02	3.02	2.12	2.22	1.45	.50	.15	.10	.15	.75	1.65
7	3.50	3.15	2.92	2.00	2.00	1.28	.37	.08	.10	.14	.55	1.45
8	3.68	3.18	2.88	2.25	1.82	1.10	.34	-.02	.08	.18	.45	1.40
9	3.45	3.16	2.88	2.70	1.62	.90	.24	-.01	.02	.18	.40	1.35
10	2.91	3.08	2.88	2.58	1.50	.74	.18	-.05	.00	.18	.35	1.80
11	2.92	2.99	2.88	2.35	1.42	.76	.25	-.09	.12	.12	.20	2.45
12	3.00	2.92	3.25	2.25	1.28	1.00	.29	-.09	.41	.12	.15	2.00
13	2.76	3.04	3.55	2.26	1.24	.96	.21	-.10	.35	.08	.12	2.30
14	2.90	3.10	3.82	2.15	1.19	.77	.15	-.12	.10	.08	.15	2.60
15	2.70	2.98	3.50	1.85	1.28	.66	.19	-.10	.05	.12	.22	2.20
16	2.45	3.00	4.40	1.75	1.35	.64	.30	-.02	.00	.10	.15	2.48
17	2.60	2.95	6.68	1.69	1.32	.43	.20	.18	.12	.10	.15	2.25
18	2.68	2.85	6.30	1.60	1.25	.42	.15	.10	.08	.08	.08	1.80
19	2.98	2.90	5.80	1.45	1.19	.60	.10	.00	.20	.06	.08	1.82
20	7.25	2.90	6.00	1.35	1.00	.55	.45	.18	.40	.02	.20	1.82
21	7.00	2.78	5.91	1.32	.92	.50	.32	.12	.26	.00	.84	1.75
22	4.85	2.66	5.68	1.25	.82	1.00	.22	.00	.10	.02	1.25	1.72
23	4.15	2.65	6.45	1.32	.88	2.50	.15	.00	.10	.02	.95	1.52
24	3.62	2.72	6.35	1.28	.82	2.50	.18	-.06	.15	.04	.65	1.35
25	3.60	2.64	5.30	1.72	.82	2.10	.15	-.10	.20	.02	.45	1.38
26	3.46	2.66	5.15	2.00	1.25	2.50	.32	-.08	.12	.02	.50	1.42
27	3.45	2.70	5.08	1.88	2.25	2.01	.22	-.05	.10	.15	.52	1.50
28	3.40	2.60	4.50	1.75	2.50	1.50	.05	.00	.10	.15	.50	1.38
29	3.25	......	4.62	2.55	2.20	1.12	.09	-.02	.65	.15	.38	1.22
30	3.16	......	4.72	3.85	1.88	.95	.00	-.05	1.05	.10	.48	1.50
31	3.20	......	3.90	......	1.41	......	.05	-.08	......	.08	......	1.25
1908.												
1	1.25	1.24	1.94	3.60	1.55	.34	......	......	......	......	......	.10
2	1.22	1.34	1.88	3.15	1.25	.20	......	......	......	......	......	.00
3	1.12	1.32	1.91	2.55	1.20	.10	......	......	......	......	......	.25
4	1.02	1.42	1.88	2.70	1.00	.02	......	......	......	......	......	.05
5	1.00	1.52	1.88	2.30	.80	.00	......	......	......	......	......	.42
6	.96	1.58	2.12	2.35	.65	.00	......	......	......	......	......	.95
7	.95	1.65	2.43	2.68	1.02	.05	......	......	......	......	......	1.95
8	.92	1.66	2.64	3.12	2.08	.14	......	......	......	......	......	2.45
9	.85	1.61	2.40	3.22	2.35	.00	......	......	......	......	......	2.20
10	.84	1.62	2.35	3.05	1.95	......	......	......	......	......	......	1.90
11	1.12	1.66	2.25	2.98	1.50	......	......	......	......	......	......	1.88
12	1.25	1.82	2.50	2.50	2.50	......	......	......	......	......	......	1.75
13	1.00	1.98	2.96	2.18	2.40	......	......	......	......	......	......	1.60
14	1.11	2.19	3.27	2.08	3.20	......	......	......	......	......	......	1.68
15	1.26	2.19	3.40	1.90	2.95	......	......	......	......	......	......	1.85
16	1.24	2.16	3.07	1.72	2.43	......	......	......	......	......	......	1.30
17	1.12	2.06	2.92	1.33	1.90	......	......	......	......	......	......	1.38
18	1.17	2.02	2.84	1.29	1.55	......	.10	......	......	......	......	1.30
19	1.29	1.95	2.60	1.19	1.41	......	.12	......	......	......	......	1.22
20	1.29	1.85	2.34	1.08	1.12	......	.02	......	......	......	......	1.10
21	1.28	1.91	2.40	1.02	.90	......	......	......	......	......	......	1.05
22	1.32	1.85	2.60	.97	.75	......	......	......	......	......	......	.80
23	1.26	1.88	3.80	.78	.62	......	......	......	......	......	......	.45
24	1.12	1.80	5.35	.82	.48	......	......	......	......	......	......	1.05
25	1.08	1.83	4.89	.75	.25	......	......	......	......	......	......	.85
26	1.35	1.92	4.40	.85	.30	......	......	......	......	......	.05	.82
27	1.05	1.85	4.81	1.05	.45	......	......	......	......	......	.05	.78
28	1.30	1.90	4.62	2.31	.15	......	......	......	......	......	......	.30
29	1.32	1.85	4.28	2.25	.20	......	......	......	......	......	......	.70
30	1.18	......	3.50	1.95	.13	......	......	......	......	......	.25	.85
31	1.16	......	3.75	......	.35	......	......	......	......	......	......	.45

NOTE.—Ice conditions probably prevailed from about January 1 to March 24 and December 5-31, 1907, and from about January 1 to March 28, and December 6 to 31, 1908. Water below gage and no readings taken for all missing days.

SAGINAW RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of Saginaw River lies in the north-central part of Michigan, surrounding Saginaw Bay. The Saginaw is formed by three rivers: Tittabawassee River, which is the most northern; Shiawassee River, which extends to the south; and Cass River, which drains the eastern part of the basin. Tittabawassee River rises in the southwestern part of Ogemaw County, flows southward to the central part of Midland County near Midland, then southeastward, and joins Saginaw River a few miles above the city of Saginaw; it receives the waters of Tobacco, Salt, and Pine rivers, and Chippewa River, which discharges to the Pine. Shiawassee River rises in the central part of Livingston County and flows northward into Saginaw River. This river is really the main stream of the drainage basin, as it is a direct continuation of Saginaw River. Its principal tributaries are Bad and Flint rivers. Cass River, the smallest of the three tributaries that form the Saginaw, is formed by the union of the North and South branches. Considering the South Branch as the main stream, the river rises in the western part of Sanilac County, flows northward until it crosses into Tuscola County, then southwestward into the Saginaw about opposite the mouth of the Tittabawassee. It has no important tributaries of any size.

Saginaw River proper is only 20 miles long; the Tittabawassee and the Shiawassee are about 80 miles in length; and the Cass is about 75 miles long. None of these measurements takes into account the short bends and angles. The total drainage area of Saginaw River comprises about 6,260 square miles; of this area about 2,620 square miles belong to the Tittabawassee; about 2,420 square miles to the Shiawassee; and about 994 square miles to the Cass.

This drainage basin, like most of the river basins in Michigan, is covered with glacial drift, and presents a flat surface varied only by the valleys which the larger streams have cut from 10 to 30 feet below the plain. The depth of the surface deposits is not anywhere uniform, varying from a thin film to a layer 500 feet thick, but being in most places about 80 to 100 feet in thickness. To the southeast the drift coating is very thin, the maximum being about 40 feet, but toward the west it becomes thicker.

The sources of the Tittabawassee lie about 900 feet above sea level; at Midland the elevation is about 600 feet; Saginaw Bay is about 581 feet above sea level. The elevation of the sources of the Shiawassee is about 920 feet; at Coruna the elevation is about 740 feet. The sources of the Cass are at an elevation of about 800 feet; at Vassar the elevation is about 610 feet. The slope of the Saginaw River is so small that fluctuations in the elevation of Saginaw Bay caused by strong winds sometimes reverse the current in the river.

This section of Michigan has been about cleared of its timber, and the entire area is largely under cultivation, but some lumbering is still being done on the Tittabawassee.

The mean annual rainfall is from 25 to 30 inches. The winter conditions are comparatively severe in the northern half of the basin; the snowfall is heavy, and ice of considerable thickness forms on the streams; in the southern half of the basin the winters are somewhat milder. The climate and temperature of the entire lower peninsula of Michigan is much modified by the bodies of water that surround it.

Storage possibilities have not yet been investigated. The land in the drainage basins of the Shiawassee and Cass and in the lower part of the Tittabawassee is becoming of such value for agricultural purposes and swamp areas are being reclaimed to such an extent that there is little opportunity for storage on these two streams. The map, however, shows several lakes at the sources of the Shiawassee and Tittabawassee that may be utilized as reservoirs for conserving the flow of these two streams.

The Shiawassee and Tittabawassee and their tributaries afford some opportunities for water-power development; but the flow of the Cass is so small in dry seasons that such opportunities are lacking.

The following gaging stations have been maintained in this drainage basin:

Flint River at Flint, Mich., 1903–4.
Cass River at Frankenmuth, Mich., 1908.
Cass River at Bridgeport, Mich., 1908.
Tittabawassee River at Freeland, Mich., 1903–1908.

CASS RIVER AT FRANKENMUTH, MICH.

This station, which is located at the highway bridge at Frankenmuth, Mich., was established February 18, 1908, to obtain data for studying water-supply and pollution problems.

Perrys Creek enters from the south about 5 miles above the section.

The low-water flow is controlled by a power plant above the station. The discharge is affected by ice during the winter periods.

Nearly all the discharge measurements at this station were made by employees of the city engineer of Saginaw, Mich. It is believed that the measurements are reliable and accurate. The gage heights are referred to the city datum of Saginaw, Mich.

Discharge measurements of Cass River at Frankenmuth, Mich., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 28	G. A. Gray	244	2,590	19.45	7,710
June 20	G. A. Lowry	115	330	5.50	103
July 18	.....do	111	437	6.30	206
September 22	.....do	112	267	4.60	37
October 23 [a]	A. H. Horton	9.5	2.4	3.88	3.3
October 27	Wm. M. O'Neill	114	318	5.01	70

[a] Float measurement.

Daily gage height, in feet, of Cass River at Frankenmuth, Mich., for 1908.

[Observer, Conrad Schriener.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			12.28	16.48	7.10	6.80	5.30	5.20		4.60	4.06	5.00
2			12.18	15.88	7.00	6.70	5.30	5.00		4.40	3.86	4.96
3			11.68	15.08	6.80	6.50	5.20	4.80		4.40	4.92	5.30
4			11.48	14.18	6.80	6.40	5.30	5.00		4.50	5.06	5.45
5			11.73	13.98	6.50	6.00	5.30	5.10		4.60	4.85	5.15
6			11.88	12.38	6.40	5.60	5.40	5.20		4.70	4.56	4.20
7			13.88	12.48	6.60	5.50	5.30	5.30		4.60	4.65	4.45
8			15.03	12.78	12.60	5.50	5.20	5.30		4.20	4.05	5.40
9			13.83	14.58	14.00	5.80	5.00	5.40		4.60	4.55	5.45
10			14.58	14.18	13.90	6.10	4.90	5.40		4.60	4.76	6.35
11			15.58	12.68	12.40	5.80	4.90	5.50		4.00	5.00	6.30
12			16.88	11.98	10.70	5.70	4.80	5.20		4.70	4.85	4.85
13			18.08	10.18	10.90	5.70	4.90	5.10		4.70	4.96	4.45
14			19.38	9.28	13.00	6.10	4.90	5.20	3.85	4.60	4.65	5.25
15			19.58	8.68	17.98	5.90	4.90	5.10	4.15	4.70	4.15	4.65
16			20.98	8.60	17.48	5.80	4.90	5.00	4.85	4.60	5.25	5.20
17			19.88	8.20	16.58	5.70	5.00	5.10	4.60	4.20	5.15	5.35
18		12.88	19.18	8.10	14.48	5.60	5.80	5.30	4.60	3.90	4.95	5.50
19		12.88	18.45	8.70	11.18	5.60	7.00	5.40	4.40	4.60	4.85	5.40
20		12.88	17.48	8.60	9.58	5.50	7.00	5.50	4.40	4.20	4.80	4.35
21		12.88	15.68	8.40	9.20	5.40	6.50	5.50	4.50	4.40	5.00	5.15
22		12.88	15.58	8.20	8.80	5.40	5.90	5.30	4.60	4.50	4.15	5.40
23		12.73	16.18	7.50	8.10	5.50	5.80	5.20	4.60	3.90	4.26	5.40
24		12.58	17.38	7.10	7.60	5.50	5.70	5.40	4.50	4.80	4.80	5.05
25		12.43	18.28	6.70	7.00	5.50	5.60	5.60	4.50	4.00	4.96	4.55
26		12.48	17.18	7.20	6.40	5.40	5.40	5.40	4.60	4.90	4.56	4.60
27		12.48	16.38	7.30	6.20	5.40	5.50	5.10	3.90	5.10	5.05	4.20
28		12.48	19.18	7.40	6.50	5.40	5.40	5.00	3.80	4.92	5.16	5.20
29		12.48	20.08	7.30	6.50	5.40	5.30		4.50	4.65	4.65	5.25
30			19.38	7.20	6.60	5.40	5.30		4.60	4.50	5.00	5.05
31			17.68		6.70		5.20			4.80		5.45

NOTE.—No gage from August 29 to September 13. Discharge probably not materially affected by ice conditions except about February 18 to March 7, when the effect of ice conditions increased the apparent discharge several hundred per cent.

Rating table for Cass River at Frankenmuth, Mich., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.80	2	5.30	90	6.80	285	9.60	932
3.90	4	5.40	99	6.90	302	9.80	995
4.00	6	5.50	108	7.00	320	10.00	1,060
4.10	9	5.60	118	7.20	356	11.00	1,420
4.20	14	5.70	129	7.40	394	12.00	1,850
4.30	19	5.80	141	7.60	434	13.00	2,350
4.40	25	5.90	153	7.80	476	14.00	2,910
4.50	31	6.00	165	8.00	520	15.00	3,570
4.60	37	6.10	178	8.20	566	16.00	4,320
4.70	44	6.20	192	8.40	614	17.00	5,190
4.80	51	6.30	206	8.60	663	18.00	6,150
4.90	58	6.40	221	8.80	713	19.00	7,220
5.00	65	6.50	236	9.00	765	20.00	8,360
5.10	73	6.60	252	9.20	818	21.00	9,550
5.20	81	6.70	268	9.40	873		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on 12 discharge measurements made during 1908-9 and is fairly well defined.

Monthly discharge of Cass River at Frankenmuth, Mich., for 1908.

[Drainage area, 863 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
March 8-31	9,530	2,810	5,910	6.85	6.11	B.
April	4,720	268	1,500	1.74	1.94	B.
May	6,130	192	1,400	1.62	1.87	B.
June	285	99	140	.162	.18	A.
July	320	51	109	.126	.15	A.
August	118	51	81.9	.095	.11	A.
September	81	2	40.1	.046	.05	B.
October	73	4	33.4	.039	.04	B.
November	86	3	47.2	.055	.06	A.
December	214	14	78.8	.091	.10	B.

NOTE.—Discharge assumed unaffected by ice and open channel rating applied March 8 to December 31. Discharge August 29 to September 13 estimated on the basis of gage-height comparisons with Cass River at Bridgeport.

CASS RIVER AT BRIDGEPORT, MICH.

This station is located at the highway bridge at Bridgeport, Mich., a short distance above the Pere Marquette Railroad crossing. It was established January 31, 1908, to obtain data for studying water-supply problems, and was discontinued October 1, 1908.

Winters are comparatively severe at this point and ice forms to considerable thickness, modifying the relation between discharge and gage heights.

The datum of the gage has remained unchanged; the records may be affected by backwater from Saginaw River.

The Bridgeport station was replaced February 18, 1908, by the Frankenmuth station, which is farther up the river, and less liable to be affected by backwater.

Discharge measurements of Cass River at Bridgeport, Mich., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 27	G. A. Gray	312	2,760	7.65	4,520
March 28[a]	do	763	3,440	9.05	8,530

[a] Water running over road measured.

Daily gage height, in feet, of Cass River at Bridgeport, Mich., for 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		0.5	3.8	8.0	1.6	1.8	−0.7	−0.2	−0.9
2		.6	3.8	8.0	1.4	1.6	− .5	− .4	− .4
3		.4	3.6	7.7	1.2	1.4	− .2	− .8	− .4
4		.1	3.0	6.6	1.0	1.0	− .2	− .75	−1.4
5		.1	2.5	6.4	1.0	.6	− .45	− .6	−1.1
6		.2	3.0	6.3	.8	.4	− .6	− .7	− .9
7		.2	5.0	6.1	1.9	− .2	− .3	− .2	− .4
8		.2	6.8	6.6	5.0	− .1	− .4	.0	−1.1
9		.2	7.3	6.8	6.2	− .1	− .6	− .1	−1.4
10		.2	7.3	6.8	6.5	.0	− .6	− .7	− .7
11		.3	7.4	6.6	6.0	.1	− .7	− .8	− .6
12		.5	7.8	5.8	5.2	.0	− .5	− .8	− .6
13		.9	8.3	5.4	4.7	− .1	− .4	− .7	− .7
14		3.0	8.8	4.8	5.0	− .1	− .45	− .6	− .7
15		4.0	10.0	4.4	7.6	.4	− .4	− .2	− .7
16		4.0	10.9	4.0	8.3	− .1	− .5	.0	−1.0
17		3.6	10.8	3.4	8.0	− .2	− .3	− .5	−1.0
18		3.6	10.0	2.8	7.6	.0	− .1	− .4	− .9
19		3.4	9.7	3.0	7.0	− .2	.5	− .4	− .7
20		3.4	9.0	2.7	6.6	− .3	.6	− .4	− .9
21		3.3	8.6	2.5	6.0	− .2	.2	− .6	−1.2
22		3.3	8.0	2.0	5.4	− .4	.1	− .5	−1.4
23		3.3	8.1	1.6	4.7	− .6	.0	− .3	−1.3
24		3.9	8.0	1.2	3.8	− .6	− .05	− .2	− .9
25		4.0	8.8	1.0	3.2	− .3	− .1	.0	−1.3
26		4.0	8.0	1.6	2.8	− .7	− .25	− .1	−1.3
27		4.0	7.8	1.6	1.7	− .9	− .4	− .5	−1.4
28		3.9	8.8	1.8	1.3	− .9	− .5	− .7	−1.5
29		3.8	10.0	1.7	1.0	− .8	− .55	− .9	−1.9
30			9.5	1.6	1.0	− .6	− .5	−1.0	−1.5
31			8.9		1.6		− .2	−1.0	

NOTE.—Ice conditions probably prevailed from about February 1 to March 13.

TITTABAWASSEE RIVER AT FREELAND, MICH.

This station, which is located at the highway bridge at Freeland, Mich., was established August 22, 1903, to obtain data for studying water-power, water-supply, and pollution problems. It was discontinued August 3, 1906, and was reestablished October 28, 1906.

The drainage area above the station is about 2,550 square miles.

Ice forms at the measuring section, and special studies are necessary to determine the flow during the frozen period.

The records are reliable and accurate. The datum of the gage has remained unchanged. The gage reader at this station was paid by Gardner S. Williams during 1907 and part of 1908.

Discharge measurements of Tittabawassee River at Freeland, Mich., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 18	A. H. Horton	233	1,580	4.51	3,000
1908.					
October 24	O'Neill and Chapman	216	886	1.63	606
October 28	Wm. M. O'Neill	216	919	1.78	679

Daily gage height, in feet, of Tittabawassee River at Freeland, Mich., for 1907 and 1908.

[Observer, W. E. Denison.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	9.2	6.2	5.65	11.3	8.5	4.0	2.15	1.65	1.4	2.0	2.2	2.1
2	9.0	6.0	5.6	11.0	10.1	3.7	2.2	1.65	1.4	2.0	2.25	2.15
3	8.85	5.9	5.5	10.25	9.0	3.6	2.15	1.6	1.45	1.95	2.3	2.2
4	8.4	5.85	5.45	9.1	8.1	3.45	2.1	1.6	1.45	1.95	2.3	2.3
5	7.65	5.8	5.4	7.65	7.4	3.3	2.0	1.55	1.5	1.95	2.2	2.3
6	7.1	5.7	5.35	6.5	6.0	3.15	2.0	1.55	1.55	1.9	2.15	2.25
7	7.0	5.65	5.35	5.3	5.75	3.05	1.95	1.55	1.6	1.9	2.1	2.25
8	8.2	5.6	5.3	5.3	5.4	3.0	1.9	1.6	1.65	1.85	2.15	2.2
9	8.0	5.55	5.3	5.25	5.15	2.95	1.9	1.6	1.66	1.85	2.0	2.2
10	7.7	5.5	5.3	5.2	4.7	2.8	1.85	1.6	1.7	1.8	2.0	2.25
11	6.2	5.5	6.0	5.15	4.35	2.6	1.85	1.65	1.75	1.8	2.1	2.25
12	5.0	5.45	7.25	5.1	4.0	2.6	1.8	1.65	1.75	1.8	2.25	2.3
13	5.0	5.4	8.1	5.0	4.0	2.6	1.8	1.6	1.8	1.8	2.35	2.3
14	5.0	5.4	9.35	5.0	3.9	2.6	1.8	1.55	1.8	1.85	2.5	2.35
15	5.1	5.35	10.2	4.9	3.85	2.6	1.8	1.5	1.85	1.85	2.6	2.4
16	5.1	5.35	11.1	4.75	3.8	2.5	1.75	1.4	1.85	1.9	2.7	2.55
17	5.15	5.3	11.3	4.65	3.75	2.5	1.7	1.35	1.85	1.95	2.8	2.65
18	5.1	5.3	11.0	4.5	3.7	2.35	1.7	1.35	1.9	1.95	2.9	2.7
19	5.1	5.3	10.8	4.15	3.7	2.3	1.65	1.35	2.0	2.0	3.0	2.85
20	9.7	5.4	10.5	3.9	3.65	2.3	1.6	1.4	2.0	2.0	3.0	3.0
21	12.7	5.45	10.25	3.6	3.6	2.2	1.6	1.4	1.95	2.0	2.9	3.1
22	14.7	5.5	10.0	3.5	3.5	2.25	1.65	1.35	1.9	1.95	2.75	3.0
23	13.6	5.7	10.2	3.5	3.45	2.7	1.65	1.35	1.9	1.9	2.6	3.0
24	12.1	5.9	10.5	3.55	3.4	3.3	1.7	1.3	1.9	1.9	2.45	3.1
25	10.0	5.9	10.7	3.65	3.3	3.6	1.7	1.3	1.95	1.85	2.35	3.2
26	8.5	5.85	10.9	3.8	3.3	3.6	1.7	1.35	1.95	1.9	2.3	3.3
27	7.7	5.8	10.95	4.0	3.35	3.35	1.75	1.35	1.95	1.9	2.25	3.45
28	7.55	5.7	11.2	4.1	3.5	3.0	1.75	1.36	2.0	1.95	2.2	3.55
29	7.0	......	11.5	4.6	3.7	2.7	1.7	1.4	2.0	2.0	2.2	3.7
30	6.8	......	11.45	5.35	3.95	2.1	1.7	1.4	2.0	2.0	2.15	3.8
31	6.55	......	11.3	......	4.2	......	1.7	1.4	......	2.1	......	3.9
1908.												
1	3.55	3.05	4.3	10.5	6.0	5.15	1.7	1.4	1.4	1.6	1.78	2.0
2	3.5	3.0	4.55	10.0	5.8	4.8	1.7	1.4	1.4	1.65	1.70	2.1
3	3.5	3.0	4.7	9.35	5.65	4.55	1.8	1.35	1.4	1.65	1.65	2.15
4	3.45	3.1	4.8	9.0	5.4	4.0	1.8	1.4	1.4	1.6	1.61	2.2
5	3.45	3.1	4.95	8.6	5.15	3.55	1.8	1.4	1.4	1.6	1.60	2.2
6	3.45	3.0	5.0	8.4	5.0	3.15	1.9	1.4	1.3	1.55	1.60	2.25
7	3.5	3.0	5.2	8.65	5.85	2.55	1.9	1.35	1.3	1.55	1.61	2.35
8	3.55	3.0	5.3	9.1	6.25	2.45	1.9	1.3	1.25	1.55	1.63	......
9	3.5	3.0	6.7	9.85	6.9	2.4	1.8	1.3	1.3	1.5	1.65	......
10	3.45	3.1	8.0	10.2	6.65	2.35	1.8	1.3	1.3	1.5	1.63	......
11	3.45	3.25	9.3	9.0	7.0	2.3	1.7	1.4	1.3	1.5	1.62	......
12	3.4	3.4	10.5	8.2	7.55	2.3	1.7	1.4	1.3	1.55	1.63	......
13	3.4	3.55	11.0	8.0	9.2	2.25	1.6	1.5	1.35	1.55	1.64	......
14	3.35	3.7	12.6	7.75	10.9	2.2	1.6	1.5	1.35	1.6	1.63	......
15	3.35	3.8	14.5	7.5	11.0	2.1	1.5	1.5	1.35	1.55	1.63	......
16	3.35	3.9	14.1	7.28	11.0	2.05	1.5	1.6	1.3	1.55	1.62	......
17	3.3	4.0	13.7	7.0	10.1	2.0	1.7	1.6	1.4	1.5	1.63	......
18	3.3	4.1	12.95	6.2	9.0	2.0	2.1	1.6	1.4	1.5	1.65	......
19	3.35	4.15	11.9	5.45	7.75	1.95	2.4	1.6	1.4	1.55	1.65	......
20	3.35	4.2	10.75	4.75	6.55	1.95	2.4	1.6	1.4	1.55	1.64	......
21	3.3	4.2	9.5	4.0	5.5	1.9	2.4	1.6	1.4	1.6	1.65	......
22	3.3	4.2	9.2	3.65	4.8	1.9	2.4	1.6	1.4	1.55	1.65	......
23	3.3	4.25	10.2	3.7	4.45	1.85	2.2	1.6	1.4	1.55	1.63	......
24	3.25	4.3	10.4	3.95	4.1	1.8	2.0	1.6	1.5	1.6	1.63	......
25	3.2	4.3	10.1	4.3	3.8	1.8	1.9	1.5	1.5	1.6	1.64	......
26	3.2	4.25	10.0	4.75	3.65	1.75	1.8	1.5	1.4	1.65	1.64	......
27	3.15	4.25	10.5	5.0	4.55	1.7	1.7	1.4	1.4	1.65	1.65	......
28	3.15	4.3	10.9	5.6	5.6	1.65	1.5	1.4	1.5	1.85	1.60	......
29	3.1	4.3	11.2	5.8	5.45	1.6	1.5	1.4	1.5	1.85	1.69	......
30	3.1	......	11.0	6.0	5.2	1.65	1.5	1.4	1.5	1.83	2.00	......
31	3.05	......	10.75	......	5.0	......	1.4	1.4	......	1.8	......	......

NOTE.—Ice conditions probably prevailed until about the middle of March and from about December 14 to 31, 1907, and prevailed from about January 1 to March 23 and December 4 to 31, 1908.

LAKE ERIE DRAINAGE BASIN.

GENERAL FEATURES.

The drainage basin of Lake Erie within the United States covers the northern third of Ohio, a small corner of northeastern Indiana, and a similar area in southeastern Michigan. South of the lake the drainage area is narrow, the divide lying in places scarcely 50 miles back from the lake shore. To the west the width of the area is greater, and the Maumee, which enters the lake near Toledo, is the largest stream of northern Ohio. The average altitude of the watershed above Lake Erie is 500 feet, but the head of the Maumee at Fort Wayne, Ind., is only 170 feet above the lake. The surface is level or gently rolling.

The principal streams are Huron and Raisin rivers, which enter the lake from the Michigan corner, and Maumee, Black, and Cuyahoga rivers, which enter from Ohio. Of these, the Maumee, formed by the junction of St. Marys and St. Joseph rivers at Fort Wayne, Ind., is the most important.

HURON RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of Huron River lies in the southeastern part of Michigan. The river rises in several small lakes near Pontiac, in Oakland County, flows southwestward until it enters Washtenaw County, and then turns to the southeast and joins Lake Erie near the mouth of Detroit River. Its length, not following the bends of the river, is about 80 miles; and its total drainage area comprises about 1,060 square miles. The only important tributary is Mill Creek, which enters on the right bank at Dexter, Mich.

The drainage basin is irregularly shaped, having its greatest length, about 50 miles, parallel to and lying at a distance of 25 to 30 miles from Detroit River. This basin is connected with Lake Erie by a long narrow valley averaging not more than 5 miles in width, extending from a point near Ypsilanti southeastward to Lake Erie, a distance of 28 miles. In this portion of its course a large part of the total fall of the river occurs.

The northern part of the catchment area is rolling and its topography is complex. The stream flows through a series of lakes, and north of Dover the entire basin is largely composed of lakes and surrounding marshes. In the vicinity of Ann Arbor the topography is very rolling. Below Ypsilanti the drainage basin is flat.

The sources of the river have an elevation of about 900 feet above sea; at Portage Lake, where the river turns and flows southeastward, the elevation is 850 feet; at Ypsilanti the elevation is 690 feet; at the mouth of the river the elevation is 573 feet.

There are no forested areas in this section. The mean annual rainfall is about 35 inches. The winters are comparatively mild, the snowfall is not heavy, and ice does not form very thick.

Storage possibilities have not been investigated, but as lakes and swamps abound there must be excellent sites for reservoirs.

The conditions for water power on this stream are nearly ideal, as nearly the entire catchment area is situated above the portion of the river that is most suited for the location of dams, and the numerous lakes and swamps afford a natural storage and produce a steady flow. There are a few developed sites below Ann Arbor, and there are opportunities for others in this stretch of the river.

The following gaging stations have been maintained in this drainage basin:

Huron River at Dover, Mich., 1904.
Huron River at Dexter, Mich., 1904-1908.
Huron River at Geddes, Mich., 1904-1908.
Huron River at French Landing, Mich., 1904-5.
Huron River at Flat Rock, Mich., 1904-1908.

HURON RIVER AT DEXTER, MICH.

This station, which is located at the highway bridge at Dexter, Mich., was established September 1, 1904, to obtain data for use in studying water-power, water-supply, and pollution problems.

Mill Creek enters a short distance above the station.

On March 12, 1908, the staff gage which was in use until that time was carried out by the ice; a chain gage was installed March 26, 1908, at the same datum as the staff gage. As the current is swift at the section, little ice forms and the gage heights are only slightly affected thereby.

The datum of the gage has remained unchanged.

The high water that carried away the gage produced a permanent change in the bed of the river and altered the relation between the gage heights and discharge which existed prior to March 12, 1908.

A small headrace runs to an abandoned mill on the left bank, but at ordinary and low stages there is little or no flow in this canal; at high stages a small amount of water may pass around the gage through this raceway.

The service of the gage reader at this station is paid by the Washtenaw Light and Power Company, Ann Arbor.

The discharge measurements taken at this station plot very erratically, and any estimates of discharges attempted on the basis of the records which follow should be used with great caution.

Discharge measurements of Huron River at Dexter, Mich., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 16	A. H. Horton	175	285	1.51	939
1908.					
October 17	O'Neill and Chapman	88	142	-.19	138

Daily gage height, in feet, of Huron River at Dexter, Mich., for 1907 and 1908.

[Observer, Elisha White.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	2.20	2.28	1.12	2.00	2.10	1.35	0.75	0.75	0.38	1.38	0.95	1.00
2	2.20	2.05	1.40	2.00	2.08	1.40	.70	.75	.50	1.30	1.10	1.00
3	2.30	2.00	1.40	2.00	2.00	1.38	.65	.75	.50	1.30	1.20	.98
4	2.80	2.00	1.38	1.92	2.00	1.35	.65	.75	.55	1.30	1.15	.95
5	2.70	2.00	1.30	1.82	1.98	1.35	.65	.72	.60	1.25	1.15	.92
6	2.58	2.00	1.25	1.78	1.90	1.32	.65	.70	.60	1.25	1.10	.90
7	2.65	2.00	1.20	1.68	1.88	1.30	.60	.70	.60	1.25	1.10	.90
8	3.30	1.92	1.20	1.58	1.78	1.25	.60	.70	.60	1.22	1.08	.90
9	3.30	1.85	1.20	1.50	1.70	1.20	.60	.68	.62	1.18	1.02	.90
10	3.00	1.75	1.20	1.50	1.62	1.20	.60	.65	.65	1.08	1.00	1.05
11	2.78	1.55	1.15	1.50	1.52	1.20	.70	.60	.65	1.05	1.00	1.10
12	2.68	1.35	1.50	1.55	1.48	1.20	1.00	.58	.62	1.00	.98	1.10
13	2.60	1.18	1.80	1.60	1.38	1.20	.98	.55	.62	1.00	.95	1.08
14	2.52	1.15	1.80	1.60	1.30	1.20	.90	.52	.60	.95	.95	1.05
15	2.35	1.15	1.80	1.52	1.25	1.20	.90	.50	.60	.90	.95	1.02
16	2.18	1.10	1.90	1.50	1.40	1.15	1.00	.50	.60	.90	.95	1.00
17	2.12	1.10	2.00	1.48	1.35	1.10	.92	.50	.60	.90	.95	1.00
18	2.10	1.10	2.00	1.45	1.35	1.05	.85	.50	.95	.90	.95	1.00
19	2.50	1.12	2.00	1.40	1.35	1.02	.80	.50	1.00	.85	.95	1.00
20	3.30	1.20	2.00	1.35	1.30	1.00	.80	.45	1.00	.85	.95	1.00
21	3.10	1.20	2.00	1.30	1.25	1.00	.80	.40	1.00	1.00	1.12	.95
22	2.90	1.20	2.00	1.25	1.20	.95	.80	.40	.95	1.00	1.20	.95
23	2.80	1.20	2.00	1.20	1.30	.90	.80	.40	.90	.95	1.18	1.00
24	2.70	1.20	2.00	1.20	1.30	.90	.80	.35	.85	.92	1.15	1.05
25	2.68	1.18	2.00	1.20	1.30	.90	1.00	.28	.80	.90	1.15	1.05
26	2.60	1.12	2.00	1.12	1.40	.90	1.10	.25	.82	.90	1.10	1.05
27	2.58	1.10	2.05	1.10	1.50	.82	1.05	.25	.80	.90	1.10	1.35
28	2.48	1.10	2.35	1.10	1.50	.80	.90	.25	.95	1.00	1.05	2.00
29	2.40	....	2.40	1.10	1.50	.80	.85	.25	1.50	.98	1.05	2.15
30	2.35	....	2.35	1.65	1.45	.78	.80	.25	1.48	.95	1.00	2.60
31	2.35	....	2.28	....	1.40	....	.75	.25	....	.95	....	2.60
1908.												
1	2.60	1.42	1.30	2.65	.45	.98	.00	— .25	.00	— .30	— .15	.10
2	2.58	1.52	1.18	2.52	.40	.90	— .05	— .30	.00	— .30	— .15	.10
3	2.55	1.65	1.15	2.40	.40	.82	— .10	— .30	.00	— .30	— .15	.05
4	2.50	1.70	1.10	2.25	.38	.80	— .10	— .10	.00	— 30	— .15	.05
5	2.38	1.80	1.00	2.15	.30	.80	— .10	.00	— .10	— .30	— .20	.00
6	2.28	2.00	2.38	2.12	.30	.75	— .10	.00	— .10	— .30	— .20	.00
7	2.20	2.00	5.00	2.00	.55	.68	— .10	— .05	— .15	— .30	— .20	.00
8	2.10	1.95	4.60	2.08	.90	.58	— .15	— .08	— .18	— .20	— .20	.00
9	1.95	1.88	4.10	2.02	.88	.48	— .15	— .18	— .18	— .20	— .20	.00
10	1.75	1.80	3.60	1.95	.80	.38	— .15	— .20	— .18	— .20	— .22	.00
11	1.68	1.72	3.80	1.75	.80	.28	— .15	— .20	— .20	— .15	— .25	— .05
12	1.62	1.60	4.00	1.58	.75	.20	— .15	— .05	— .20	— .10	— .25	— .05
13	1.60	1.80	....	1.48	.75	.15	— .15	.00	— .20	— .12	— .25	— .05
14	1.52	3.20	....	1.38	1.30	.12	— .15	.00	— .20	— .15	— .25	— .05
15	1.38	4.90	....	1.30	1.55	.10	— .18	.00	— .20	— .15	— .25	— .05
16	1.30	4.55	....	1.28	1.60	.10	— .20	.00	— .20	— .15	— .25	— .05
17	1.28	4.40	....	1.18	1.48	.05	— .20	.00	— .20	— .20	— .25	.05
18	1.20	4.35	....	1.10	1.40	.05	— .10	.00	— .20	— .25	— .25	.10
19	1.20	4.25	....	1.08	1.60	.02	— .10	.00	— .20	— .25	— .25	.10
20	1.20	4.15	....	.98	1.88	.00	— .18	.00	— .20	— .30	— .25	.10
21	1.25	4.00	....	.88	1.75	.15	— .20	.00	— .20	— .30	— .25	.10
22	1.68	3.70	....	.78	1.50	.15	— .20	.00	— .22	— .30	— .25	.10
23	1.50	3.25	2.72	.72	1.25	.15	— .20	.00	— .25	— .30	— .22	.10
24	1.45	2.95	2.72	.68	1.08	.10	— .20	.00	— .25	— .05	— .10	.10
25	1.28	2.60	2.67	.65	.95	.02	— .20	.00	— .25	.00	.00	.05
26	1.20	2.30	2.46	.62	.82	— .10	— .20	.00	— .25	— .02	.00	.00
27	1.20	2.15	2.32	.58	.70	— .15	— .25	.00	— .25	— .08	.00	.00
28	1.28	1.85	2.70	.52	.68	— .15	— .25	.00	— .28	— .10	.00	.00
29	1.50	1.70	3.00	.60	.60	— .10	— .25	.00	— .30	— .10	— .02	.00
30	1.50	....	2.95	.52	1.10	.00	— .25	.00	— .30	— .10	.00	.05
31	1.48	....	2.78	....	1.10	....	— .25	.00	....	— .10	....	.10

NOTE.—Gage out March 13 to 22, 1908.

HURON RIVER AT GEDDES, MICH.

This station is located at the power plant of the Washtenaw Light and Power Company at Geddes, Mich. It was established February 1, 1904, to obtain data for studying water-power, water-supply, and pollution problems.

Fleming Creek is tributary from the north about one-half mile below the station. The flow of the river at this point is determined by computing the flow through the turbines by knowing the gate opening, rating of the wheels, and the number of hours the turbines are run; the flow over the crest of the dam is determined by considering the dam as a weir, the proper coefficient to be applied being assumed.

The records at this station are furnished by the Washtenaw Light and Power Company, of Ann Arbor, Mich. The computations of the discharge are furnished by Gardner S. Williams.

Daily discharge, in second-feet, of Huron River at Geddes, Mich., for 1906, 1907, and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.												
1	441	699	449	a 623	416	372	a 56	225	97	151	250	321
2	310	544	428	618	454	352	170	197	a 86	90	265	a 256
3	372	507	749	713	454	a 291	184	182	89	97	318	270
4	374	a 538	a 670	571	400	289	132	198	98	112	a 230	263
5	468	384	619	599	410	227	166	a 200	93	102	190	276
6	372	482	602	578	a 376	236	152	164	92	155	221	700
7	a 298	431	550	574	368	223	132	190	95	a 133	211	718
8	350	418	551	a 526	342	316	a 82	192	93	134	204	658
9	321	407	559	614	363	593	143	176	a 57	115	194	a 618
10	356	412	552	709	374	a 642	178	198	100	124	205	516
11	399	a 339	a 504	709	364	523	155	214	95	135	a 186	514
12	381	364	498	667	362	538	163	a 143	75	137	199	524
13	363	357	483	641	a 325	478	134	172	95	131	170	559
14	a 206	402	496	837	677	368	155	129	81	a 102	184	537
15	428	294	457	a 862	891	376	a 73	140	98	117	183	598
16	579	349	434	856	760	399	132	135	a 40	147	147	a 537
17	457	340	413	739	584	a 365	130	133	100	127	220	460
18	491	a 319	a 397	698	469	347	134	149	80	93	a 211	422
19	464	297	407	653	444	328	122	a 104	68	112	230	404
20	770	353	414	687	a 407	324	120	145	66	120	292	420
21	a 1,330	382	227	608	400	266	136	128	84	a 105	418	444
22	1,500	410	419	a 626	359	215	a 95	134	93	117	405	402
23	1,320	394	352	530	328	220	135	196	a 44	107	478	a 208
24	1,320	404	328	550	385	a 200	145	160	58	119	442	322
25	1,210	a 521	a 300	494	375	246	163	159	51	139	a 343	298
26	1,120	574	502	508	366	224	144	a 117	98	135	389	272
27	1,100	536	759	490	a 387	142	92	115	94	188	378	330
28	a 1,180	471	810	459	626	170	111	118	74	a 196	374	285
29	1,060	....	734	a 439	652	222	a 176	116	122	241	304	296
30	962	....	654	417	514	168	364	98	a 88	240	335	a 320
31	952	....	659	....	448	....	313	97	....	288	....	1,120
1907.												
1	1,140	558	305	1,240	1,370	611	285	209	a 59	541	266	a 289
2	813	652	738	1,160	1,340	a 571	252	236	124	451	356	288
3	1,000	a 507	a 634	1,150	1,130	575	205	224	143	407	a 520	294
4	1,470	570	651	1,110	1,150	534	157	a 207	148	448	346	264
5	1,070	507	581	1,020	a 1,110	545	194	210	152	473	386	256

a Sunday.

Daily discharge, in second-feet, of Huron River at Geddes, Mich., for 1906, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
6	[a]1,040	377	498	961	1,100	536	221	171	173	[a]468	394	248
7	1,050	347	518	[a]967	1,140	515	[a]89	204	174	415	444	254
8	1,540	333	472	925	1,070	500	220	150	[a]142	374	402	[a]230
9	1,570	365	461	952	1,010	[a]506	140	158	211	362	386	327
10	1,200	[a]343	[a]488	921	915	420	126	129	181	336	[a]407	408
11	1,160	285	520	863	870	482	211	[a]152	181	355	368	402
12	1,060	281	771	893	[a]862	475	310	139	156	290	329	348
13	[a]950	276	1,010	890	814	456	331	154	151	[a]365	329	357
14	936	346	912	[a]873	542	433	[a]216	157	130	256	340	348
15	931	329	852	858	588	461	294	139	[a]136	253	326	[a]333
16	737	383	810	883	628	[a]425	327	128	155	246	302	322
17	738	[a]400	[a]802	828	532	381	273	125	148	257	[a]258	316
18	696	405	808	826	620	382	191	[a]150	300	254	267	336
19	1,170	429	760	782	[a]642	358	250	105	286	248	280	323
20	[a]1,970	505	782	762	501	360	236	123	285	[a]278	287	301
21	1,140	369	716	[a]721	503	342	[a]232	136	269	306	400	352
22	964	348	705	695	454	325	262	111	[a]358	253	428	[a]335
23	733	342	719	635	587	[a]279	222	107	245	256	414	321
24	628	[a]302	[a]760	623	580	270	236	78	209	257	[a]340	379
25	623	332	756	583	530	289	272	[a]57	228	242	418	378
26	613	321	725	614	[a]579	322	358	56	254	270	406	385
27	[a]777	299	755	754	907	280	422	44	223	[a]199	413	518
28	681	295	970	[a]532	739	232	[a]186	98	285	328	354	1,300
29	740	....	1,030	585	730	258	241	75	[a]544	289	345	[a]1,140
30	649	....	927	1,160	691	[a]487	245	82	588	268	345	1,340
31	579	....	[a]870	....	683	....	224	150	....	259	....	1,300
1908.												
1	2,010	282	[a]629	1,280	566	574	138	93	254	78	[a]77	298
2	1,200	[a]386	716	1,200	400	519	135	[a]36	190	94	182	300
3	1,070	366	577	1,320	[a]408	490	146	113	232	84	179	270
4	1,040	268	559	1,370	345	431	99	109	178	[a]104	162	378
5	[a]1,030	300	619	[a]1,200	390	454	[a]127	392	146	98	176	263
6	784	258	1,860	1,230	349	427	71	258	[a]92	94	167	[a]144
7	843	273	3,400	1,160	412	[a]441	85	222	101	80	149	317
8	783	329	[a]2,940	1,180	508	324	76	182	169	129	[a]125	187
9	661	[a]339	2,700	1,150	558	370	84	[a]120	208	96	158	210
10	641	295	2,630	1,120	[a]558	403	79	102	204	111	144	180
11	586	271	3,030	1,100	423	212	140	110	206	[a]123	154	261
12	[a]840	257	3,160	[a]958	409	209	[a]65	156	151	236	146	183
13	725	1,080	3,360	896	514	204	82	424	[a]119	120	135	[a]161
14	534	1,940	3,250	834	840	[a]277	91	364	167	140	138	225
15	569	2,830	[a]3,100	847	962	266	140	313	148	144	[a]136	207
16	600	[a]2,150	3,180	859	986	103	90	[a]316	120	156	150	205
17	420	2,060	2,970	788	[a]941	192	124	445	142	147	141	220
18	521	1,720	2,730	721	826	179	137	493	101	[a]146	130	229
19	[a]479	1,590	2,390	[a]798	846	288	[a]82	409	122	123	136	334
20	453	1,400	2,330	695	946	136	134	397	[a]91	135	80	[a]239
21	496	1,280	2,030	690	1,090	[a]298	92	394	122	121	158	314
22	651	1,270	[a]2,040	635	842	309	79	438	117	119	[a]198	210
23	605	[a]1,250	1,590	609	689	95	84	[a]225	108	140	186	187
24	520	1,140	1,720	534	[a]691	165	75	317	107	200	89	204
25	494	1,140	1,380	540	638	60	99	317	118	[a]204	165	226
26	[a]478	1,000	1,250	[a]508	481	59	[a]102	317	138	198	123	310
27	411	960	1,220	566	489	113	83	250	[a]144	192	211	[a]178
28	459	793	1,770	524	484	[a]101	60	190	114	176	206	225
29	356	755	[a]1,740	498	425	140	93	265	111	192	[a]141	205
30	313	....	1,620	498	695	146	38	[a]250	76	170	244	239
31	292	....	1,470	....	[a]735	....	46	315	....	216	....	233

[a] Sunday.

Monthly discharge of Huron River at Geddes, Mich., for 1906, 1907, and 1908.

[Drainage area, 757 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1906.					
January	1,500	206	686	0.906	1.04
February	699	294	426	.563	.59
March	810	227	515	.680	.78
April	862	417	620	.819	.91
May	891	325	454	.600	.69
June	642	142	322	.425	.47
July	364	56	148	.196	.23
August	225	97	156	.206	.24
September	122	40	83.6	.110	.12
October	288	90	139	.184	.21
November	478	147	272	.359	.40
December	1,120	208	447	.590	.68
The year	1,500	40	356	.470	6.36
1907.					
January	1,970	579	980	1.29	1.49
February	652	276	386	.510	.53
March	1,030	305	720	.951	1.10
April	1,240	532	859	1.13	1.26
May	1,370	454	804	1.06	1.22
June	611	232	410	.542	.60
July	422	88.8	240	.317	.37
August	236	44	138	.182	.21
September	588	58.8	221	.292	.33
October	541	199	316	.417	.48
November	520	258	362	.478	.53
December	1,340	230	452	.597	.69
The year	1,970	44	491	.647	8.81
1908.					
January	2,010	292	673	.889	1.02
February	2,830	257	965	1.27	1.37
March	3,400	559	2,060	2.72	3.14
April	1,370	498	877	1.16	1.29
May	1,090	345	627	.828	.95
June	574	59	266	.351	.39
July	146	38	96	.127	.15
August	493	36	269	.355	.41
September	254	76	143	.189	.21
October	236	78	141	.186	.21
November	244	77	153	.202	.23
December	378	144	237	.313	.36
The year	3,400	36	542	.716	9.73

HURON RIVER AT FLAT ROCK, MICH.

This station, which is located at the highway bridge at Flat Rock, Mich., about one-half mile below the crossing of the Detroit, Toledo and Ironton Railroad, was established August 6, 1904, to obtain data for use in studying water-power, water-supply, and pollution problems.

No important tributaries enter near the gaging station.

The ordinary flow of the stream is controlled by a dam and power plant immediately above the station, but as the river is very steady the dam produces very little artificial control. The nearness of the mill to the section prevents the formation of ice in winter at the gaging section, but jams frequently form below the station, causing backwater.

The datum of the gage has remained unchanged. The records are reliable and accurate.

The services of the gage reader at this station are paid by the Washtenaw Light and Power Company, Ann Arbor, Mich.

Discharge measurements of Huron River at Flat Rock, Mich., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 16	A. H. Horton	100	412	3.53	906
April 17	do	100	401	3.54	884
1908.					
October 16	O'Neill and Chapman	95	116	.58	152

Daily gage height, in feet, of Huron River at Flat Rock, Mich., for 1907 and 1908

[Observer, C. L. Metler.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
1	6.75	6.2	3.35	4.95	4.3	3.10	1.45	1.65	.7	3.05	1.9	2.1
2	7.1	6.2	4.05	4.7	5.5	3.20	1.65	1.5	.65	2.8	2.0	1.95
3	6.65	5.7	4.9	4.55	5.2	3.15	1.7	1.55	.7	2.5	2.1	2.1
4	6.45	5.05	5.15	4.4	4.7	3.1	1.4	1.45	.85	2.4	2.6	2.15
5	6.6	4.75	4.8	4.4	4.35	3.1	1.2	1.6	....	2.45	2.55	2.25
6	6.0	4.65	4.6	4.35	4.4	3.05	1.35	1.8	.80	2.35	2.45	2.0
7	5.55	4.3	4.4	4.05	4.3	2.95	1.35	1.55	.90	2.25	2.35	2.0
8	5.95	4.25	4.45	4.0	4.35	2.85	.95	1.45	1.05	2.4	2.25	1.85
9	6.6	4.15	4.2	4.0	4.15	2.7	1.25	1.4	1.05	2.3	2.2	1.6
10	6.65	4.0	4.0	3.95	3.95	2.6	1.25	1.2	1.25	2.15	1.95	2.0
11	5.7	3.9	4.1	3.8	3.65	2.65	1.25	1.2	1.3	2.15	2.1	2.4
12	5.85	3.8	4.75	3.7	3.45	2.95	1.25	1.15	1.3	2.0	2.25	2.4
13	5.15	3.7	6.1	3.65	3.3	3.55	1.85	1.15	1.5	1.95	2.15	1.75
14	4.8	3.75	6.75	3.55	3.15	3.7	2.0	1.05	1.25	2.05	2.25	1.65
15	4.95	3.85	6.45	3.6	3.05	3.3	1.75	1.1	1.15	2.05	2.1	2.0
16	4.85	3.9	6.0	3.55	3.05	2.65	2.15	1.0	1.0	2.0	2.0	2.25
17	4.2	4.0	5.2	3.55	3.05	2.45	2.05	.95	1.4	1.8	1.8	2.3
18	4.45	4.1	4.95	3.55	3.1	2.35	2.0	.95	1.4	1.7	1.8	2.25
19	5.1	4.3	4.75	3.4	3.15	2.15	1.6	.95	1.8	1.75	2.05	2.25
20	6.25	4.45	4.75	3.25	3.05	2.15	1.65	1.0	1.85	1.75	1.9	1.85
21	7.25	4.4	4.8	3.05	3.0	2.1	1.6	1.05	1.85	1.95	2.15	1.2
22	6.4	4.05	4.75	2.6	2.85	2.1	1.45	.85	1.75	2.0	2.6	2.1
23	8.0	3.8	4.65	3.65	2.8	2.0	1.7	.85	1.65	1.85	2.75	2.15
24	7.5	3.8	4.65	3.05	2.8	1.95	1.45	.85	1.8	1.8	2.6	2.95
25	7.35	3.85	4.8	2.5	2.85	2.1	1.5	.75	1 6	1.8	2.5	2.8
26	6.9	3.9	4.8	2.5	2.95	2.0	1.65	.75	1.5	1.85	2.7	2.75
27	6.8	3.55	4.9	2.45	3.1	1.95	1.9	.6	1.55	1.65	2.5	3.2
28	6.8	3.4	5.3	2.4	2.6	1.9	1.95	.70	1.65	1.75	2.5	5.3
29	6.65	....	5.9	2.4	3.7	1.75	1.8	.85	1.8	2.0	2.25	6.75
30	6.55	....	5.65	2.95	3.55	1.5	1.6	.7	2.5	2.05	2.15	7.55
31	6.4	....	5.3	....	3.2	....	1.7	.55	....	1.95	....	7.3
1908.[a]												
1	6.95	3.85	7.1	6.9	3.05	4.0	1.55	.85	1.35	.85	1.1	1.4
2	6.1	3.4	6.9	6.7	3.0	3.8	1.35	.65	1.35	85	.95	1.55
3	5.4	3.3	6.85	6.65	2.95	3.55	1.35	.8	1.4	.8	1.05	1.4
4	4.9	3.65	6.5	6.35	2.9	3.35	1.25	.45	1.4	.6	1.15	1.95
5	4.6	3.35	6.5	6.05	2.95	3.25	1.2	.6	1.15	.5	1.15	1.45

[a] See note at end of table, next page.

Daily gage height, in feet, of Huron River at Flat Rock, Mich., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
6	4.35	3.3	7.45	6.0	2.75	3.15	1.15	1.25	1.05	.95	1.25	1.45
7	4.85	3.4	....	6.1	2.85	3.05	1.45	1.45	.65	.8	1.2	1.45
8	4.55	3.45	....	6.05	3.25	3.0	1.2	1.05	.4	.8	1.05	1.5
9	4.0	3.35	....	6.0	3.8	2.85	1.15	1.15	.8	.8	1.1	1.65
10	4.2	3.35	....	6.05	3.75	2.6	1.2	.8	.75	.95	1.2	1.7
11	5.4	3.65	....	5.75	3.5	2.5	1.35	1.05	.9	.85	1.25	1.5
12	5.5	3.8	....	5.4	3.35	2.25	.8	1.3	.9	.8	1.15	1.45
13	6.5	4.2	....	5.0	3.4	2.2	.8	1.65	.85	1.1	1.1	1.4
14	7.55	6.2	....	4.85	3.85	2.3	.8	2.0	.6	1.15	1.15	1.1
15	8.05	8.0	....	4.75	4.95	2.15	1.05	1.8	.75	1.05	1.05	1.55
16	7.35	....	....	4.7	5.55	2.1	1.15	1.6	1.05	.95	1.15	1.25
17	6.75	....	....	4.5	5.45	2.05	1.05	1.7	.95	1.0	1.3	1.3
18	6.1	....	....	4.5	5.2	1.85	1.0	2.15	.85	.85	1.15	1.55
19	6.35	....	....	4.5	4.7	1.85	.65	2.2	.35	.85	1.2	1.7
20	6.0	....	....	4.35	4.6	1.75	.5	2.05	.9	.8	1.15	1.45
21	6.25	....	7.85	4.1	5.1	1.95	.95	1.7	.55	.8	1.15	1.3
22	6.3	....	7.6	3.8	5.25	2.25	1.1	1.65	.9	.9	1.1	1.65
23	6.5	....	7.35	3.65	4.85	2.1	1.1	1.65	.85	.8	1.05	1.5
24	4.5	....	7.2	3.5	4.1	1.8	.8	1.45	.85	.95	1.0	1.65
25	4.3	....	6.85	3.4	3.8	1.6	.65	1.55	.65	1.15	1.1	1.5
26	4.9	....	6.6	3.3	3.45	1.4	.5	1.45	.75	1.1	1.1	1.35
27	4.4	....	6.4	3.25	3.4	1.3	.75	1.45	.75	1.7	1.15	1.65
28	4.1	7.65	6.55	3.4	3.25	1.05	.55	1.35	.8	1.3	1.45	1.2
29	3.85	7.45	7.05	3.3	3.15	1.1	.8	1.25	.8	2.0	1.2	1.85
30	4.1	....	7.35	3.25	3.2	1.55	.8	1.25	.75	1.05	1.1	1.6
31	3.5	....	7.25	....	3.85	....	.8	.9	....	1.1	....	1.6

NOTE.—Ice conditions below the gaging section causing backwater at the gage probably prevailed from about January 23 to March 11, 1907, and from about January 11 to February 13 and from about February 20 to March 5, 1908. Water above the gage February 16 to 27 and March 7 to 20, 1908.

Rating table for Huron River at Flat Rock, Mich., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.30	109	1.70	379	3.10	757	5.00	1,380
0.40	124	1.80	403	3.20	787	5.20	1,450
0.50	140	1.90	427	3.30	818	5.40	1,520
0.60	157	2.00	452	3.40	849	5.60	1,590
0.70	174	2.10	477	3.50	880	5.80	1,660
0.80	192	2.20	503	3.60	911	6.00	1,730
0.90	211	2.30	529	3.70	943	6.20	1,800
1.00	230	2.40	556	3.80	975	6.40	1,870
1.10	250	2.50	583	3.90	1,007	6.60	1,940
1.20	270	2.60	611	4.00	1,040	6.80	2,010
1.30	291	2.70	639	4.20	1,106	7.00	2,080
1.40	312	2.80	668	4.40	1,173	8.00	2,480
1.50	334	2.90	697	4.60	1,241		
1.60	356	3.00	727	4.80	1,310		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1906-1908 and the form of the 1906 curve. It is well defined between gage heights 0.5 foot and 4 feet. This curve is probably also better for 1906 in place of the one used in Water-Supply Paper No. 206.

Monthly discharge of Huron River at Flat Rock, Mich., for 1907 and 1908.

[Drainage area, 1,000 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
January	2,180		1,490	1.49	1.72	C.
February			700	.700	.73	D.
March	1,990		1,290	1.29	1.49	C.
April	1,360	556	903	.903	1.01	A.
May	1,560	611	909	.909	1.05	A.
June	943	334	610	.610	.68	A.
July	490	220	357	.357	.41	B.
August	403	148	253	.253	.29	B.
September	583	166	306	.306	.34	B.
October	742	368	475	.475	.55	A.
November	654	403	517	.517	.58	A.
December	2,300	270	689	.689	.79	B.
The year	2,300	148	708	.708	9.64	
1908.						
January	2,060		1,030	1.03	1.19	D.
February			1,490	1.49	1.61	D.
March			2,860	2.86	3.30	C.
April	2,040	802	1,340	1.34	1.50	A.
May	1,570	654	1,000	1.00	1.15	A.
June	1,040	240	550	.550	.61	A.
July	345	140	231	.231	.27	B.
August	503	132	309	.309	.36	B.
September	312	116	207	.207	.23	B.
October	452	140	227	.227	.26	B.
November	323	220	258	.258	.29	B.
December	440	250	336	.336	.39	B.
The year			820	.820	11.16	

NOTE.—Discharge during the periods of ice conditions 1907–8, and during the period when the water was over the gage, were estimated on the basis of comparison with the discharge at Geddes and climatological reports. Discharge January 23 to 31, 1907, 1,020 second-feet; March 1 to 11, 1907, 950 second-feet; January 11 to 31, 1908, 860 second-feet; February 1 to 13, 1908, 600 second-feet; February 16 to 29, 1908, 2,230 second-feet; March 1 to 5, 1908, 1,100 second-feet; March 7 to 20, 1908, 4,100 second-feet.

LAKE ONTARIO DRAINAGE BASIN.

GENERAL FEATURES.

In the northwestern part of the State of New York, between Niagara and St. Lawrence rivers, is an area aggregating 12,400 square miles drained by streams which flow into Lake Ontario. The divide which controls this drainage is very irregular. Extending to the south and southeast from Fort Niagara, it passes around the headwaters of the Genesee a short distance into Pennsylvania; thence reentering New York it runs southward and eastward from the interior group of lakes, turns to the north, encircles the sources of Black River, turns again to the west, and descends to the lake. The country thus included is level or gently undulating in the counties bordering the lake, but farther south it becomes more rolling, and a series of ridges, gradually increasing in height, stretch down between Cayuga and Seneca and their companion lakes, finally becoming merged with the elevated, broken country forming the principal divide, the abrupt slopes of which attain altitudes of from 2,000 to 2,500 feet about the headwaters of the Genesee.

The easterly or Black River lobe of the drainage basin receives the run-off from the southwestern slope of the Adirondack Mountains—largely a rugged and forest-covered area receiving heavy precipitation, especially in the winter.

The principal streams of the area are the Genesee, the Oswego, formed by the union of Seneca and Oneida rivers, which drain the chain of lakes in central New York, Salmon, and Black rivers.

GENESEE RIVER DRAINAGE BASIN.

DESCRIPTION.

Genesee River rises in Potter County, Pa., 8 or 10 miles south of the New York-Pennsylvania boundary, flows northwestward for about 32 miles, then turns to the northeast and empties into Lake Ontario, 7 miles north of Rochester. Its entire length, following bends, is about 135 miles, and its drainage area comprises about 2,450 square miles.

In the northern portion of this basin the topography is rolling, with long easy slopes, except along the streams, most of which flow in deep ravines, hemmed in by steep banks. There is a gradual rise in a general way through the lakes and in the upper half of the basin the country becomes rough and is broken by ridges; the summits of which attain elevations of from 2,000 to 2,500 feet above the tide.

The mean annual precipitation in the Genesee basin is about 34 inches, ranging from 30 inches in the lower part of the basin to 42 inches in the higher altitudes in the southern part. The winters are rather less severe than in the westerly or northerly parts of New York State, although the rivers are generally frozen over for varying periods of time.

The series of remarkable lakes tributary to the Oswego basin is continued westward into the basin of the Genesee and includes Conesus, Hemlock, Canadice, and Honeoye. These lakes form natural reservoirs and have inlets draining considerable areas at their upper ends. The slopes adjacent to the lakes themselves are narrow and steep and are drained by gulleys and torrential brooks. Below the lakes the area is rolling and the soil rich and extensively cultivated. The areas and elevations of these lakes are shown in the following table:

Areas and elevations of lakes in the Genesee River basin.[a]

Lake.	Elevation.	Water-surface area.	Drainage area.
	Feet.	*Sq. miles.*	*Sq. miles.*
Hemlock Lake	896	2.8	46.8
Canadice Lake	1,092	.7	12.6
Honeoye Lake	800	2.5	39.6

[a] These lake basins are shown on the Honeoye, Canandaigua, Naples, and Wayland topographic atlas sheets of the United States Geological Survey, from which the areas have been taken, with the exception of those for Hemlock and Canadice lakes, which are from surveys of Rochester waterworks.

There are other excellent possibilities for storage in the Genesee basin and extensive surveys and studies have been made by the state water supply commission, which has suggested a dam at Portage, furnishing a storage capacity of 11,000,000,000 cubic feet, this to be utilized also for power development affording some 30,000 horsepower. Such a reservoir would do much to control the floods upon the Genesee, which under the present conditions periodically cause much damage.

In the 39 miles between Belmont, in central Allegany County, and Portage the river falls 253 feet. At Portage there is a total fall of about 300 feet, made up in three portions, and thence nearly to Mount Morris the river flows at the bottom of a deep gorge. From Mount Morris to Rochester the valley is broad and open and the stream is bordered by meadows which are subject to overflow. At Rochester there is another abrupt descent in three heavy falls, amounting to about 360 feet within the city, most of which has been developed.

The State has maintained a dam above Rochester for diverting water to the Erie Canal, and in the basin of Black Creek, one of the upper tributaries of the Genesee from the west, are two reservoirs owned by the State, also used for the benefit of the Erie Canal.

Cuba Reservoir, on the Genesee-Allegheny divide, receives a drainage from a tributary area of 26.6 square miles, having a storage volume of 454,000,000 cubic feet. The overflow from this reservoir enters Allegheny River, but the storage water may be turned into the summit of the abandoned Genesee Valley Canal and thence into Genesee River.

In the improved barge canal, now under construction, the water supply for this section is to be taken from Lake Erie and it is probable that no diversion for this purpose will be necessary from the Genesee drainage basin.

The following gaging stations have been maintained in this river basin:

Genesee River at St. Helena, N. Y., 1908.
Genesee River at Mount Morris, N. Y., 1903-1908.
Genesee River at Jones Bridge, Mount Morris, N. Y., 1903-1906, 1908.
Genesee River at Rochester, N. Y., 1904-1908.
Hemlock Lake at Hemlock, N. Y., 1894-1902.
Canadice Lake Outlet at Hemlock, N. Y., 1903-1908.
Honeoye Creek at East Rush, N. Y., 1903-1906.

GENESEE RIVER AT ST. HELENA, N. Y.

This station is located at the steel highway bridge over the Genesee River at St. Helena, about 6 miles by river below Genesee Lower Falls, 4 miles from Castile, and 5½ miles from Portageville. It was established August 14, 1908, primarily to determine the low-water discharge of Genesee River at this point. Conditions for obtaining accurate records of discharge appear to be good, hence the station will be maintained to obtain general statistical and comparative data regarding the run-off conditions in the upper Genesee drainage basin. These data will be of value principally for power development.

The discharge is somewhat affected by ice during the winter period, but it is probable that fairly good records of flow under ice cover can be obtained. The bed of the stream is of coarse gravel with a few rocks, and is fairly permanent, and a fairly good rating curve has been developed. The datum of the chain gage has not been changed since the establishment of the station.

Information in regard to this station is contained in the annual reports of the state water supply commission of New York.

Discharge measurements of Genesee River at St. Helena, N. Y., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 14	Brett and Allen	142	260	2.42	311
September 11	C. R. Adams	120	193	1.90	132
October 19	...do	104	164	1.83	89.2

Daily gage height, in feet, of Genesee River at St. Helena, N. Y., for 1908.

[Observer, Herman Piper.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.00	2.00	1.90	1.95	16	2.45	1.80	1.90	2.02	2.08
2		2.00	2.00	1.85	1.95	17	2.65	1.90	1.92	2.25	2.20
3		2.00	1.90	1.88	1.92	18	3.05	1.80	1.88	2.12	2.15
4		1.90	1.90	1.92	2.02	19	2.75	1.75	1.88	2.08	2.25
5		2.00	1.90	1.82	1.98	20	2.45	1.80	1.82	2.18	2.35
6		2.00	1.90	1.85	2.12	21	2.35	1.75	1.82	2.22	2.28
7		2.00	1.90	1.88	1.90	22	2.35	1.75	1.82	2.15	2.22
8		1.90	1.80	1.90	1.95	23	2.25	1.8	1.82	2.15	2.45
9		1.80	1.85	1.82	2.00	24	2.25	1.8	1.80	2.12	2.35
10		1.65	1.80	1.92	2.15	25	2.15	1.8	1.82	2.15	2.25
11		1.90	1.90	1.65	2.12	26	2.15	1.75	1.80	2.08	2.28
12		1.90	1.85	2.15	2.02	27	2.15	1.7	1.82	2.00	2.30
13		1.80	1.85	2.12	2.05	28	2.15	1.7	1.90	2.02	2.30
14	2.40	1.80	1.85	2.18	1.98	29	2.05	1.9	1.82	2.02	2.28
15	2.55	1.85	1.92	2.02	2.05	30	2.05	1.9	1.90	2.02	2.25
						31	2.00		1.88		2.38

NOTE.—It is probable that ice conditions prevailed from December 4-31.

Rating table for Genesee River at St. Helena, N. Y., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	53	2.00	152	2.40	303	2.80	495
1.70	71	2.10	185	2.50	347	2.90	550
1.80	95	2.20	221	2.60	394	3.00	610
1.90	122	2.30	261	2.70	444		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on three discharge measurements made during 1908 and high-water measurements made during 1909, and is fairly well defined.

Monthly discharge of Genesee River at St. Helena, N. Y., for 1908.

[Drainage area, 1,030 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
August 14-31	640	152	289	0.281	0.19	A.
September	152	62	109	.106	.12	B.
October	152	95	114	.111	.13	B.
November	241	62	160	.155	.17	B.
December			160	.155	.18	C.

NOTE.—Discharge for December estimated on the basis of comparisons with the discharge at High Dam and Jones Bridge.

GENESEE RIVER AT MOUNT MORRIS, N. Y.

This station is located at the dam of the Mount Morris Power Company, Mount Morris, N. Y., and is about 2 miles above Canaseraga Creek. It was established May 22, 1903, to obtain data regarding the flow of the Genesee River. The discharge is divided into two parts—that which runs over the dam and wasteways and that which is used at the mills. The station for obtaining the latter is at the wooden highway bridge crossing the tailrace of the Mount Morris Power Company, about one-eighth mile below the power station.

The dam is of stone masonry, with horizontal crest and ogee cross section, and a clear length of about 255 feet. There are two wasteways, each with a crest 18 feet long and 12 inches wide, closed by stop sills to an elevation of about 2 feet above the main dam; also one wasteway with crest 17 feet long and 6 inches wide, about 3 feet higher in elevation than the main dam. The spillways are separated by masonry piers, aggregating 20 feet in width and reaching an elevation of several feet above the main dam.

Several mills and factories use a portion of the flow, which is diverted through a headrace composed of a section of the old Genesee Valley canal. The amount of this diversion is determined by the station on the tailrace below the mills.

During medium and low water stages the water used by the wheels can be fairly well estimated from the gage readings in the tailrace, but at high water there is backwater effect from Canaseraga Creek, at times affecting gage readings. At such times, however, the quantity used by the wheels is relatively a very small portion of the total flow.

There is some leakage from a wasteway at the head of the canal and seepage through the canal banks which is not included in the estimates of discharge given below. This loss varies from about 6 second-feet at low stages to about 40 second-feet at medium and high stages.

The combined results of discharge over the dam and through the wheels at this gaging station are fairly good at medium and high stages, when considerable water is flowing over the dam, and at very low stages when all the water is used by these wheels. At the ordinary low summer stage results are uncertain owing to the effect of pondage by the dam.

The observer at the dam is John McAstocker; the observer at the tailrace is F. M Goff.

Information regarding this station is contained in the annual reports of the state water supply commission of New York and the state engineer and surveyor, State of New York.

Discharge measurements of tailrace of Mount Morris power plant at Mount Morris, N. Y., in 1905-1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 30	Covert and Weeks	34	106	2.62	245
March 31	do	34	102	2.35	221
Do	do	33	95	2.11	189
August 24	C. C. Covert	36	85	2.08	158
1906.					
April 23	C. C. Covert	34	82.3	2.15	130
September 15	do	36	90.1	2.15	123
1907.					
March 18 [a]	C. C. Covert	34	97.6	2.40	243
1908.					
May 7	D. M. Wood	36	100	2.23	196
July 22	Adams and Brett	30	67	2.04	144
August 12	Brett and Allen	30	74.4	1.91	150
September 10 [b]	C. R. Adams	29	58.1	1.64	121
October 21	do	29	63.6	1.81	130

[a] Measured from downstream side of bridge. The channel below was considerably obstructed by brush causing more or less backwater.
[b] No flow over the dam. Leakage about 2 second-feet. Waste from canal about 4 second-feet.

Daily discharge, in second-feet, of Genesee River at Mount Morris, N. Y., for 1905-1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905. [a]												
1				4,840					274	[b] 187	417	1,500
2				[b] 2,140					274	216	545	1,140
3				2,050					[b] 289	231	572	[b] 2,070
4				1,640					245	245	460	3,320
5				1,970					231	289	[b] 545	1,990
6				2,050					274	274	598	1,660
7				1,880					274	216	1,640	1,430
8				1,480					245	[b] 260	1,120	1,430
9				[b] 1,410					216	216	1,060	1,660
10				1,270					[b] 274	216	872	[b] 1,660
11				1,340					274	202	809	1,220
12				2,050					274	216	[b] 809	955
13				1,720					703	245	783	955
14				1,340					417	375	651	776
15				1,270					417	[b] 417	598	437
16				[b] 1,560					417	318	598	352
17			1,340	1,410					[b] 703	318	598	[b] 437
18			1,590	1,340					545	318	598	395
19			[b] 23,500						460	289	[b] 598	437
20			16,400						375	809	502	544

[a] See note at end of table, next page. [b] Sunday.

Daily discharge, in second-feet, of Genesee River at Mount Morris, N. Y., for 1905–1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
21	......	......	9,850	......	......	......	......	......	332	809	502	671
22	......	......	8,290	......	......	......	......	......	303	a 783	417	6,750
23	......	......	8,450	......	......	......	......	......	274	783	417	3,110
24	......	......	13,100	......	......	......	......	......	a 303	756	375	a2,070
25	......	......	14,400	......	......	......	......	......	245	703	375	1,360
26	......	......	a11,100	......	......	......	......	......	245	677	a 460	1,080
27	......	......	15,200	......	......	......	......	a 245	216	545	502	1,020
28	......	......	9,930	......	......	......	......	216	216	572	417	829
29	......	......	7,460	......	......	......	......	216	216	a 502	2,590	4,010
30	......	......	5,810	......	......	......	......	216	202	481	4,110	4,980
31	......	......	4,420	......	......	......	......	274	......	439	......	a2,070
1906.												
1	1,770	985	324	a3,890	841	814	a 214	259	274	545	1,950	859
2	1,390	806	386	3,020	779	814	306	227	a 289	545	1,790	a1,050
3	1,110	552	579	2,610	3,420	a 722	315	279	274	439	1,960	868
4	1,460	a 467	a1,320	3,100	3,900	656	363	444	245	332	a1,550	552
5	2,640	467	1,740	5,480	1,990	568	489	a 445	274	354	1,390	648
6	1,610	510	836	4,250	a1,610	1,680	419	319	274	625	1,120	2,950
7	a1,050	595	833	3,540	1,250	2,270	326	308	260	a4,110	1,030	8,450
8	806	648	789	a2,490	918	985	a 227	630	231	2,050	877	2,220
9	648	806	693	2,200	832	710	317	577	a 231	1,410	806	a1,640
10	573	859	675	5,530	1,360	a 548	315	465	187	1,840	780	1,800
11	753	a 985	a 530	5,250	1,150	629	306	380	180	1,560	a 877	3,590
12	859	859	640	3,560	1,100	559	288	a 772	180	1,340	909	1,700
13	753	552	550	2,790	a 733	456	247	541	231	1,160	1,100	1,390
14	a 701	552	503	2,140	918	422	263	444	245	a1,030	1,140	1,460
15	806	467	510	a3,310	1,080	422	a 116	328	260	783	1,110	4,640
16	1,050	467	517	3,330	895	392	248	299	a 274	651	1,050	a4,990
17	1,460	467	425	2,500	886	a 433	431	279	216	598	931	2,550
18	922	a 467	a 347	2,080	1,290	692	286	288	216	524	a2,500	1,880
19	1,110	467	372	1,590	1,010	674	277	a 199	180	502	4,280	922
20	1,110	382	306	1,370	a 697	577	306	940	180	1,480	2,550	868
21	a5,460	510	380	1,200	630	486	315	1,840	216	a2,180	7,010	1,130
22	7,070	806	432	a1,090	577	462	a 181	958	303	1,310	4,640	985
23	6,920	806	455	1,220	529	440	274	682	a 460	1,270	2,550	a 713
24	6,070	701	497	1,090	550	a 390	221	895	396	998	1,870	510
25	3,040	a 859	a 432	1,050	1,080	498	207	691	318	2,220	a1,470	552
26	1,850	859	519	926	761	419	234	a 398	274	2,050	1,330	561
27	1,530	648	2,820	823	a 644	364	221	474	245	1,380	1,270	648
28	a1,390	467	10,900	753	2,760	355	377	612	216	a1,060	1,550	868
29	1,110	......	4,290	a 539	1,650	362	a 267	504	216	1,480	1,400	753
30	985	......	5,000	726	1,280	306	265	398	a 303	1,270	1,050	a 665
31	985	......	8,400	......	994	......	279	308	......	1,720	......	1,340
1907.[b]												
1	4,280	922	467	1,930	2,120	735	3,470	313	a 190	542	267	a 745
2	2,270	985	552	1,460	1,950	a1,420	1,940	313	190	415	414	613
3	1,850	a 985	a 552	1,390	1,560	2,660	1,550	313	190	314	a 468	294
4	6,210	859	510	1,170	2,210	1,550	1,120	a 177	190	457	838	443
5	4,520	859	552	1,110	a2,620	1,350	868	246	190	1,600	827	477
6	a2,550	753	552	1,250	1,720	3,070	657	255	190	a 796	710	510
7	3,040	648	467	a1,050	1,490	2,050	a 595	255	190	585	1,470	516
8	9,410	753	467	922	2,300	1,340	570	248	a 190	1,040	3,260	a 607
9	7,800	753	467	985	2,060	a 936	1,060	216	227	2,540	2,200	571
10	3,690	a 859	a 467	1,050	1,640	893	771	209	256	1,100	a1,620	1,360
11	2,640	753	467	1,110	1,420	787	666	a 97	314	743	1,190	4,350
12	2,190	648	467	1,460	a1,270	682	3,160	224	415	743	1,070	2,180
13	a2,190	648	753	1,850	1,200	682	3,070	226	314	a 849	885	1,420
14	1,770	648	1,850	a1,690	1,070	674	a1,280	226	256	638	775	849
15	3,460	753	6,070	1,460	877	674	877	218	a 285	585	719	a 902
16	1,850	753	5,130	1,390	1,080	a 477	657	218	205	585	566	1,220
17	1,110	a 753	a6,780	1,460	1,200	578	570	209	190	457	a 604	1,030
18	1,050	648	6,920	1,390	956	493	519	a 82	190	415	525	914
19	1,530	648	4,890	1,250	a 694	485	476	209	205	415	531	867
20	a7,070	648	5,660	1,110	893	832	476	226	256	a 372	578	565

[a] Sunday. [b] See note at end of table, next page.

NOTE.—March 17-31, 1905, tailrace discharge assumed 220 second-feet; April 1-18, 1905, 150 second-feet; August 27-November 30, 1905, 150 second-feet; December 1-31, 1905, 170 second-feet.

January and February, 1906, tailrace discharge assumed 200 second-feet; September and October, 1906, 150 second-feet. During the remainder of 1906 discharge through the tailrace based on daily gage heights and discharge measurements.

Daily discharge, in second feet, of Genesee River at Mount Morris, N. Y., for 1905–1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
21	4,400	648	3,460	a1,050	885	528	a 349	218	227	372	581	750
22	1,850	552	3,690	859	779	570	362	209	a 227	372	584	a 796
23	1,250	467	7,360	859	779	a1,350	443	218	205	415	587	1,220
24	985	a 552	a4,890	8,270	674	2,050	443	218	190	415	a 590	13,200
25	859	510	3,460	4,760	674	1,720	443	a 82	190	415	508	5,450
26	1,250	467	2,640	6,350	a 993	1,880	371	218	190	343	510	3,310
27	a 985	510	4,760	6,920	1,590	1,190	400	209	190	a 415	485	2,600
28	985	510	7,360	a3,690	2,050	948	a 398	209	190	343	545	10,100
29	985	....	5,010	2,550	2,750	771	371	226	a 190	542	763	a6,820
30	985	....	3,460	2,100	931	a 810	342	209	585	585	780	3,620
31	859	....	2,550	....	815	....	313	209	....	500	....	5,050
1908.												
1	2,520	618	a 829	2,710	1,660	3,110	437	346	177	193	a 111	201
2	1,990	a 522	1,500	3,320	3,550	1,990	437	a 474	193	177	185	185
3	1,660	437	2,900	2,800	a4,980	1,360	352	346	209	193	170	201
4	1,510	522	2,330	1,820	3,320	1,080	1,660	288	193	a 111	185	185
5	a1,080	522	1,990	a1,820	2,520	955	a1,080	288	193	226	201	185
6	723	829	1,990	2,330	1,820	829	618	431	a 153	193	185	a 99
7	829	776	2,520	1,820	2,520	a 723	522	431	193	177	170	201
8	829	723	a2,710	1,580	6,320	723	437	346	209	162	a 111	201
9	829	a 829	1,990	4,490	6,040	618	352	a 516	201	162	185	201
10	678	829	1,990	2,330	a6,890	618	294	431	193	162	185	185
11	678	892	2,160	2,160	3,550	671	352	288	185	a 99	201	201
12	a1,020	829	5,230	a1,660	2,520	522	a 352	266	209	142	201	201
13	3,110	1,220	9,710	1,360	1,820	437	236	344	a 135	148	215	a 99
14	2,160	1,500	12,500	1,220	2,520	a 522	294	308	177	148	185	201
15	1,500	23,000	a14,400	1,140	4,490	6,890	352	330	162	148	a 247	231
16	1,360	a13,600	11,100	2,160	3,780	1,820	294	a 209	193	148	185	233
17	829	5,760	4,730	2,160	a2,900	1,220	294	437	162	135	267	251
18	829	3,110	3,550	1,220	1,990	723	1,020	715	177	a 129	231	267
19	a 829	2,520	4,730	a5,230	1,500	618	a1,990	529	177	177	231	303
20	618	2,330	3,110	4,490	1,500	723	829	425	a 111	193	251	a 317
21	723	1,220	2,160	3,110	2,710	a 723	1,080	323	162	148	325	296
22	955	1,360	a 2,330	2,240	2,160	618	4,370	294	162	155	a 305	284
23	1,660	a 1,220	3,110	1,580	1,660	522	1,500	a 281	162	162	251	201
24	829	1,080	4,250	1,430	a1,080	5,230	955	350	148	162	251	185
25	565	955	4,010	1,360	1,080	1,660	6,320	257	148	a 111	267	94
26	a 618	1,220	3,320	a1,360	955	1,220	a1,990	236	142	155	267	325
27	829	1,080	5,760	1,140	4,490	723	1,080	214	a 99	142	200	a 317
28	723	723	7,770	1,020	2,330	a 829	829	192	177	185	201	325
29	671	723	a 7,770	829	1,360	437	618	215	193	185	a 111	279
30	565	....	4,490	892	3,780	437	522	a 259	193	170	201	296
31	565	....	3,110	....	a3,780	....	480	248	....	185	....	367

a Sunday.

NOTE.—January to April, 1907, tailrace discharge assumed 200 second-feet; September to October, 1907, 190 second-feet. During the remainder of 1907 daily discharge through the tailrace based on daily gage heights and discharge measurements.

January to July, 1908, tailrace discharge assumed 170 second-feet; August 1 to 11, 1908, 164 second-feet. After August 11, 1908, discharge through the tailrace determined from daily gage heights and discharge measurements.

Monthly discharge of Genesee River at Mount Morris, N. Y., for 1905–1908.

[Drainage area, 1,070 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1905.					
March 17–31	23,500	1,340	10,100	9.44	5.27
April 1–18	4,840	1,270	1,820	1.70	1.14
August 27–31	274	216	233	.218	.04
September	703	202	324	.303	.34
October	809	187	416	.389	.45
November	4,110	375	818	.764	.85
December	6,750	352	1,690	1.58	1.82
1906.					
January	7,070	573	1,900	1.78	2.05
February	985	382	643	.601	.63
March	10,900	306	1,520	1.42	1.64
April	5,530	539	2,450	2.29	2.56
May	3,900	529	1,230	1.15	1.33
June	2,270	306	637	.595	.66
July	489	116	287	.268	.31
August	1,840	199	522	.488	.56
September	460	180	255	.238	.27
October	4,110	332	1,250	1.17	1.35
November	7,010	780	1,790	1.67	1.86
December	8,450	510	1,730	1.62	1.87
The year	10,900	116	1,180	1.11	15.09
1907.					
January	9,410	859	2,770	2.59	2.99
February	985	467	696	.650	.68
March	7,360	467	2,990	2.79	3.22
April	8,270	859	2,130	1.99	2.22
May	2,750	674	1,400	1.31	1.51
June	3,070	477	1,140	1.07	1.19
July	3,470	313	922	.862	.99
August	313	82	216	.202	.23
September	585	190	234	.219	.24
October	2,540	314	642	.600	.69
November	3,260	267	848	.793	.88
December	13,200	294	2,370	2.21	2.55
The year	13,200	82	1,360	1.27	17.39
1908.					
January	3,110	565	1,110	1.04	1.20
February	23,000	437	2,450	2.29	2.47
March	14,400	829	4,520	4.22	4.86
April	5,230	829	2,090	1.95	2.18
May	6,890	955	2,950	2.76	3.18
June	6,890	437	1,280	1.20	1.34
July	6,320	236	1,030	.963	1.11
August	715	192	342	.319	.37
September	209	99	173	.162	.18
October	226	99	161	.150	.17
November	325	111	209	.195	.22
December	367	94	230	.215	.25
The year	23,000	94	1,380	1.29	17.53

NOTE.—Discharge 1905-1908 determined by adding the flow over the dam to the flow through the tailrace. Discharge through the waterway near the head of the canal has been disregarded.

Results 1905-1908 are considered to be fairly good for medium and high stages; at low stages estimates may be affected by insufficient gage readings to take account of pondage. At very low stages, where practically all the water flows through the tailrace, estimates are good where based upon gage heights and occasional discharge measurements.

For 1908, where available, the estimates at the Jones Bridge and St. Helena stations are considered to be more reliable than those at this station.

GENESEE RIVER AT JONES BRIDGE, NEAR MOUNT MORRIS, N. Y.

This station is located at the highway bridge across Genesee River, known as Jones Bridge, a short distance below the junction of Canaseraga Creek, and is about 5 miles below Mount Morris. It was established May 22, 1903, discontinued April 30, 1906, and reestablished August 12, 1908. It is maintained to obtain comparative data regarding the discharge of Genesee River and as a check on the discharge records obtained at High Dam, at Mount Morris.

Conditions of flow are subject to change. Both banks are high, but the left bank is flooded during extreme high water. The records are affected by ice during the winter period. The datum of the chain gage has not been changed since its establishment.

Information in regard to this station is contained in the annual reports of the state water supply commission of New York and the state engineer and surveyor, State of New York.

Discharge measurements of Genesee River at Jones Bridge, near Mount Morris, N. Y., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 12	Brett and Allen	84	251	4.68	563
September 10	C. R. Adams	71	184	3.80	232
October 21	do	67	164	3.53	156

Daily gage height, in feet, of Genesee River at Jones Bridge, near Mount Morris, N. Y., for 1908.

[Observer, Elizabeth B. Trewer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.8	3.65	3.1	3.8	16	4.35	3.65	3.55	3.65	3.9
2		3.85	3.65	3.45	3.9	17	4.75	3.4	3.55	3.75	3.9
3		3.6	3.6	3.5	3.75	18	5.6	3.75	3.15	3.85	4.05
4			2.95	3.5	3.5	19	5.15	3.45	3.55	3.85	4.15
5			3.6	3.45	3.55	20	4.75	3.1	3.6	3.95	4.1
6			3.6	3.6	3.3	21	4.55	3.5	3.4	4.15	4.1
7		3.7	3.5	3.55	3.55	22	4.25	3.55	3.45	4.05	4.1
8		3.8	3.45	3.5	3.65	23	4.2	3.55	3.5	3.9	4.75
9		3.6	3.55	3.5	3.7	24	4.3	3.55	3.4	3.9	4.75
10		3.55	3.6	3.65	3.8	25	4.3	3.5	3.3	3.9	4.5
11	4.55	3.6	3.2	3.75	3.6	26	4.1	3.45	3.5	3.85	4.25
12	4.65	3.65	3.65	3.65	3.55	27	4.0	3.05	3.6	3.85	4.05
13	4.6	3.25	3.6	4.0	3.35	28	4.05	3.55	3.5	3.8	4.1
14	4.6	3.7	3.6	4.0	3.6	29	3.95	3.65	3.55	3.6	4.1
15	4.45	3.7	3.5	3.75	3.7	30	3.75	3.7	3.55	3.7	4.0
						31	3.85		3.55		4.2

NOTE.—The discharge was probably more or less affected by ice conditions December 15 to 31.

Rating table for Genesee River at Jones Bridge, near Mount Morris, N. Y., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.90	35	3.60	175	4.30	410	5.00	710
3.00	45	3.70	205	4.40	450	5.10	760
3.10	60	3.80	235	4.50	490	5.20	810
3.20	80	3.90	265	4.60	530	5.30	860
3.30	100	4.00	300	4.70	575	5.40	910
3.40	125	4.10	335	4.80	620	5.50	960
3.50	150	4.20	370	4.90	665	5.60	1,010

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on three discharge measurements made during 1908 and is well defined between gage heights 3.5 feet and 4.7 feet.

Monthly discharge of Genesee River at Jones Bridge, near Mount Morris, N. Y., for 1908.

[Drainage area, 1,410 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
August 11-31	1,010	220	467	0.331	0.26	A.
September	250	52	171	.121	.14	A.
October	190	40	151	.107	.12	A.
November	352	60	216	.153	.17	A.
December			230	.163	.19	B.

NOTE.—Discharge December 15 to 31, estimated, 270 second-feet on the basis of the discharge at High Dam and St. Helena. Discharge September 4-6, interpolated.

GENESEE RIVER AT ROCHESTER, N. Y.

This station is on the Elmwood avenue steel highway bridge in the city of Rochester, N. Y. It was established February 9, 1904, to determine the total flow of Genesee River. The record up to October 4, 1908, was furnished by the city engineer and board of park commissioners of the city of Rochester, N. Y. Discharge measurements were made and rating curve developed by the United States Geological Survey.

The elevation of zero of gage is 506.848 Barge Canal datum, and 245.591 feet Rochester City datum. The gage datum has remained the same since starting of record. The rating curve is fairly well developed for all stages, and open-water estimates are considered fair except for extreme low water. During a portion of the winter estimates are affected by ice.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

Discharge measurements of Genesee River at Rochester, N. Y., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 18	C. C. Covert	383	2,820	6.02	11,100
1908.					
August 11	Brett and Adams	341	1,130	1.30	670

Daily gage height, in feet, of Genesee River at Rochester, N. Y., for 1907 and 1908.

[Observer, W. Moran.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	4.6	3.0	1.8	3.5	3.6	2.0	2.5	1.2	0.9	1.1	1.3	1.9
2	5.0	2.7	2.0	3.1	3.5	1.9	3.6	1.2	.9	1.4	1.2	1.9
3	3.9	4.7	2.9	2.8	3.2	2.0	2.7	1.3	.9	1.3	1.2	1.8
4	4.9	4.8	2.8	2.6	3.0	3.1	2.4	1.2	.9	1.3	1.2	1.7
5	6.7	4.5	2.5	2.5	4.2	2.5	1.9	1.1	.9	1.3	1.7	1.7
6	5.4	4.3	2.1	2.5	4.0	2.3	1.8	1.1	.9	2.3	1.7	1.6
7	4.4	4.1	2.2	2.4	3.2	3.5	1.7	1.1	.9	1.9	1.9	1.6
8	5.1	3.9	2.0	2.3	3.0	2.9	1.5	1.0	.9	1.7	2.5	1.6
9	7.0	3.7	1.8	2.3	3.5	2.3	1.4	1.0	.9	2.3	4.0	1.5
10	6.5	3.5	1.7	2.3	3.1	2.0	1.3	1.0	.9	2.9	3.3	1.5
11	4.8	3.3	1.6	2.4	2.9	1.9	1.2	1.0	1.0	2.2	3.0	2.6
12	3.9	3.1	1.5	2.7	2.7	1.8	1.1	1.0	1.1	1.9	2.6	3.8
13	3.5	3.1	1.8	3.1	2.6	1.7	3.1	1.0	1.1	1.9	2.3	2.9
14	3.3	2.9	3.0	3.3	2.4	1.6	3.0	1.0	1.15	1.8	2.0	2.5
15	3.7	2.7	4.7	3.1	2.1	1.5	2.2	1.0	1.1	1.8	2.0	2.4
16	3.8	2.7	6.8	3.0	2.2	1.5	1.8	.95	1.0	1.7	1.8	2.3
17	2.8	2.6	5.7	2.9	2.4	1.5	1.6	.95	1.0	1.5	1.6	2.5
18	2.7	2.4	6.0	2.8	2.4	1.5	1.5	.9	1.0	1.4	1.6	3.0
19	2.7	2.4	6.0	2.7	2.3	1.5	1.4	.9	1.0	1.3	1.6	2.7
20	4.4	2.3	5.1	2.5	2.1	1.5	1.3	.9	.95	1.2	1.6	2.3
21	4.8	2.4	5.2	2.4	2.2	2.0	1.3	.9	.95	1.2	1.6	2.2
22	4.3	2.4	4.8	2.3	2.0	1.8	1.5	.9	.95	1.2	1.6	2.3
23	3.2	2.5	4.7	2.1	1.9	2.0	1.6	.9	.95	1.3	1.4	2.0
24	2.8	2.4	5.8	2.7	1.9	2.5	2.0	.9	1.0	1.2	1.6	5.5
25	2.6	2.3	5.1	6.55	1.8	2.7	1.6	.95	1.0	1.2	1.6	7.9
26	3.1	1.9	4.3	5.1	1.8	2.7	1.4	.9	1.0	1.2	1.6	7.3
27	3.8	1.8	3.9	6.1	1.8	2.5	1.6	.9	.9	1.2	1.6	5.3
28	3.5	1.8	5.3	5.9	2.6	2.2	1.5	.9	.9	1.1	1.7	5.6
29	3.4	......	6.1	4.5	2.8	2.0	1.3	.9	.9	1.2	1.8	7.2
30	3.1	......	5.2	3.8	2.5	1.9	1.2	.9	1.0	1.3	2.0	7.0
31	3.0	......	4.0	......	2.2	......	1.2	.9	......	1.5	......	5.7
1908.												
1	5.3	2.9	2.4	4.1	2.3	3.6	1.6	1.5	1.2	1.0	......	......
2	5.0	2.6	2.3	3.7	4.0	3.4	1.6	1.4	1.2	1.0	......	......
3	3.4	2.6	2.9	3.7	5.2	2.9	1.5	1.3	1.2	1.0	......	......
4	3.0	2.5	3.7	3.5	5.3	2.4	1.6	1.3	1.2	1.0	......	......
5	2.8	2.5	3.9	3.1	4.6	2.1	1.9	1.3	1.3	......	......	......
6	2.6	2.4	3.4	3.0	3.8	2.0	2.2	1.3	1.2	......	......	......
7	2.6	2.5	4.6	3.1	3.3	1.9	2.0	1.2	1.2	......	......	......
8	2.4	2.6	5.0	3.0	4.6	1.9	1.8	1.4	1.1	......	......	......
9	2.3	2.6	4.5	3.0	6.2	1.8	1.8	1.3	1.1	......	......	......
10	2.1	2.6	4.0	3.7	6.5	1.6	1.5	1.3	1.1	......	......	......
11	2.3	2.6	3.4	3.3	6.5	1.4	1.4	1.3	1.1	......	......	......
12	2.1	2.6	4.7	3.0	5.4	1.4	1.3	1.3	1.1	......	......	......
13	2.4	2.7	5.9	3.0	4.2	1.4	1.3	1.3	1.1	......	......	......
14	3.7	5.6	7.6	2.9	3.6	1.4	1.3	1.3	1.0	......	......	......
15	3.8	5.4	8.2	2.7	4.0	1.6	1.4	1.4	1.0	......	......	......
16	3.0	7.4	8.7	2.4	5.1	6.6	1.4	1.4	1.0	......	......	......
17	3.0	8.5	9.1	2.7	4.7	4.4	1.4	1.4	1.0	......	......	......
18	2.8	8.9	8.6	2.8	4.2	2.9	1.8	1.4	1.0	......	......	......
19	2.9	7.8	7.5	2.6	3.6	2.1	2.4	1.8	1.0	......	......	......
20	3.0	5.3	5.1	4.3	3.1	2.0	2.8	1.8	1.0	......	......	......
21	2.1	4.5	4.5	5.5	3.0	1.9	2.1	1.6	1.0	......	......	......
22	2.3	3.9	3.7	4.5	3.4	1.8	2.5	1.5	1.0	......	......	......
23	2.8	3.4	3.7	3.6	3.0	2.0	4.0	1.4	1.0	......	......	......
24	3.1	2.9	4.1	3.1	3.0	3.6	3.0	1.3	1.0	......	......	......
25	4.1	2.8	4.6	2.9	2.8	2.3	2.3	1.3	1.0	......	......	......
26	3.8	2.5	4.5	2.7	2.5	2.1	3.0	1.2	1.0	......	......	......
27	3.6	2.7	4.1	2.7	2.2	2.0	3.1	1.2	1.0	......	......	......
28	3.3	2.5	5.3	2.5	3.6	1.9	2.7	1.2	1.0	......	......	......
29	3.7	2.8	6.1	2.3	3.2	1.8	2.4	1.2	1.0	......	......	......
30	3.5	......	6.0	2.1	3.5	1.6	2.1	1.2	1.0	......	......	......
31	2.6	......	5.0	......	3.5	......	1.8	1.2	......	......	......	......

NOTE.—The discharge was probably not materially affected by ice conditions during January to March, 1908.

Rating table for Genesee River at Rochester, N. Y., 1903 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	310	2.20	1,960	3.50	4,600	5.40	9,620
1.00	400	2.30	2,140	3.60	4,840	5.60	10,200
1.10	490	2.40	2,320	3.70	5,080	5.80	10,800
1.20	580	2.50	2,500	3.80	5,320	6.00	11,400
1.30	670	2.60	2,700	3.90	5,560	6.20	12,000
1.40	760	2.70	2,900	4.00	5,800	6.40	12,600
1.50	850	2.80	3,100	4.20	6,320	6.60	13,220
1.60	1,000	2.90	3,300	4.40	6,840	6.80	13,860
1.70	1,150	3.00	3,500	4.60	7,380	7.00	14,500
1.80	1,300	3.10	3,720	4.80	7,940	8.00	17,800
1.90	1,450	2.20	3,940	5.00	8,500	9.00	21,400
2.00	1,600	3.30	4,160	5.20	9,060	10.00	25,100
2.10	1,780	3.40	4,380				

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on discharge measurements made during 1904–1908, and is well defined.

Monthly discharge of Genesee River at Rochester, N. Y., for 1907 and 1908.

[Drainage area, 2,360 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
January	15,000	2,700	6,350	2.69	3.10	A.
February	....	....	1,500	.636	.66	C.
March	12,900	....	5,400	2.29	2.64	B.
April	13,100	1,780	4,210	1.78	1.99	B.
May	6,320	1,300	2,870	1.22	1.41	B.
June	4,600	850	1,850	.784	.87	B.
July	4,840	490	1,420	.602	.69	B.
August	670	310	393	.167	.19	C.
September	535	310	368	.156	.17	C.
October	3,300	490	1,020	.432	.50	B.
November	5,800	580	1,540	.653	.73	B.
December	17,500	850	4,930	2.09	2.41	B.
The year	17,500	310	2,650	1.12	15.36	
1908.						
January	9,340	1,780	3,790	1.61	1.86	B.
February	21,000	2,320	5,940	2.52	2.72	A.
March	21,800	2,140	9,080	3.85	4.44	A.
April	9,910	1,780	4,000	1.69	1.89	B.
May	12,900	1,960	6,020	2.55	2.94	A.
June	13,200	760	2,420	1.03	1.15	B.
July	5,800	670	1,780	.754	.87	B.
August	1,300	580	733	.311	.36	B.
September	....	....	280	.119	.13	C.
October	....	....	260	.110	.13	C.
November	....	....	350	.148	.17	C.
December	....	....	380	.161	.19	C.
The year	21,800	....	2,920	1.24	16.85	

NOTE.—Discharge February 1 to March 15, 1907, estimated by the United States Geological Survey by comparison with the discharge at High Dam.

Discharge September to December, 1908, based on a study and intercomparison of the discharge at the three upper stations on this river. These results agree closely with discharge obtained for Genesee River at St. Helena and Jones Bridge. These latter records are considered much more reliable than those at High Dam. The discharge at Rochester as obtained by the rating table for September to December, 1908, was believed to be too high and hence was reduced in accordance with the above.

CANADICE LAKE OUTLET AT HEMLOCK, N. Y.

Canadice Lake is tributary to Genesee River through Hemlock Lake outlet and Honeoye Creek. Hemlock Lake is used as a source of water supply for the city of Rochester. The gaging station was established at the outlet at the foot of the lake by the city engineers' department of Rochester in February, 1903.

A standard thin-edged weir with a 5-foot crest and two end contractions is so arranged with needle timbers at the ends that during high water the length may be increased to 14.96 feet with no end contractions. The weir crest stands 3 feet above the stream channel and is never submerged by backwater. There are two additional rectangular gates, each 1 foot square, with three complete contractions and a fourth partial contraction at the bottom. The outflow from the lake above the weir is controlled by gates.

A reading of the depth on the weir is taken each morning and also for each change of the gates, the depth being read to hundredths and corrections being made for velocity of approach for the larger discharges. The discharge is calculated by the Francis formula. The record has been furnished by E. A. Fisher, city engineer, and John F. Skinner, principal assistant city engineer, of Rochester, N. Y.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York, and the city engineer of Rochester.

Monthly discharge of Canadice Lake Outlet, Hemlock, N. Y., for 1907 and 1908.

[Drainage area, 12.6 square miles.]

Month.	Discharge in second-feet.		Run-off (depth in inches on drainage area).	Mean elevation of lake above low water, in feet.	Month.	Discharge in second-feet.		Run-off (depth in inches on drainage area).	Mean elevation of lake above low water, in feet.
	Mean.	Per square mile.				Mean.	Per square mile.		
1907.					1908.				
January	27.56	2.19	2.52	....	January	26.4	2.10	2.42	2.042
February	13.06	1.04	1.08	....	February	23.2	1.84	1.98	1.658
March	17.26	1.37	1.58	....	March	33.6	2.67	3.08	2.143
April	21.37	1.70	1.90	....	April	16.5	1.31	1.46	2.146
May	11.18	.888	1.02	....	May	32.0	2.54	2.93	1.893
June	7.66	.608	.681	....	June	10.2	.810	.90	2.479
July	7.63	.606	.697	....	July	11.2	.889	1.02	2.213
August	5.90	.468	.538	....	August	8.6	.683	.79	1.448
September	4.40	.349	.391	....	September	4.3	.341	.38	.718
October	3.44	.273	.314	....	October	2.9	.230	.27	.155
November	6.20	.492	.551	....	November	4.0	.317	.35	-.345
December	17.02	1.35	1.55	....	December	3.7	.294	.34	-.841
The year	11.89	.944	12.82	....	The year	14.7	1.17	15.92	1.309

OSWEGO RIVER DRAINAGE BASIN.

DESCRIPTION.

Oswego River is formed by the union of Seneca and Oneida rivers about 25 miles northwest of Syracuse; whence its course is northwestward to Oswego, where it enters Lake Ontario. The length of the river from the junction to the mouth is about 20.5 miles, and the drainage basin in this district is a narrow strip of moderately rolling country. Above the junction of Seneca and Oneida rivers the basin spreads out, attaining a total width east and west of about 100 miles and north and south of about 80 miles. The total drainage area is about 5,000 square miles.

There is on the whole a gradual rise from the low, level lands, which border Lake Ontario, to the north-south ridges which separate the various lakes south of Seneca River and which farther south become merged with the still more elevated country lying along the southern boundary of the Lake Ontario drainage basin.

The most remarkable feature of the drainage basin is the chain of lakes stretching across its southern border. From west to east the principal lakes are, in order, Canandaigua, Keuka, Seneca, Cayuga, Owasco, Skaneateles, and Oneida. These seven lakes include a water surface of approximately 280 square miles, increased by four smaller lakes—Cross, Onondaga, Otisco, and Cazenovia—to about 295 square miles. The larger of the lakes—Oneida, Cayuga, and Seneca—are used for steam-towing navigation, having connection with the Erie and Oswego canals. Cayuga and Seneca lakes are noted for their depth and for the abrupt slopes of their beds. The influence of the lakes on Oswego River is of the utmost importance in contributing to the steadiness of its flow.

A fall of 100 feet in the course of the main river is largely utilized by seven dams, which also partly canalize the stream (Pl. VII, *A*). The intervening stretches are covered by the Oswego Canal, which draws its water supply from the river.

The mean annual precipitation in this basin is about 35 inches, and the winters are rather less severe than farther east and north in the State.

The Oswego and its tributaries are of importance in connection with the new barge canal. The Oswego itself is to be canalized and serve as a connection from the main canal at Three Rivers to Lake Ontario. The route of the main canal passes through Oneida Lake down Oneida River to its junction with Seneca River at Three River Point, thence up Seneca River in its general westward course. The water supply for the Oswego River section will be furnished from this drainage.

The following gaging stations have been maintained in this river basin:

- Seneca Lake at Geneva, N. Y., 1905–6.
- Seneca River at Baldwinsville, N. Y., 1898–1908.
- Oswego River above Minetto, N. Y., 1900–1903.
- Oswego River at Battle Island, N. Y., 1900–1906.
- Oswego River at Oswego, N. Y., 1897–1901.
- Fall Creek near Ithaca, N. Y., 1908.
- Cayuga Lake at Ithaca, N. Y., 1905–1908.
- Skaneateles Lake at Skaneateles, N. Y., 1890–91.
- Skaneateles Lake outlet at Willow Glen, N. Y., 1892–1908.
- Skaneateles Lake outlet at Jordan, N. Y., 1890–1892.
- Onondaga Lake outlet at Long Branch, N. Y., 1904.
- East Branch of Fish Creek at Point Rock, N. Y., 1898–99.

West Branch of Fish Creek at McConnellsville, N. Y., 1898–1901.
Oneida River at Brewerton, N. Y., 1899.
Oneida River at Euclid, N. Y., 1902–1908.
Oneida Creek at Kenwood, N. Y., 1898–1900.
Chittenango Creek at Chittenango, N. Y., 1901–1906.
Chittenango Creek at Bridgeport, N. Y., 1898–1901.

FALL CREEK NEAR ITHACA, N. Y.

This station is located at the steel highway bridge about 1¼ miles north of the city of Ithaca and about one-half mile below the Cornell University hydraulic laboratory. It was established July 7, 1908, to obtain general statistical and comparative data regarding the total flow of Fall Creek.

The gage heights are somewhat affected by ice during the winter and may at times be slightly affected by backwater from Cayuga Lake, about 800 feet downstream and 4 or 5 feet lower in elevation.

The following wading measurement was made October 23, 1908: Width, 26.5 feet; area, 13.4 square feet; gage height, 0.34 foot; discharge, 22 second-feet.

Daily gage height, in feet, of Fall Creek near Ithaca, N. Y., for 1908.

[Observer, John J. Nolan.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	0.42	0.26	0.35	0.35	0.40	16	0.68	0.40	0.25	0.31	0.48	0.32
2	.....	.42	.26	.30	.26	.40	17	.61	.34	.20	.30	.51	.32
3	.....	.42	.21	.26	.30	.42	18	.58	.38	.15	.28	.48	.42
4	.....	.45	.26	.12	.38	.45	19	.60	.32	.16	.25	.51	.52
5	.....	.41	.28	.28	.32	.36	20	.58	.32	.12	.28	.46	4.00
6	.....	.42	.25	.25	.36	.72	21	.60	.32	.14	.28	.52	5.55
7	.....	.50	.25	.28	.30	.58	22	1.52	.42	.18	.28	.38	6.75
8	.....	.52	.25	.32	.28	.43	23	.95	.38	.10	.15	.40	9.25
9	.....	.45	.25	.25	.45	.45	24	.75	.32	.00	.12	.41	12.00
10	.....	.40	.28	.15	.50	.70	25	.90	.32	.02	.12	.42	10.75
11	.....	.35	.25	.28	.51	.11	26	.80	.28	.00	.22	.40	9.90
12	0.52	.38	.25	.28	.50	.25	27	.75	.30	.11	.25	.42	10.00
13	.82	.39	.25	.30	.41	.40	28	.68	.28	.20	.35	.34	10.00
14	.70	.38	.32	.25	.42	.32	29	.56	.28	.35	.35	.30	6.55
15	.64	.78	.25	.28	.35	.40	30	.54	.26	.28	.35	.32	5.05
							31	.45	.28	.....	.35	.....	4.15

NOTE.—Ice conditions prevailed during December.

CAYUGA LAKE AT ITHACA, N. Y.

This station is located at the breakwater about 150 feet from the light-house at the south end of Cayuga Lake, near Ithaca, N. Y. It was established August 6, 1905. The station has been maintained to obtain records of fluctuations in the level of Cayuga Lake.

The datum of the staff gage has remained the same during the maintenance of the station. Readings are subject to occasional slight error when the water is rough.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

A. STATE DAM ON OSWEGO RIVER AT OSWEGO, N. Y.

B. FALL ON MOOSE RIVER ABOVE LYONSDALE, N. Y.

Daily gage height, in feet, of Cayuga Lake at Ithaca, N. Y., for 1907 and 1908.

[Observer, Fred Thomas.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1						1.4						
2		2.35	1.0								0.55	
3								1.1				
4					1.95							
5	2.5									0.95		
6				1.5			1.15					
7									1.5			0.35
8						1.15						
9		1.8	.75								.9	
10								1.5				
11					2.0							
12	2.8									.9		
13				1.45			1.2					.7
14									1.0			
15						.95						
16		1.55	1.05								.85	
17								1.0				
18					1.7							
19	2.5									.85		
20				1.25			1.1					
21									1.0			.75
22						.8						
23		1.5	1.55								.55	1.7
24								.95				
25					1.5							
26	2.6									.65		
27				1.9			1.15					
28									1.5			1.8
29			1.75			.9						
30											.5	
31								.95				
1908.												
1		1.1						1.85				
2					2.5							
3										1.2		
4	1.75			3.1			1.8					
5									1.65			−.4
6						2.4						
7			0.75								0.45	
8		.8						1.9				
9					2.7							
10										1.1		
11	1.6			2.6			1.75					
12									1.5			−.45
13						2.3						
14			2.4								.15	
15		1.3						1.9				
16					3.0							
17										.95		
18	1.5			2.4			1.7					
19									1.55			−.4
20						2.5						
21			3.1								.00	
22		.85						1.75				
23					2.65							
24										.8		
25	1.45			2.3			1.95					
26									1.3			−.6
27						1.95						
28			3.05								−.25	
29		.6			2.6			1.7				
30												
31										.9		

NOTE.—Lake frozen about the gage from about January 19 to about March 20, 1907; also from the early part of December to December 23, 1907, when the ice went out.

Lake frozen about the gage from about January 11 to March 14, 1908, when the ice went out; also probably frozen during part of December, 1908, although no note is available to that effect.

SENECA RIVER AT BALDWINSVILLE, N. Y.

This gaging station was established November 12, 1898, at the state dam in Baldwinsville, 12 miles along the river from the junction of Seneca and Oneida rivers. Beginning with 1907, this station has been maintained by the New York state engineer's department, which has furnished the accompanying records.

The record at this station includes the discharge over the main dam, which is calculated by the formula for a broad, flat-crested weir, when flashboards are removed. The discharge over the flashboards is calculated by the Francis formula. Gage readings in the river channel below the dam are utilized to determine the average working head on the turbines. The discharge through the three main canals is determined from records of the run of water wheels kept in each mill and from the recorded lockage and opening of paddles at the Oswego Canal lock at the foot of the canal. Current-meter measurements to determine the leakage of the several mills have been made during 1905, as in previous years, and allowance for this leakage has been made. The record has also been checked by current-meter measurements made during 1901, 1903, 1904, and 1905 at Belgium.

Owing to the complicated conditions of flow at this station and the uncertainty regarding leakage the results are considered to be only fair in accuracy.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

Daily discharge, in second-feet, of Seneca River at Baldwinsville, N. Y., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	5,341	4,242	2,712	5,630	5,426	3,842	2,918	2,057	[a]625	1,959	2,477	[a]3,114
2	5,742	4,226	2,829	5,507	5,476	[a]3,039	2,846	2,063	1,245	2,048	2,583	3,610
3	5,775	[a]3,731	[a]2,814	5,423	5,326	3,829	2,767	2,054	1,267	2,048	[a]2,249	3,386
4	6,579	4,285	3,304	5,127	5,171	3,884	1,989	[a]1,311	1,277	2,121	2,850	3,284
5	6,511	4,242	3,320	5,261	[a]4,623	3,950	1,597	1,892	1,405	2,127	2,924	3,217
6	[a]6,346	4,105	3,166	4,736	5,150	3,861	2,634	2,151	1,497	[a]1,253	2,885	3,163
7	6,820	4,105	3,129	[a]4,087	5,070	4,132	[a]2,068	2,205	1,322	2,138	2,164	3,083
8	7,115	4,057	3,033	4,775	4,996	4,003	2,829	1,998	[a]839	2,128	3,539	[a]2,404
9	7,143	3,982	3,006	4,667	4,980	[a]3,160	2,782	1,903	1,426	2,135	4,012	2,976
10	7,143	[a]3,526	[a]2,633	4,591	4,779	3,773	2,711	1,893	1,375	2,397	[a]3,619	2,893
11	7,041	3,924	3,071	4,514	4,942	3,738	2,424	[a]1,311	1,137	2,595	4,525	3,366
12	7,038	3,507	3,013	4,446	[a]4,241	3,525	2,643	2,213	1,801	2,675	4,587	3,588
13	[a]6,282	3,378	3,146	4,388	4,912	3,519	2,628	1,923	1,690	[a]1,806	4,513	3,588
14	6,864	3,296	3,461	[a]3,729	4,964	3,432	[a]1,883	1,714	1,415	2,454	4,267	3,332
15	6,717	3,107	3,855	4,499	4,704	3,365	2,737	1,663	[a]898	2,458	4,136	[a]2,712
16	6,623	3,097	4,381	4,454	4,952	[a]2,695	2,578	1,663	1,671	2,409	4,201	3,291
17	6,358	[a]3,038	[a]4,403	4,454	4,775	3,123	2,578	1,511	1,587	2,409	[a]3,140	3,476
18	6,488	3,352	5,423	4,275	4,742	3,245	2,532	[a]1,038	1,671	2,377	3,541	3,596
19	5,417	3,351	5,570	4,319	[a]4,045	3,214	2,418	1,679	1,671	2,376	3,405	3,729
20	[a]5,337	3,402	5,817	4,010	4,754	2,995	2,284	1,448	1,640	[a]1,742	3,349	3,690
21	5,565	3,398	5,817	[a]3,393	4,486	2,850	[a]1,843	1,247	1,735	2,510	3,294	3,645
22	3,944	3,302	5,870	3,934	4,463	2,913	2,319	1,114	[a]1,119	2,510	3,251	[a]3,081
23	3,523	3,007	5,942	3,657	4,255	[a]2,392	2,353	978	1,990	2,527	3,388	3,746
24	3,164	[a]2,599	[a]5,423	3,840	4,143	2,865	2,121	1,000	1,879	2,247	[a]2,771	4,395
25	2,920	2,801	6,051	4,375	4,076	2,801	2,659	[a]823	1,784	2,239	3,174	4,597

[a] Sunday.

Daily discharge, in second-feet, of Seneca River at Baldwinsville, N. Y., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
26	4,110	2,588	5,915	4,667	a3,416	2,768	2,604	1,196	1,732	2,101	3,184	5,596
27	a4,292	2,530	5,825	4,824	4,199	2,671	2,509	1,119	1,610	a1,279	3,168	5,880
28	4,187	2,626	5,825	a4,432	4,170	2,616	a1,794	1,076	1,770	2,596	2,050	6,037
29	4,187	....	5,826	5,332	4,005	2,673	2,344	983	a1,151	2,546	3,519	a5,595
30	4,144	....	5,725	5,355	3,694	a3,203	2,212	1,115	1,855	2,585	3,339	6,113
31	4,177	....	a5,134	....	3,998	....	2,164	1,065	....	2,550	....	6,192
1903.												
1	6,017	2,511	a4,196	....	5,222	4,461	2,412	2,254	1,116	1,605	a1,300	1,850
2	6,162	a1,804	4,687	....	5,449	4,288	2,234	a1,737	1,058	1,705	1,908	1,761
3	6,001	2,303	4,692	....	a4,424	4,250	2,240	2,273	1,150	1,718	1,801	1,789
4	5,873	2,420	4,684	....	5,575	4,174	1,846	2,004	1,052	a1,346	1,801	1,740
5	a5,219	2,848	4,687	....	5,561	3,852	a1,507	2,036	987	1,773	1,798	1,741
6	5,286	2,915	4,684	....	5,695	4,003	2,741	2,042	a 653	1,579	1,801	a1,450
7	4,783	2,777	5,046	....	5,441	a2,958	2,669	2,044	967	1,582	1,798	1,871
8	4,455	2,791	a4,672	5,835	5,678	3,962	2,814	1,881	1,205	1,552	a1,502	1,701
9	4,455	a2,434	5,177	5,835	5,949	3,943	2,648	a1,280	1,179	1,712	2,003	1,693
10	4,332	2,709	5,229	5,828	a5,184	3,756	2,585	1,951	1,110	1,787	2,003	1,592
11	5,175	2,891	5,427	5,789	6,078	3,758	2,398	1,851	1,597	a1,288	1,978	1,581
12	a3,756	2,921	5,937	a4,822	6,338	3,568	a1,583	1,814	1,648	1,773	1,833	1,554
13	4,470	2,951	6,192	5,310	6,518	3,237	2,333	1,790	a1,400	1,659	1,779	a1,363
14	4,583	3,105	6,172	5,052	6,262	a2,385	2,384	1,793	1,591	1,609	1,779	1,778
15	4,603	4,474	a5,788	4,803	6,258	3,876	2,327	1,760	1,501	1,662	a1,300	1,637
16	4,541	a5,117	6,873	4,797	6,239	4,296	2,182	a1,187	1,323	1,678	1,586	1,572
17	5,732	5,586	7,072	5,055	a5,184	4,494	2,266	1,837	1,403	1,646	1,509	1,517
18	4,161	5,372	7,188	4,913	6,128	4,472	2,335	1,910	1,390	a1,346	1,509	1,339
19	a3,573	5,649	7,269	a3,944	6,002	4,344	a1,933	1,861	1,338	1,799	1,636	1,634
20	4,800	5,632	7,269	4,838	5,872	4,348	2,536	1,748	a1,001	1,771	1,580	a1,684
21	3,445	5,497	7,217	5,059	5,742	a3,772	2,771	1,884	1,312	1,771	1,578	1,925
22	3,588	5,369	a6,550	5,459	5,738	3,407	3,001	1,306	1,277	1,741	a1,274	1,780
23	3,293	a5,007	7,032	5,315	5,460	3,202	3,093	a1,109	1,307	1,771	1,638	1,660
24	3,109	5,305	6,892	5,356	a4,414	3,212	3,007	1,671	1,380	1,826	1,688	1,381
25	2,965	5,055	6,612	5,325	5,330	2,824	3,061	1,453	1,386	a1,374	1,562	633
26	a2,193	5,089	6,612	a4,314	5,090	2,738	a2,333	1,535	1,396	1,934	1,353	1,698
27	2,948	5,029	6,482	5,247	5,037	2,611	3,031	1,537	a1,053	1,934	1,608	a1,242
28	2,654	4,812	6,188	5,340	4,645	a2,291	3,031	1,601	1,473	1,934	1,606	1,772
29	2,470	4,694	a5,740	5,090	4,536	2,460	2,875	1,112	1,461	2,035	a1,121	1,512
30	2,353	....	6,168	5,090	4,485	2,684	2,719	a 526	1,018	1,299	1,407	1,491
31	2,145	....	6,042	....	a3,971	....	1,950	1,103	....	1,284	....	1,474

a Sunday.

Monthly discharge of Seneca River at Baldwinsville, N. Y., for 1907 and 1908.

[Drainage area, 3,100 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1907.					
January	7,140	2,920	5,580	1.80	2.08
February	4,280	2,530	3,460	1.12	1.17
March	6,050	2,630	4,370	1.41	1.63
April	5,630	3,390	4,560	1.47	1.64
May	5,480	3,420	4,610	1.49	1.72
June	4,130	2,390	3,270	1.05	1.17
July	2,920	1,600	2,410	.777	.90
August	2,210	823	1,530	.494	.57
September	1,990	625	1,470	.474	.53
October	2,680	1,250	2,240	.723	.83
November	4,590	2,050	3,340	1.08	1.20
December	6,190	2,400	3,880	1.25	1.44
The year	7,140	625	3,390	1.09	14.88
1908.					
January	6,160	2,140	4,170	1.35	1.56
February	5,650	1,800	3,970	1.28	1.38
March	7,270	4,200	5,950	1.92	2.21
April		3,940	5,140	1.66	1.42
May	6,520	3,970	5,470	1.76	2.03
June	4,490	2,290	3,590	1.16	1.29
July	3,090	1,510	2,480	.800	.92
August	2,270	526	1,670	.539	.62
September	1,650	653	1,260	.406	.45
October	2,040	1,280	1,660	.535	.62
November	2,000	1,120	1,630	.526	.59
December	1,920	633	1,590	.513	.59
The year	7,270	526	3,220	1.04	13.68

NOTE.—Discharge April 1 to 7, 1908, estimated 5,850 second-feet.

SKANEATELES LAKE OUTLET AT WILLOW GLEN, N. Y.

This station is located in the village of Willow Glen, 1.5 miles below the foot of Skaneateles Lake, and was established March 10, 1895. It has been maintained by the city of Syracuse to obtain data regarding the flow of Skaneateles Creek.

Observation is made of the daily discharge over a thin-edged weir, having a crest length of 27.8 feet, with two end contractions. The discharge is calculated from the observed depth on an iron pin set with its top at crest level, 5.2 feet upstream from the weir, by means of the Francis formula, including corrections for end contractions and velocity of approach.

Since July 1, 1894, the water supply of the city of Syracuse has been drawn from Skaneateles Lake, and the amount of this diversion should be added to the discharge of the outlet to obtain the total run-off of the drainage basin. The calculated diversion, as determined from the record of gate openings and head at the inlet gates, using the orifice formula with a constant coefficient, stated as 0.62, has been furnished by the city of Syracuse.

There are several small water-power developments on Skaneateles Creek, all below the weir, but these do not affect the flow. The gage datum has remained the same during the maintenance of the station. During the winter months the discharge is only slightly affected by the presence of ice. Conditions are good for obtaining accurate discharge, and a very good rating table has been developed.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

Discharge measurements of Skaneateles Lake outlet at Willow Glen, N. Y., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 29[a]	D. M. Wood	24	....	0.86	72.5
Do	do	24	....	.86	74.6
May 6	do	27.5	53.1	1.17	138
Do	do	27.5	51.2	1.17	131
August 16	Brett and Allen	28.5	37.6	1.00	91.2

[a] Measurement made at second bridge above weir

Daily discharge, in second-feet, of Skaneateles Lake outlet at Willow Glen, N. Y., for 1907 and 1908.

[Observer, Edward Couran.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	41.7	48.9	39.4	53.8	25.0	27.0	39.4	39.4	35.0	53.8	53.8	53.8
2	44.1	48.9	39.4	53.8	25.0	27.0	39.4	41.7	58.9	53.8	53.8	51.4
3	48.9	44.1	39.4	53.8	25.0	27.0	39.4	39.4	44.1	53.8	53.8	51.4
4	48.9	41.7	39.4	16.3	25.0	27.0	37.2	39.4	35.0	56.5	53.8	53.8
5	39.4	41.7	39.4	16.3	25.0	27.0	35.0	39.4	35.0	58.9	53.8	53.8
6	58.9	41.7	39.4	16.3	25.0	28.9	35.0	39.4	35.0	58.9	53.8	53.8
7	58.9	39.4	39.4	16.3	23.2	35.0	35.0	39.4	35.0	56.5	64.0	53.8
8	58.9	39.4	39.4	16.3	23.2	30.9	35.0	39.4	35.0	66.5	58.9	53.8
9	48.9	39.4	39.4	16.3	23.2	27.0	35.0	39.4	35.0	58.9	58.9	56.5
10	48.9	39.4	39.4	10.4	25.0	27.0	35.0	39.4	35.0	53.8	56.5	58.9
11	48.9	39.4	39.4	10.4	25.0	27.0	35.0	39.4	35.0	56.5	56.5	61.5
12	48.9	39.4	39.4	7.8	23.2	27.0	35.0	39.4	35.0	56.5	56.5	58.9
13	58.9	39.4	39.4	7.8	23.2	27.0	35.0	39.4	64.0	53.8	53.8	58.9
14	58.9	39.4	39.4	7.8	23.2	27.0	35.0	39.4	64.0	53.8	53.8	61.5
15	58.9	39.4	41.7	7.8	23.2	27.0	35.0	39.4	61.5	53.8	53.8	61.5
16	53.8	39.4	41.7	7.8	23.2	27.0	35.0	39.4	61.5	53.8	53.8	58.9
17	53.8	39.4	39.4	7.8	23.2	27.0	35.0	39.4	58.9	53.8	64.0	58.9
18	53.8	39.4	39.4	7.8	23.2	27.0	35.0	39.4	56.5	53.8	64.0	53.8
19	53.8	39.4	39.4	7.8	27.0	48.9	35.0	39.4	35.0	53.8	61.5	53.8
20	53.8	39.4	41.7	7.8	27.0	48.9	35.0	39.4	97.0	53.8	56.5	53.8
21	53.8	39.4	41.7	7.8	27.0	48.9	35.0	39.4	97.0	53.8	56.5	53.8
22	53.8	39.4	41.7	5.4	27.0	48.9	35.0	39.4	97.0	53.8	56.5	53.8
23	48.9	39.4	41.7	5.4	27.0	37.2	58.9	39.4	53.8	53.8	56.5	53.8
24	48.9	39.4	44.1	13.3	27.0	35.0	64.0	39.4	53.8	53.8	56.5	64.0
25	48.9	39.4	46.4	19.6	28.9	35.0	64.0	37.2	53.8	53.8	56.5	64.0
26	48.9	39.4	48.9	16.3	30.9	35.0	58.9	37.2	53.8	53.8	56.5	61.5
27	48.9	39.4	51.4	16.3	30.9	35.0	53.8	35.0	53.8	58.9	56.5	61.5
28	48.9	39.4	53.8	7.8	28.9	35.0	53.8	35.0	53.8	58.9	56.5	64.0
29	48.9	....	53.8	5.4	28.9	35.0	53.8	35.0	56.5	53.8	51.4	10.4
30	48.9	....	53.8	3.1	28.9	35.0	53.8	35.0	53.8	53.8	53.8	64.0
31	48.9	....	53.8	....	27.0	....	53.8	35.0	....	53.8	....	58.9
1908.												
1	61.5	56.5	56.5	122	119	133	91.0	85.3	85.3	82.4	82.4	82.4
2	56.5	56.5	58.9	122	119	106	91.0	85.3	85.3	82.4	82.4	82.4
3	56.5	56.5	61.5	122	106	106	91.0	106	85.3	82.4	82.4	82.4
4	56.5	56.5	58.9	82.4	119	106	91.0	106	85.3	82.4	82.4	82.4
5	56.5	56.5	61.5	91.0	119	106	88.0	106	85.3	82.4	82.4	82.4

Daily discharge, in second-feet, of Skaneateles Lake outlet at Willow Glen, N. Y., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
6	56.5	56.5	82.4	91.0	127	106	88.0	106	85.3	82.4	82.4	82.4
7	56.5	56.5	82.4	94.0	127	100	88.0	106	85.3	82.4	82.4	82.4
8	56.5	56.5	77.0	94.0	127	100	88.0	106	85.3	82.4	82.4	82.4
9	56.5	53.8	77.0	94.0	133	94.0	88.0	106	82.4	82.4	82.4	37.2
10	56.5	53.8	77.0	94.0	130	88.0	88.0	106	82.4	82.4	82.4	37.2
11	56.5	51.4	77.0	94.0	140	88.0	88.0	106	82.4	82.4	82.4	37.2
12	56.5	51.4	82.4	97.0	140	88.0	88.0	94.0	82.4	82.4	82.4	37.2
13	56.5	51.4	85.3	94.0	140	88.0	88.0	94.0	82.4	82.4	82.4	37.2
14	56.5	56.5	85.3	94.0	140	94.0	85.3	85.3	82.4	82.4	82.4	37.2
15	56.5	66.5	91.0	106	140	94.0	85.3	85.3	82.4	82.4	82.4	37.2
16	56.5	61.5	85.3	106	133	94.0	85.3	88.0	82.4	82.4	82.4	37.2
17	56.5	56.5	82.4	100	140	85.3	88.0	85.3	82.4	82.4	82.4	37.2
18	56.5	56.5	82.4	97.0	140	85.3	91.0	85.3	82.4	82.4	82.4	37.2
19	56.5	56.5	82.4	110	140	85.3	94.0	85.3	82.4	82.4	82.4	37.2
20	56.5	56.5	82.4	106	140	85.3	100	85.3	82.4	82.4	82.4	37.2
21	56.5	56.5	82.4	100	140	85.3	106	85.3	82.4	82.4	82.4	37.2
22	56.5	56.5	91.0	94.0	136	85.3	94.0	85.3	82.4	82.4	82.4	37.2
23	56.5	56.5	91.0	113	136	88.0	85.3	85.3	82.4	82.4	82.4	37.2
24	56.5	56.5	91.0	113	133	88.0	85.3	85.3	82.4	82.4	82.4	53.8
25	56.5	56.5	91.0	113	133	85.3	85.3	85.3	82.4	82.4	82.4	53.8
26	56.5	56.5	94.0	113	133	85.3	85.3	85.3	82.4	82.4	82.4	53.8
27	56.5	56.5	106	113	133	85.3	85.3	85.3	82.4	82.4	82.4	53.8
28	56.5	56.5	113	113	133	85.3	85.3	85.3	82.4	85.3	82.4	53.8
29	56.5	56.5	113	113	133	85.3	85.3	85.3	82.4	82.4	82.4	46.4
30	56.5	......	113	113	133	85.3	85.3	85.3	82.4	82.4	82.4	48.9
31	56.5	......	122	......	133	......	85.3	85.3	......	82.4	......	[a] 48.9

[a] Estimated.

Monthly discharge of Skaneateles Lake outlet at Willow Glen, N. Y., for 1906, 1907, and 1908.

[Drainage area, 74.2 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).[a]
	In outlet.	Through conduit.	Total.	Per square mile.[a]	
1906.					
January [b]	30.9	18.1	49.0	0.660	0.76
February [b]	30.7	19.7	50.4	.679	.71
March [b]	31.2	19.7	50.9	.686	.79
April	35.1	19.4	54.5	.735	.82
May	69.7	19.2	88.9	1.20	1.38
June	67.8	19.2	87.0	1.17	1.30
July	67.1	19.2	86.3	1.16	1.34
August	77.2	18.9	96.1	1.30	1.50
September	68.4	18.6	87.0	1.17	1.30
October	57.8	18.6	76.4	1.03	1.19
November	58.1	18.6	76.7	1.03	1.15
December	55.6	18.5	74.1	1.00	1.15
The year	54.1	19.0	73.1	.985	13.39
1907.					
January	51.2	18.6	69.8	0.941	1.08
February [c]	40.5	18.7	59.2	.798	.83
March [c]	42.8	18.8	61.6	.830	.96
April	15.0	18.9	33.9	.457	.51
May	25.8	19.0	44.8	.604	.70
June	32.6	19.0	51.6	.695	.78
July	41.9	19.0	60.9	.821	.95
August	38.6	19.0	57.6	.776	.89
September	52.6	18.7	71.3	.961	1.07
October	55.4	18.4	73.8	.995	1.15
November	56.4	18.4	74.8	1.01	1.13
December	55.9	18.4	74.3	1.00	1.15
The year	42.4	18.7	61.1	.824	11.20

[a] Including diversion for water supply of Syracuse.
[b] The discharge during January, February, and March, 1906, was slightly affected by ice.
[c] The discharge during February and March, 1907, was probably slightly affected by ice.

Monthly discharge of Skaneateles Lake outlet at Willow Glen, N. Y., for 1906, 1907, and 1908—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1908.					
January	56.7	18.4	75.1	1.01	1.16
February	56.3	18.6	74.9	1.01	1.09
March	85.0	19.0	104	1.40	1.61
April	104	19.0	123	1.66	1.85
May	132	19.0	151	2.04	2.35
June	93.0	19.0	112	1.51	1.68
July	88.8	19.0	108	1.46	1.68
August	92.0	19.0	111	1.50	1.73
September	83.2	19.0	102	1.37	1.53
October	82.5	19.0	102	1.37	1.58
November	82.4	19.0	101	1.36	1.52
December	52.6	19.0	71.6	.965	1.11
The year	84.0	18.9	103	1.39	18.89

NOTE.—Discharge measurements made during 1908 indicate that the above values for 1906 should be rated as fair (c) instead of approximate, as given in Water Supply Paper No. 206.
Values for 1907 and 1908 rated as fair (c).

ONEIDA RIVER NEAR EUCLID, N. Y.

This station is located at Schroeppel's bridge, about 7 miles upstream from Three River Point, and was established August 30, 1902, to obtain general information regarding the flow of Oneida River, which is of importance both for water-power development and canal purposes.

Gage-height observations are made by measuring down to the water surface from a reference point on the bulkhead coping of the lock at Oak Orchard state dam, 0.4 mile above Schroeppel's bridge. Gage readings are taken above the dam to avoid, as far as possible, backwater from ice or other causes, and the flow over the dam is computed on the basis of a rating curve constructed from current-meter measurements made at Schroeppel's bridge.

The reference datum has remained the same during the maintenance of the station. During the winter months ice occasionally affects the gage heights. Above a certain stage the dam becomes submerged and the discharge is modified. A special rating table, deduced from measurements made during the period of submergence, is used to calculate the discharge during the high period. Allowance is made for the opening of lock paddles in winter and for flashboards when used.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York, and this station has been maintained by the state engineer's department since May 1, 1907.

Daily discharge, in second-feet, of Oneida River near Euclid, N. Y., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	3,220	3,420	1,660	6,580	4,900	....	1,450	1,240	a 574	574	1,350	a2,140
2	4,900	3,420	1,660	7,360	4,740	....	1,570	1,300	700	616	1,350	2,070
3	6,090	a3,830	a1,660	7,100	4,740	....	1,710	1,140	574	616	a1,190	2,000
4	6,580	3,620	1,660	7,100	4,520	....	1,570	a1,140	530	616	1,400	2,000
5	6,580	3,620	1,660	6,580	a4,290	....	1,570	1,240	530	616	1,570	1,780
6	a7,100	3,220	1,660	6,330	4,520	1,350	1,450	1,350	530	a 658	1,780	1,640
7	7,100	3,050	1,560	a6,330	4,740	1,570	a1,450	1,350	530	700	2,070	1,570
8	7,880	3,050	1,560	6,090	4,740	1,570	1,350	1,350	a 488	700	2,470	a1,710
9	7,660	2,880	1,560	5,350	4,290	a1,710	1,400	1,190	530	742	2,800	2,070
10	7,360	a2,880	a1,560	5,600	4,520	1,710	1,400	1,140	616	949	a2,890	2,470
11	7,360	2,880	1,560	5,840	4,520	1,850	1,240	a1,140	700	1,040	2,980	2,630
12	7,100	2,880	1,560	5,130	a4,740	1,710	1,240	1,090	700	1,040	2,890	2,140
13	a7,100	2,710	1,560	3,420	4,520	1,570	1,190	949	700	a1,040	2,800	1,500
14	6,840	2,370	1,560	a1,560	4,520	1,450	a1,140	949	700	1,090	2,800	1,300
15	6,580	2,370	1,660	1,150	4,740	1,450	1,090	949	a 700	1,140	2,720	a1,350
16	6,580	2,230	2,230	1,150	4,520	a1,450	1,040	949	700	1,090	2,630	1,410
17	7,360	a2,230	a2,370	1,150	4,290	1,350	949	866	616	1,040	a2,470	1,560
18	7,880	2,080	2,370	1,350	4,290	1,350	907	a 949	742	949	2,470	1,730
19	5,840	1,940	2,540	1,560	....	1,350	990	949	783	824	2,290	1,730
20	a5,600	1,800	2,370	2,230	....	1,450	1,140	866	658	a 783	2,290	1,730
21	5,600	1,800	2,540	a1,940	....	1,350	a1,140	866	616	783	2,290	1,610
22	5,840	1,940	3,050	1,940	....	1,240	1,190	700	a 616	783	2,210	a1,660
23	5,600	1,940	4,030	2,080	....	a1,240	1,040	700	616	783	2,140	2,160
24	5,130	a2,080	a4,230	2,230	....	1,240	990	700	574	742	a2,000	2,710
25	4,680	1,940	4,680	2,370	....	1,240	1,040	a 616	446	700	2,000	3,220
26	4,450	1,800	5,600	3,050	....	1,240	949	574	262	700	2,000	3,720
27	a4,450	1,660	5,840	3,620	....	1,240	949	530	616	a 949	1,920	4,030
28	4,450	1,560	6,090	a4,680	....	1,240	a 949	446	700	1,090	1,920	4,340
29	4,450	....	6,330	4,450	....	1,240	1,240	530	a 742	1,240	2,000	a4,450
30	4,450	....	6,330	5,130	....	a1,240	1,240	530	616	1,240	2,070	4,680
31	3,620	....	a6,580	....	....	....	1,140	530	....	1,240	....	4,130
1908.												
1	5,679	3,378	a3,972	7,566	6,048	3,284	1,904	1,640	852	784	a 960	1,584
2	5,802	a4,400	4,076	7,566	6,294	3,190	1,706	a1,584	750	818	1,000	1,838
3	5,556	4,846	3,972	7,566	a6,294	3,190	1,772	1,528	784	886	1,040	1,904
4	4,846	4,962	3,972	7,181	6,417	3,100	1,772	1,584	750	a 852	1,040	1,706
5	a4,846	5,310	3,972	a7,181	6,540	2,920	a1,706	1,584	750	886	1,080	1,472
6	6,797	5,310	3,868	7,053	6,668	2,920	1,640	1,528	a 750	886	1,168	a1,360
7	6,171	4,730	3,764	7,181	7,053	a2,740	1,584	1,360	784	886	1,120	1,416
8	4,846	4,510	a3,764	7,438	6,797	2,660	1,528	1,216	750	886	a1,264	1,416
9	4,730	a4,290	3,764	7,053	6,417	2,500	1,528	a1,360	750	886	1,216	1,360
10	4,620	3,660	3,764	7,053	a6,294	2,500	1,584	1,312	750	886	1,168	1,264
11	5,310	3,378	3,868	6,797	6,171	2,500	1,584	1,216	724	a 920	1,120	1,216
12	a4,510	3,190	4,076	a6,540	5,925	2,340	a1,528	1,216	724	886	1,000	1,120
13	3,972	3,566	4,510	6,171	6,048	2,266	1,360	1,216	a 698	920	1,080	a1,080
14	4,180	3,660	5,310	5,802	6,048	a2,420	1,360	1,216	698	886	1,120	960
15	4,076	4,180	a6,171	6,048	5,925	3,378	1,264	1,216	672	886	a1,168	920
16	3,764	a4,620	6,797	6,171	5,679	3,100	1,216	a1,216	672	852	1,168	784
17	3,764	5,679	6,925	6,294	a5,433	3,010	1,264	1,216	646	818	1,080	698
18	3,566	6,294	7,053	6,417	5,310	2,830	1,472	1,264	646	a 852	1,168	672
19	a3,472	6,171	7,053	a6,048	5,078	2,740	a1,706	1,120	698	886	1,216	606
20	3,378	5,802	7,053	6,048	4,730	2,580	1,772	1,168	a 750	852	1,216	a 606
21	3,378	5,194	6,797	6,048	4,400	a2,580	1,904	1,168	724	886	1,264	578
22	3,284	5,078	a6,797	5,925	4,400	2,660	1,970	1,080	698	886	a1,312	578
23	3,100	a4,962	6,540	5,802	4,180	2,660	2,118	a1,040	698	920	1,416	592
24	3,190	4,846	6,540	....	a4,180	2,580	2,118	1,040	698	960	1,472	646
25	3,100	4,730	6,668	....	4,180	2,500	2,118	1,000	724	a1,000	1,472	724
26	a2,920	4,400	6,797	(a)	4,076	2,500	a1,970	960	698	1,000	1,528	784
27	2,830	4,400	6,797	....	3,764	2,340	1,904	960	a 750	920	1,416	a 852
28	2,920	4,180	6,797	....	3,764	a2,192	1,838	960	750	886	1,416	852
29	3,100	4,180	a7,438	....	3,566	2,118	1,838	960	750	920	a1,584	784
30	3,190	....	7,566	....	3,472	1,970	1,772	a1,000	750	1,000	1,528	750
31	3,284	....	7,566	....	a3,378	....	1,772	920	....	1,000	....	784

a Sunday.

NOTE.—No record May 19 to June 5, 1907.

Monthly discharge of Oneida River near Euclid, N. Y., for 1907 and 1908.

[Drainage area, 1,400 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area.)
	Maximum.	Minimum.	Mean.	Per square mile.	
1907.					
January	7,880	3,220	5,980	4.27	4.92
February	3,830	1,560	2,540	1.81	1.88
March	6,580	1,560	2,940	2.10	2.42
April	7,360	1,150	4,020	2.87	3.20
May 1-18	4,900	4,290	4,560	3.26	2.18
June 6-30	1,850	1,240	1,420	1.01	.94
July	1,710	907	1,220	.871	1.00
August	1,350	446	930	.664	.77
September	783	262	614	.439	.49
October	1,240	574	873	.624	.72
November	2,980	1,190	2,190	1.56	1.74
December	4,680	1,300	2,360	1.69	1.95
1908.					
January	6,800	2,830	4,130	2.95	3.40
February	6,290	3,190	4,620	3.30	3.56
March	7,570	3,760	5,610	4.01	4.62
April 1-23	7,570	5,800	6,650	4.75	4.06
May	7,050	3,380	5,310	3.79	4.37
June	3,380	1,970	2,680	1.91	2.13
July	2,120	1,220	1,700	1.21	1.40
August	1,640	920	1,220	.871	1.00
September	852	646	728	.520	.58
October	1,000	784	897	.641	.74
November	1,580	960	1,230	.879	.98
December	1,900	578	1,030	.736	.85

SALMON RIVER DRAINAGE BASIN.

DESCRIPTION.

Salmon River rises in the southwestern part of Lewis County, N. Y., flows southward and then northwestward, and enters Lake Ontario near Port Ontario. Its drainage area comprises about 285 square miles. The topography is generally rolling in character, and the soil is sandy, rock lying near the surface in the upper part of the basin, where there are also extensive tracts of original forest.

The mean annual precipitation is about 35 inches, and during the winter there is usually a heavy fall of snow, which often accumulates in the forest areas to a depth of several feet and whose slow melting in the spring operates to prevent extremely high freshets.

The basin affords several opportunities for storage. At High Falls there is an undeveloped fall of 110 feet in a very short distance, and the river is rather important in its power possibilities for a stream of its size.

The following gaging station has been maintained in this river basin: Salmon River near Pulaski, N. Y., 1900-1908.

21635—IRR 244—10——8

SALMON RIVER NEAR PULASKI, N. Y.

This station is located on the first highway bridge above the village of Pulaski, and was established September 5, 1900. The gage was taken out by ice during the winter of 1901–2, which caused a temporary break in the record. The gage was replaced and readings resumed July 23, 1902. The station was again discontinued June 30, 1907, reestablished August 16, 1908, and discontinued December 6, 1908. The station can be reached by a short drive from either Pulaski or Richland. Conditions are poor for records during the winter, when the channel usually becomes clogged with ice. The open channel rating is fairly good. The gage datum has remained the same throughout the period of records.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

The following measurement was made October 17, 1908: Width, 164 feet; area, 212 square feet; gage height, 2.52 feet; discharge, 125 second-feet.

Daily gage height, in feet, of Salmon River near Pulaski, N. Y., for 1907 and 1908.

[Observer, Seymour J. Fox.]

Day.	Jan.	Feb.	Mar.	Apr.	May	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1907.[a]							1907.						
1	5.05	3.00		4.78	4.48	3.55	16	2.98			3.45	3.80	2.95
2	4.55	3.05		4.48	4.05	3.38	17	3.00			3.45	4.05	2.90
3	4.18	3.10		4.40	3.72	3.28	18	3.02			3.55	3.78	2.88
4	6.22	3.12		4.30	4.30	3.18	19	3.15			3.40	3.60	2.80
5	6.00	3.12		4.10	5.02	3.18	20	3.75			3.30	3.45	2.75
6	4.80	3.18		3.98	4.20	4.85	21	3.65		4.05	3.22	3.32	2.72
7	4.45	3.05		3.90	3.95	5.70	22	3.70		4.15	3.28	3.25	2.70
8	4.60	3.10		3.80	3.60	4.58	23	3.05		4.50	3.35		2.62
9	4.10	3.05		3.78	3.60	3.90	24	3.10		5.58	3.92		2.65
10	3.35	3.08		3.60	3.50	3.52	25	3.10		5.75	4.30		2.62
11	3.70	3.00		3.60	3.55	3.38	26	3.10		5.60	4.22	3.18	2.68
12	3.45	3.00		3.75	3.60	3.22	27	3.10		5.38	4.25	3.52	2.68
13	3.42			3.62	3.45	3.18	28	3.10		6.82	4.05	3.80	2.72
14	3.42			3.62	3.38	3.12	29	3.00		6.60	3.90	3.55	2.80
15	3.38			3.52	3.28	3.05	30	3.00		6.42	3.90	3.42	2.95
							31	3.00		5.75		3.58	

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.						1908.					
1		2.45	2.72	2.70	3.18	16	2.68	2.45	2.60	3.05	
2		2.45	2.62	2.70	3.22	17	2.75	2.40	2.50	3.05	
3		2.45	2.58	2.62	3.15	18	2.80	2.40		3.00	
4		2.50	2.50	2.70	3.05	19	2.78	2.40		3.00	
5		2.52	2.50	2.75	3.00	20	2.75			3.05	
6		2.60	2.50	2.80	2.85	21	2.70			3.08	
7		2.60	2.45	2.85	3.00	22	2.62			3.05	
8		2.60	2.45	2.90		23	2.60			3.08	
9		2.55	2.45	3.02		24	2.58			3.08	
10		2.45	2.45	3.25		25	2.58			3.48	
11		2.45	2.55	3.52		26	2.50			4.15	
12		2.45	2.62	3.72		27	2.50	2.35		4.25	
13		2.45	2.70	3.62		28	2.45	2.35		3.70	
14		2.45	2.65	3.25		29	2.45	2.82		3.45	
15		2.45	2.62	3.10		30	2.50	3.02		3.32	
						31	2.50				

[a] River frozen over February 13 to March 20, 1907.

Rating table for Salmon River near Pulaski, N. Y., for 1906–1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.30	67	3.40	620	4.50	1,830	5.60	3,950
2.40	93	3.50	697	4.60	1,980	5.70	4,200
2.50	124	3.60	781	4.70	2,140	5.80	4,490
2.60	161	3.70	865	4.80	2,300	5.90	4,780
2.70	204	3.80	965	4.90	2,470	6.00	5,100
2.80	253	3.90	1,060	5.00	2,640	6.20	5,770
2.90	307	4.00	1,170	5.10	2,840	6.40	6,530
3.00	364	4.10	1,300	5.20	3,020	6.60	7,340
3.10	422	4.20	1,420	5.30	3,240	6.80	8,190
3.20	480	4.30	1,550	5.40	3,460	7.00	9,070
3.30	550	4.40	1,680	5.50	3,700		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made 1902–1908 and is fairly well defined.

Monthly discharge of Salmon River near Pulaski, N. Y., for 1907 and 1908.

[Drainage area, 259 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
January	5,850	353	1,160	4.48	5.16	B.
February 1-12	468	364	405	1.56	.70	B.
March 21-31	8,280	1,240	4,240	16.40	6.71	B.
April	2,270	494	1,040	4.02	4.48	B.
May	2,680	468	894	3.45	3.98	B.
June	4,200	170	636	2.46	2.74	B.
1908.						
August 16-31	253	108	169	.653	.39	B.
September	376	80	121	.467	.52	B.
October	214	108	153	.591	.68	B.
November	1,480	170	507	1.96	2.19	B.
December 1-7	494	280	402	1.55	.40	B.

NOTE.—Discharge interpolated September 20 to 26 and October 18 to 31, 1908.

BLACK RIVER DRAINAGE BASIN.

DESCRIPTION.

Black River rises in the western part of Hamilton County, N. Y., flows southwestward across Herkimer County into Oneida County, turns near Forestport and runs somewhat west of north through Lewis County to eastern Jefferson County, and then flows westward to Black River Bay, at the eastern extremity of Lake Ontario. Its total drainage area is 1,930 square miles. The upper part of the basin is very rugged and mountainous, contains a large number of lakes, and is in a part of the Adirondack forest.

The mean annual precipitation is about 40 inches, ranging from 55 inches in the extreme headwaters to perhaps 30 inches near Lake Ontario. The winters are generally quite severe, and the stream flow is affected by ice for periods of several months.

The regimen of the river is controlled by storage on its upper tributaries, including Beaver River at Beaver, a series of reservoirs at the headwaters of Moose River, and additional reservoirs at Forestport and on the headwaters of the main river. (Pl. VII, *B*.)

Water is diverted from Black River through Forestport feeder to supply the Black River Canal at Boonville. A portion of this diverted water flows northward from Boonville and enters Black River again at Lyons Falls; the remainder flows southward through the Black River Canal and enters the Erie Canal at Rome.

The following gaging stations have been maintained in this river basin:

Black River near Felts Mills, Watertown, N. Y., 1902–1908.
Black River at Huntingtonville dam, near Watertown, N. Y., 1897–1901.
Moose River at Moose River, N. Y., 1900–1908.
Beaver River at Croghan, N. Y., 1901–1903.

BLACK RIVER NEAR FELTS MILLS, N. Y.

This station is located at the dam of the Harmon Paper Company, formerly owned by the Black River Traction Company, near the village of Felts Mills, 9 miles upstream from Watertown, and 7 miles upstream from the old Huntingtonville gaging station on this stream. It was established August 29, 1902, and since May 1, 1907, has been maintained by the state engineer's department.

The dam is of sawed timber, rests on limestone foundation, and is very nearly water-tight. It has a slope on the upstream face of 2.88 horizontal to 1 vertical. The crest is protected by boiler plate and the downstream face is vertical, giving a free overfall. The main crest is 380.6 feet long. There are two additional sections on the right-hand side, one 14.1 feet long and the other 17.9 feet. A similarly constructed dam, 117 feet long, at the left bank, serves as an auxiliary spillway and as a headrace wall.

The gage, which is read twice daily, at 7 a. m. and 6 p. m., is attached vertically to a crib at the left-hand side of the stream above the mill. Correction is made to the gage readings for velocity of approach during high water. The discharge over the spillways has been calculated by means of the weir formula, using coefficients derived from experiments of the United States Geological Survey for a dam of similar cross section.

A wood-pulp mill has been constructed adjacent to this dam and was in operation during 1907. The mill contains four 72-inch and one 45-inch Smith-McCormick turbines. A record is kept of the hours run, and gate opening of each wheel, as well as of the head under which they operate.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

Daily discharge, in second-feet, of Black River near Felts Mills, N. Y., for 1907 and 1908.

Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1				16,755	8,769	2,531	2,282	790	[b] 298	1,274	4,121	[b] 1,265
2				13,795	8,965	[b] 2,676	2,116	882	442	2,294	2,690	2,116
3				10,866	8,769	3,229	2,583	761	790	2,151	[b] 2,877	1,673
4				7,499	8,769	2,157	2,044	[b] 752	731	2,022	6,413	1,598
5				7,143	[b] 12,636	1,839	2,859	874	1,373	3,185	6,757	1,780
6				6,160	10,171	1,913	1,443	836	2,706	[b] 2,848	6,929	1,698
7				[b] 5,988	9,785	3,245	[b] 1,265	1,054	1,987	5,733	8,085	1,618
8				5,840	9,369	3,375	1,141	983	[b] 2,381	5,695	9,701	[b] 1,476
9				3,931	8,573	[b] 3,368	1,141	914	1,499	6,305	9,733	2,510
10				3,807	8,769	3,083	1,329	2,226	1,488	6,585	[b] 8,560	4,429
11				3,683	6,489	2,687	1,084	[b] 723	1,427	6,069	8,360	7,889
12				3,683	[b] 4,760	2,441	817	896	1,941	5,967	7,481	8,532
13				3,735	7,765	2,116	1,730	1,103	2,743	[b] 6,200	5,749	8,254
14				[b] 3,960	4,133	1,994	[b] 1,312	817	2,855	4,529	4,825	7,563
15				4,303	3,846	1,685	1,864	783	[b] 3,063	3,985	4,121	[b] 7,728
16				4,725	3,289	[b] 1,360	1,285	596	1,607	3,229	3,547	4,529
17				5,971	3,637	1,242	868	1,412	1,387	2,743	[a] 3,960	4,257
18				5,646	4,009	986	1,255	[b] 350	1,692	2,394	3,431	4,121
19				5,651	[b] 2,676	1,248	868	576	1,181	2,246	3,005	3,725
20				5,036	4,615	1,535	1,126	596	1,226	[b] 2,299	3,005	3,353
21				[b] 2,168	3,003	1,548	[b] 804	609	1,080	1,873	2,855	3,175
22				5,704	2,808	2,354	1,539	625	[b] 1,005	1,873	3,061	[b] 2,676
23				4,948	2,707	[b] 1,472	868	715	946	1,954	3,423	3,592
24				5,022	2,710	1,618	1,164	1,138	1,415	2,075	[b] 2,812	4,521
25				3,933	2,644	1,537	1,346	[b] 152	1,320	1,994	3,398	7,324
26				5,581	[b] 2,292	1,383	868	10	1,820	1,599	3,118	9,069
27				6,787	2,294	980	802	547	1,901	[b] 2,187	3,006	9,037
28				[b] 8,144	2,687	1,171	[b] 980	635	1,941	2,536	2,416	10,915
29				9,267	3,023	522	1,498	670	[b] 3,018	4,529	3,118	[b] 11,092
30				8,235	2,634	[b] 1,123	1,255	614	2,104	4,825	2,938	10,089
31					2,341		859	601		4,529		10,309
1908.												
1			[b] 2,768	12,806	12,335	3,310	1,263	1,096	884	1,245	[b] 1,082	1,908
2			3,272	10,883	12,589	3,310	1,268	[b] 683	839	1,276	1,152	1,886
3			3,813	9,822	[b] 12,044	3,082	863	1,336	808	1,208	1,158	1,657
4			3,034	8,189	12,844	2,413	502	1,097	791	[b] 998	1,158	1,552
5			3,344	[b] 7,078	11,105	2,461	[b] 658	1,054	916	1,739	1,128	1,125
6			3,687	6,537	9,612	2,397	912	964	[b] 450	1,258	1,695	[b] 1,180
7			3,235	6,886	8,585	[b] 1,887	1,165	997	1,157	1,255	1,060	2,011
8			[b] 2,504	8,189	7,991	2,111	1,607	1,127	862	1,128	[b] 714	2,212
9			3,322	9,191	8,333	2,041	1,617	[b] 602	803	1,158	1,396	1,932
10			2,986	10,921	[b] 8,945	1,999	1,679	1,340	902	1,060	1,189	1,663
11			3,139	11,243	12,375	1,657	1,626	1,194	851	[b] 445	1,307	1,733
12			3,105	[b] 11,280	8,740	1,417	[b] 741	1,133	763	1,508	1,534	1,812
13			3,493	11,620	7,805	1,385	1,266	1,054	[b] 384	1,367	1,513	[b] 1,723
14			4,437	9,678	7,060	[b] 699	1,058	1,315	792	1,367	1,616	1,511
15			[b] 6,682	8,981	6,712	2,293	935	1,309	853	1,276	[b] 1,320	1,632
16			9,209	8,189	6,658	3,253	1,017	[b] 933	721	1,089	1,371	1,208
17			8,773	7,991	[b] 6,496	2,817	961	1,498	746	1,024	1,517	1,693
18			7,991	7,890	7,100	2,413	1,187	1,194	705	[b] 998	1,438	2,128
19			7,783	[b] 6,682	5,703	2,094	[b] 2,168	1,103	621	1,545	1,398	1,773
20			7,621	7,805	5,079	1,855	3,431	1,054	[b] 353	869	1,337	[b] 871
21			6,832	7,432	4,491	[b] 2,504	2,837	1,073	716	942	1,097	1,302
22			[b] 5,751	7,060	3,939	3,413	2,949	887	814	839	[b] 1,125	1,048
23			5,989	6,537	3,837	2,262	3,353	[b] 723	788	870	1,337	1,338
24			5,861	6,363	[b] 3,182	2,509	2,204	753	750	733	1,438	610
25			7,286	6,658	3,979	2,606	1,901	668	676	[b] 414	1,337	171
26			7,060	[b] 6,682	3,310	2,461	[b] 845	610	647	1,088	2,075	996
27			8,981	8,585	2,912	1,776	1,431	655	[b] 323	878	2,462	[b] 890
28			6,627	9,822	2,817	[b] 1,287	733	507	806	865	2,893	1,004
29			[b] 15,155	11,381	2,855	2,674	1,224	756	922	1,097	[b] 2,050	1,442
30			15,532	11,820	2,553	1,393	1,038	[b] 1,312	1,144	1,128	2,318	1,981
31			15,494		[b] 2,001		850	1,005		1,292		1,483

[a] Ice obstruction prevailed during portions of January, February, and March, 1907, and during January and February, 1908. There was some ice obstruction during December, 1908.
[b] Sunday.

Monthly discharge of Black River near Felts Mills, N. Y., for 1907 and 1908.

[Drainage area, 1,850 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1907.					
April	16,800	2,170	6,270	3.39	3.78
May	12,600	2,290	5,450	2.95	3.40
June	3,380	522	1,950	1.05	1.17
July	2,860	802	1,370	.741	.85
August	2,230	10	782	.423	.49
September	3,060	298	1,650	.892	1.00
October	6,580	1,270	3,480	1.88	2.17
November	9,730	2,420	4,780	2.58	2.88
December	11,100	1,260	5,220	2.82	3.25
1908.					
March	15,500	2,500	6,280	3.39	3.91
April	12,800	6,360	8,810	4.76	5.31
May	12,800	2,000	6,900	3.73	4.30
June	3,410	699	2,260	1.22	1.36
July	3,430	502	1,460	.789	.91
August	1,500	507	1,000	.541	.62
September	1,160	323	760	.411	.46
October	1,740	414	1,100	.595	.69
November	2,890	714	1,470	.795	.89
December	2,210	171	1,470	.795	.92

MOOSE RIVER AT MOOSE RIVER, N. Y.

This station is located in Moose River village, and was established June 5, 1900, to obtain general statistical data regarding the flow of Moose River.

It is about 2 miles below the McKeever dam, which is maintained for logging. Just below the station a considerable fall occurs. Occasionally ice and log jams form at an island just above the station. During the winter months discharge is usually affected by ice, the gage being read but once a week during this period.

The elevation of the gage zero was changed on February 28, 1903, from 15.36 feet to 15.53 feet. Conditions for obtaining discharge are fairly good, and a fairly good rating curve has been developed for open-channel conditions.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

Discharge measurements of Moose River at Moose River, N. Y., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1907.					
October 26	H. K. Barrows	263	487	1.45	405
1908.					
May 11	D. M. Wood	226	1,090	4.03	1,970
September 2	C. E. Allen	214	432	1.04	310
October 31	C. R. Adams	212	441	1.00	297

Daily gage height, in feet, of Moose River at Moose River, N. Y., for 1907 and 1908.

[Observer, Chris Hannon.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	2.65	1.35	2.2	4.95	6.15	2.15	2.4	0.95	0.65	1.8	2.4	1.55
2	3.5	1.5	2.55	4.4	4.85	2.55	2.6	.8	.65	1.3	2.45	1.55
3	3.25	1.45	2.5	3.8	4.2	2.0	2.7	.75	1.55	1.3	2.6	1.55
4	3.35	1.3	2.25	3.7	4.6	1.9	2.4	.75	2.15	1.6	4.35	1.65
5	4.35	1.4	2.15	3.6	5.55	1.8	1.95	.65	3.15	2.35	4.1	1.65
6	4.15	1.4	2.1	3.4	4.4	1.9	1.75	.95	2.5	2.3	3.1	1.65
7	3.8	1.4	2.1	3.2	4.2	2.35	2.0	1.2	1.75	2.25	3.45	1.55
8	3.3	1.3	2.1	3.0	4.15	2.75	1.35	1.0	1.5	3.45	4.85	1.45
9	3.25	1.3	2.1	3.1	3.85	2.5	.85	.7	1.25	5.9	4.4	1.65
10	3.05	1 3	2.1	3.0	3.6	2.25	.85	.75	1.15	4.25	3.7	2.75
11	3.0	1.4	2.1	3.15	3.7	2.0	.95	.9	1.15	3.75	3.4	6.1
12	2.85	1.5	2.1	2.75	3.35	1.8	1.05	.8	3.2	3.5	3.1	5.15
13	2.65	1.5	2.1	2.35	3.15	1.6	1.05	.65	2.75	3.25	3.0	4.15
14	2.4	1.5	2.2	2.45	3.0	1.55	1.15	.55	2.25	3.25	2.9	3.35
15	2.2	1.5	2.2	1.65	2.8	1.5	1.2	.55	1.85	3.0	2.75	3.05
16	2.2	1.5	2.1	1.35	2.6	1.45	1.05	.65	1.4	2.75	2.6	2.65
17	2.1	1.5	2.1	1.75	2.45	1.3	.95	.65	1.25	2.5	2.4	2.65
18	2.1	1.5	2.1	2.45	2.4	1.15	.85	.75	1.4	2.2	2.25	2.45
19	2.2	1.5	2.2	1.9	2.55	.95	.95	.75	1.2	2.0	2.15	2.45
20	2.3	1.5	2.3	1.65	2.75	2.8	1.05	.75	1.0	1.8	2.05	2.35
21	2.4	1.6	2.25	1.55	2.7	2.65	1.15	.75	.8	1.85	2.05	2.25
22	2.55	1.7	2.3	1.45	2.55	2.15	1.25	.7	.75	1.75	2.05	2.35
23	2.5	1.8	2.3	1.7	2.45	1.85	1.15	.65	1.15	1.65	2.3	2.45
24	2.35	1.95	2.45	2.15	2.35	1.45	1.05	.6	1.15	1.65	2.25	3.2
25	2.2	2.15	2.8	4.75	2.25	1.35	.95	.25	1.4	1.65	2.15	4.15
26	2.1	2.1	3.05	4.4	2.0	1.25	.85	.25	1.7	1.45	2.15	4.5
27	2.0	2.1	3.2	5.45	2.15	1.3	1.15	.65	1.85	1.9	1.95	3.75
28	1.95	2.1	4.8	4.75	2.45	1.6	1.1	.75	1.9	2.3	1.65	3.65
29	1.8	......	......	4.65	2.45	1.4	1.0	65	2.1	3.25	1.65	3.6
30	1.7	......	......	5.15	2.0	1.6	.95	.65	2.45	3.25	1.65	3.65
31	1.55	......	......	......	1.8	......	.85	.65	......	2.85	......	3.95
1908.												
1	3.75	2.55	......	4.3	6.35	2.3	.8	1.1	1.1	1.5	.9	1.4
2	3.6	2.55	......	4.1	6.2	2.25	.8	1.2	1.0	1.4	.9	1.3
3	3.55	2.45	......	3.8	6.0	2.1	.95	1.2	.9	1.3	.9	1.4
4	3.65	2.35	......	3.6	5.7	2.0	.9	1.3	.9	1.2	.95	1.5
5	3.55	2.2	......	3.6	5.3	1.9	1.1	1.2	1.0	1.1	1.0	1.6
6	3.25	2.05	......	3.4	4.85	1.75	1.4	1.2	1.1	1.0	.9	1.5
7	3.1	2.15	......	3.55	4.35	1.55	1.8	1.1	1.1	.9	.75	1.35
8	2.9	2.15	......	4.15	4.3	1.5	1.65	1.1	1.1	.45	.7	1.2
9	2.75	2.15	......	5.35	4.95	1.4	1.6	1.0	1.0	.2	.7	1.1
10	2.5	2.15	......	5.3	4.5	1.3	1.45	1.0	1.0	.45	.2	1.2
11	2.35	2.05	......	5.25	4.0	1.2	1.2	.9	1.0	.7	.8	1.3
12	2.25	......	......	5.2	4.2	1.1	1.05	1.0	1.0	.8	1.5	1.1
13	2.1	......	......	4.95	4.6	1.05	.9	1.1	1.0	.9	1.45	1.25
14	2.15	......	......	4.3	4.55	2.2	.9	1.2	1.0	.8	1.2	1.5
15	2.15	......	......	4.4	4.3	2.0	.9	1.1	.9	.8	1.05	1.4
16	2.05	......	......	4.4	4.0	2.2	.8	1.1	.85	.9	.8	1.15
17	2.05	......	......	4.55	3.85	2.2	.9	1.0	.8	.9	.7	1.2
18	2.05	......	......	4.85	3.75	2.1	1.0	1.0	.8	1.0	.7	1.1
19	2.05	......	......	4.75	3.45	2.0	1.1	.9	.9	1.0	.7	1.1
20	1.95	......	......	4.45	3.2	1.85	1.1	.9	1.0	.9	.6	1.0
21	1.95	......	......	4.2	3.0	1.65	1.0	.8	1.0	.9	.75	1.05
22	1.95	......	......	4.2	2.95	1.45	1.0	.9	1.0	.8	.8	1.1
23	1.85	......	......	4.3	3.15	1.2	1.0	.9	.9	.8	.9	1.1
24	1.85	......	......	5.15	2.9	1.2	.9	.95	.9	.7	.9	1.0
25	1.85	......	......	6.0	2.6	1.35	.9	1.0	.9	.7	1.0	.9
26	1.85	......	......	6.7	2.45	1.55	.9	1.0	.8	.7	1.9	.8
27	1.95	......	......	7.05	2.35	1.6	1.0	.9	.8	.7	2.25	1.05
28	1.95	......	......	7.2	2.3	1.4	1.1	.9	.8	.8	2.2	1.25
29	1.95	......	5.15	6.2	2.2	1.25	1.1	.8	1.1	.8	1.95	1.1
30	2.25	......	4.85	6.6	2.1	.95	1.05	.9	1.35	.9	1.6	1.0
31	2.55	......	4.6	......	2.2	......	1.0	1.0	......	1.0	......	.9

NOTE.—Ice conditions prevailed from about February 5 to March 31, 1907. Discharge probably affected by ice conditions from January 30 to March 28 and December 4 to 31.

Rating table for Moose River at Moose River, N. Y., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	140	1.60	465	3.00	1,150	4.80	2,780
.30	155	1.70	500	3.10	1,220	5.00	3,020
.40	170	1.80	535	3.20	1,290	5.20	3,260
.50	190	1.90	570	3.30	1,360	5.40	3,520
.60	210	2.00	610	3.40	1,430	5.60	3,790
.70	230	2.10	650	3.50	1,510	5.80	4,070
.80	250	2.20	700	3.60	1,590	6.00	4,360
.90	275	2.30	750	3.70	1,670	6.20	4,660
1.00	300	2.40	800	3.80	1,760	6.40	4,960
1.10	325	2.50	855	3.90	1,850	6.60	5,260
1.20	350	2.60	910	4.00	1,940	6.80	5,580
1.30	375	2.70	965	4.20	2,140	7.00	5,900
1.40	405	2.80	1,025	4.40	2,340	7.20	6,220
1.50	435	2.90	1,085	4.60	2,560		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on four discharge measurements made during 1907 and 1908 and the form of the 1906 curve, and is well defined between gage heights 0.8 foot and 5.5 feet.

Monthly discharge of Moose River at Moose River, N. Y., for 1907 and 1908.

[Drainage area, 346 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
January	2,290	450	988	2.86	3.30	B.
February			272	.786	.82	D.
March			755	2.18	2.51	D.
April	3,580	390	1,430	4.13	4.61	B.
May	4,580	535	1,450	4.19	4.83	B.
June	1,020	288	573	1.66	1.85	B.
July	965	262	406	1.17	1.35	B.
August	350	148	234	.676	.78	B.
September	1,290	220	525	1.52	1.70	B.
October	4,210	375	985	2.85	3.29	B.
November	2,840	482	1,070	3.09	3.45	B.
December	4,510	420	1,240	3.58	4.13	B.
The year		148	827	2.39	32.62	
1908.						
January	1,720	552	851	2.46	2.84	B.
February			834	2.41	2.60	D.
March			1,500	4.34	5.00	D.
April	6,220	1,430	2,990	8.64	9.64	B.
May	4,880	650	2,050	5.92	6.82	B.
June	750	288	499	1.44	1.61	B.
July	535	250	321	.928	1.07	B.
August	375	250	305	.882	1.02	B.
September	390	250	292	.844	.94	B.
October	435	140	271	.783	.90	B.
November	725	140	328	.948	1.06	B.
December			303	.876	1.01	D.
The year	6,220	140	879	2.54	34.51	

NOTE.—Discharge during frozen periods 1907 and 1908 based mainly on the discharge of Oswegatchie River at Ogdensburg, where the flow is not affected by ice conditions. Discharge January 30–31, 1908, 560 second-feet; February 1–15, 400 second-feet; February 16–29, 1,300 second-feet; March 1–28, 1,350 second-feet; December 4–31, 293 second-feet.

ST. LAWRENCE RIVER DRAINAGE BASIN.

GENERAL FEATURES.

St. Lawrence River, the outlet of the Great Lakes system, receives also the flow of a number of New York streams having their sources in a northerly slope of the Adirondacks and fed by the innumerable lakes with which the region is dotted. Some of these rivers, as the Grass, Raquette, and St. Regis, lie entirely within the United States; others, notably Salmon, Trout, Chateaugay, and English rivers, cross the international boundary and flow northward into the St. Lawrence in Canada, as does also Richelieu River, the outlet of Lake Champlain. The following table gives a list of the principal tributaries of the St. Lawrence in the United States, with the areas drained by them:

Drainage areas of St. Lawrence River tributaries in the United States.

	Square miles.		Square miles.
Oswegatchie River	1,609	Salmon River [a]	273
Grass River	637	Trout River [b]	129
Raquette River	1,219	Chateaugay River [b]	199
St. Regis River	910	English River [b]	53
Little Salmon River [a]	103	Lake Champlain [b]	8,187

The St. Lawrence drains, through Lake Champlain, an area of 4,560 square miles in the State of Vermont. This drainage is practically all from Missisquoi, Lamoille, and Winooski rivers and Otter Creek.

OSWEGATCHIE RIVER DRAINAGE BASIN.

DESCRIPTION.

Oswegatchie River has its source in the region of lakes and timbered swamps in the southern part of St. Lawrence County, N. Y. The largest of the lakes is Cranberry Lake, which affords valuable storage to water-power users on its outlet, East Branch of Oswegatchie River. The East and West branches flow in a general northwesterly direction and unite near Talcville. From Gouverneur to Oxbow the river flows southwestward; it then turns sharply and flows northeastward to Rensselaer Falls, turns again to the northwest, receives the outlet of Black Lake at Galilee, and finally enters the St. Lawrence at Ogdensburg. Its total drainage area comprises about 1,600 square miles.

The mean annual precipitation is about 35 inches, and winter conditions are usually severe.

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[a] Above junction near international boundary.
[b] Above New York state line.

The basin affords numerous opportunities for water storage and the utilization of these sites is especially desirable, on account of the quick spilling character of this area and the tendency to floods. Considerable water power is developed, mostly in small units, and there is a large amount of undeveloped power.

The following gaging station has been maintained in this river basin: Oswegatchie River near Ogdensburg, N. Y., 1903-1908.

OSWEGATCHIE RIVER NEAR OGDENSBURG, N. Y.

This station is located at what is known as the Eel Weir highway bridge, about 6 miles upstream from Ogdensburg, N. Y., and one-half mile below Black Lake outlet. It was established May 16, 1903, and has been maintained continuously since that date to obtain information for use in studies of power and storage development on Oswegatchie and Black rivers.

There are three dams in the vicinity of the gaging station on Oswegatchie River, one at Heuvelton about 5 miles above, one at Rensselaer Falls 10 miles above, and one in the city of Ogdensburg about one-half mile above the outlet.

Open-water conditions prevail at this station throughout the year. The stream bed is rocky and permanent and the results are considered fairly good for all stages. The gage datum has remained the same since the beginning of the record.

Information in regard to this station is contained in the annual reports of the state engineer and surveyor, state of New York.

Discharge measurement of Oswegatchie River near Ogdensburg, N. Y., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 9 [a]	C. C. Covert	222	370	4.90	1,120
1908.					
September 9 [b]	C. E. Allen	213	366	4.82	753

[a] Shore ice and ice around piers. River open below for 2 miles until backwater from dam at Ogdensburg interferes. Discharge probably not reduced by the ice conditions.
[b] Measurement poor on account of clogging of meter by eel grass.

Daily gage height, in feet, of Oswegatchie River near Ogdensburg, N. Y., for 1907 and 1908.

[Observer, Joseph H. La Rue.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	5.3	5.6	4.5	8.5	5.8	5.4	4.9	4.5	4.4	4.8	5.1	5.5
2	5.6	5.4	4.6	8.5	6.1	5.3	4.9	4.5	4.4	4.8	5.2	5.4
3	6.4	5.4	4.6	8.2	6.3	5.2	4.9	4.5	4.4	4.9	5.4	5.4
4	6.4	5.4	4.6	8.1	6.4	5.1	4.8	4.5	4.4	5.0	5.4	5.3
5	6.7	5.3	4.8	7.7	6.8	5.2	4.8	4.5	4.5	5.0	5.4	5.3
6	7.4	5.1	4.8	7.3	6.9	5.2	4.8	4.5	4.5	5.1	5.4	5.3
7	7.4	5.0	4.9	7.1	7.3	5.2	4.8	4.5	4.5	5.1	5.8	5.3
8	7.5	4.9	4.8	7.0	7.2	5.3	4.9	4.5	4.6	5.1	6.4	5.2
9	7.5	4.9	4.9	6.8	7.3	5.2	4.9	4.5	4.5	5.1	6.8	5.2
10	7.5	4.9	4.8	6.7	7.4	5.0	4.9	4.5	4.6	5.3	7.0	5.2
11	7.3	4.9	4.8	6.7	7.1	5.0	4.9	4.5	4.6	5.3	7.2	5.4
12	7.0	4.8	4.8	6.7	6.9	5.0	4.9	4.5	4.8	5.4	7.3	5.6
13	6.8	4.9	4.9	6.5	6.6	5.0	4.8	4.5	4.8	5.4	7.3	6.3
14	6.5	4.7	4.9	6.4	6.3	5.0	4.8	4.4	4.8	5.5	7.2	6.3
15	6.6	4.7	4.9	6.2	6.3	4.8	4.7	4.4	4.8	5.5	7.0	6.1
16	6.5	4.6	5.0	6.1	6.2	4.9	4.8	4.4	4.8	5.6	6.8	6.1
17	6.4	4.6	5.2	6.1	6.0	4.9	4.7	4.4	4.8	5.6	6.6	5.9
18	6.4	4.6	5.4	6.0	6.0	4.9	4.6	4.4	4.8	5.4	6.4	6.0
19	6.2	4.6	5.5	5.9	5.8	4.8	4.6	4.4	4.8	5.4	6.2	6.1
20	6.2	4.6	5.7	5.8	5.8	4.8	4.6	4.4	4.8	5.3	6.2	5.8
21	6.6	4.7	5.9	5.7	5.6	4.7	4.6	4.4	4.7	5.3	6.2	5.7
22	7.1	4.7	6.1	5.6	5.5	4.7	4.6	4.4	4.7	5.3	6.1	5.8
23	7.5	4.7	6.3	5.5	5.4	4.7	4.5	4.4	4.7	5.2	6.0	5.8
24	7.1	4.6	6.6	5.3	5.3	4.7	4.6	4.4	4.7	5.3	5.8	5.9
25	6.9	4.6	7.1	5.3	5.3	4.8	4.6	4.4	4.7	5.3	5.8	6.2
26	6.9	4.6	7.3	5.3	5.3	4.8	4.5	4.4	4.7	5.2	5.8	6.4
27	6.6	4.6	7.8	5.3	5.3	4.8	4.5	4.4	4.7	5.2	5.7	6.6
28	6.4	4.6	8.1	5.5	5.3	4.8	4.5	4.4	4.7	5.1	5.6	6.9
29	6.2	......	8.2	5.5	5.2	4.8	4.5	4.4	4.7	5.1	5.5	7.7
30	5.9	......	8.5	5.6	5.6	4.8	4.5	4.4	4.9	5.1	5.5	7.9
31	5.7	......	8.5	......	5.5	......	4.5	4.4	......	5.1	......	8.0
1908.												
1	8.3	5.4	6.1	9.1	6.5	5.6	5.1	5.1	4.7	4.6	4.4	5.0
2	8.3	5.4	6.0	9.2	6.4	5.5	5.1	5.1	4.7	4.5	4.4	4.7
3	8.2	5.4	5.9	8.9	6.2	5.5	5.0	5.1	4.7	4.5	4.4	4.6
4	8.0	5.3	5.9	8.7	7.0	5.5	5.0	5.1	4.7	4.5	4.4	4.6
5	7.7	5.2	5.9	8.4	7.4	5.4	5.1	5.1	4.7	4.5	4.4	4.7
6	7.6	5.2	5.9	8.1	7.4	5.3	5.0	5.1	4.7	4.5	4.4	4.7
7	7.4	5.1	5.9	7.9	7.5	5.3	5.0	5.0	4.7	4.5	4.4	4.6
8	7.1	5.1	5.8	7.6	7.9	5.3	5.1	5.0	4.7	4.5	4.4	4.6
9	6.7	5.0	5.7	7.5	8.1	5.3	4.9	5.0	4.7	4.5	4.4	4.6
10	6.4	5.0	5.7	7.3	8.3	5.2	4.9	5.0	4.7	4.5	4.4	4.6
11	6.4	4.9	5.7	7.6	8.3	5.1	4.9	5.0	4.7	4.6	4.4	4.6
12	6.2	4.9	5.6	7.5	8.4	5.1	4.9	4.9	4.6	4.5	4.4	4.6
13	6.0	4.9	5.6	7.5	8.3	5.0	4.8	5.0	4.6	4.5	4.4	4.6
14	6.0	5.0	5.9	7.4	8.2	5.0	4.8	4.9	4.6	4.5	4.5	4.6
15	5.8	5.2	6.5	7.3	8.2	5.0	4.8	4.9	4.6	4.5	4.4	4.6
16	5.8	5.7	7.2	7.1	8.1	4.9	4.8	4.8	4.6	4.5	4.4	4.6
17	5.8	5.9	8.2	7.0	7.9	5.0	4.8	4.8	4.6	4.4	4.4	4.6
18	5.8	7.1	8.2	7.0	7.5	5.2	4.8	4.8	4.6	4.4	4.4	4.6
19	5.6	7.2	8.4	6.8	7.4	5.4	4.8	4.8	4.5	4.4	4.5	4.6
20	5.5	7.6	8.3	6.8	7.1	5.5	4.9	4.8	4.5	4.4	4.6	4.6
21	5.4	7.5	8.1	6.6	6.8	5.3	4.9	4.8	4.5	4.4	4.6	4.6
22	5.4	7.4	7.8	6.5	6.8	5.2	5.1	4.8	4.5	4.4	4.6	4.6
23	5.4	7.3	7.8	6.3	6.8	5.3	5.2	4.8	4.5	4.4	4.6	4.6
24	5.6	7.2	7.7	6.1	6.7	5.4	5.2	4.7	4.5	4.4	4.6	4.6
25	5.7	7.0	8.0	6.1	6.7	5.2	5.3	4.7	4.5	4.4	4.6	4.6
26	5.6	6.8	7.8	6.5	6.5	5.2	5.4	4.7	4.5	4.4	4.7	4.6
27	5.6	6.6	8.1	6.0	6.4	5.2	5.4	4.7	4.5	4.4	4.8	4.6
28	5.6	6.4	8.3	6.0	6.1	5.2	5.4	4.7	4.5	4.4	4.7	4.6
29	5.5	6.2	8.6	6.3	6.0	5.2	5.4	4.7	4.6	4.4	4.7	4.6
30	5.5	......	8.8	6.1	5.9	5.2	5.3	4.7	4.6	4.4	4.7	4.6
31	5.5	......	9.0	......	5.8	......	5.2	4.7	......	4.4	......	4.6

NOTE.—Owing to swiftness of current this stream is not ordinarily affected by ice conditions at this station except occasionally, due to backwater from ice collecting below.

Rating table for Oswegatchie River near Ogdensburg, N. Y., for 1903 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.40	590	5.50	2,180	6.60	5,185	7.70	8,450
4.50	680	5.60	2,400	6.70	5,480	7.80	8,750
4.60	780	5.70	2,640	6.80	5,775	7.90	9,050
4.70	890	5.80	2,890	6.90	6,070	8.00	9,350
4.80	1,010	5.90	3,160	7.00	6,365	8.20	9,960
4.90	1,140	6.00	3,440	7.10	6,660	8.40	10,570
5.00	1,280	6.10	3,730	7.20	6,955	8.60	11,180
5.10	1,440	6.20	4,020	7.30	7,250	8.80	11,790
5.20	1,610	6.30	4,310	7.40	7,550	9.00	12,400
5.30	1,790	6.40	4,600	7.50	7,850	9.20	13,020
5.40	1,980	6.50	4,890	7.60	8,150		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 20 discharge measurements made during 1903-1907. Although the discharge measurements plot somewhat erratically, due to poor measuring conditions, the curve can be considered fairly well defined, owing to the tendency for errors of measurement to compensate and the permanency of conditions of flow at this point from year to year.

Monthly discharge of Oswegatchie River near Ogdensburg, N. Y., for 1907 and 1908.

[Drainage area, 1,580 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
January	7,850	1,790	5,390	3.41	3.93	B.
February	2,400	780	1,140	.722	.75	B.
March	10,900	680	3,380	2.14	2.47	B.
April	10,900	1,790	4,800	3.04	3.39	B.
May	7,550	1,610	3,910	2.47	2.85	B.
June	1,980	890	1,250	.791	.88	B.
July	1,140	680	909	.575	.66	B.
August	680	590	628	.397	.46	B.
September	1,010	590	847	.536	.60	B.
October	2,400	1,010	1,670	1.06	1.22	B.
November	7,250	1,440	3,940	2.49	2.78	B.
December	9,350	1,610	3,550	2.25	2.59	B.
The year	10,900	590	2,620	1.66	22.58	
1908.						
January	10,300	1,980	4,420	2.80	3.23	B.
February	8,150	1,140	3,650	2.31	2.49	B.
March	12,400	2,400	6,560	4.15	4.78	B.
April	13,000	3,440	7,100	4.49	5.01	B.
May	10,600	2,890	6,930	4.39	5.06	B.
June	2,400	1,140	1,710	1.08	1.20	B.
July	1,980	1,010	1,370	.867	1.00	B.
August	1,440	890	1,130	.715	.82	B.
September	890	680	787	.498	.56	B.
October	780	590	643	.407	.47	B.
November	1,010	590	688	.435	.49	B.
December	1,280	780	807	.511	.59	B.
The year	13,000	590	2,980	1.89	25.70	

NOTE.—The river does not freeze over at this point, owing to the swiftness of the current. There may, however, be occasional backwater from ice collecting below the station.

RAQUETTE RIVER DRAINAGE BASIN.

DESCRIPTION.

Raquette River drains a long, narrow basin, extending from northern Hamilton County to St. Lawrence River. Its sources are on an elevated plateau, dotted with mountains, interspersed with lakes and in general timbered, and containing numerous marsh areas, many of which are on the divide, and feed streams flowing into adjacent drainages.

The mean annual precipitation is about 38 inches, ranging from about 42 inches in the headwaters to 32 inches near the St. Lawrence.

Winter conditions are the usual ones occurring in the Adirondack region, and snow and ice prevail for several months.

Raquette River presents remarkable storage possibilities and has been very extensively studied by the state water supply commission of New York. They propose a large reservoir at Tupper Lake to afford an effective storage of about 10,000,000,000 cubic feet. They further estimate that about double this amount will be required to adequately regulate the flow of the river. This additional storage it is planned to obtain by a system of smaller reservoirs, involving the following lakes and ponds: Little Tupper, Forked, Raquette, Blue Mountain, Utowana, Brandreth, Horseshoe, and Long lakes, South and Slim ponds, and Dead Creek.

Raquette River is very important in its power possibilities, and, in the words of the state water supply commission, "presents in many ways one of the most attractive fields for water power and storage studies of any stream in the State."

The following gaging stations have been maintained in this basin:

Raquette River at Raquette Falls, near Coreys, N. Y., 1908.
Raquette River at Piercefield, N. Y., 1908.
Raquette River at South Calton, N. Y., 1904.
Raquette River at Massena Springs, N. Y., 1903–1908.
Bog River at Tupper Lake, N. Y., 1908.

RAQUETTE RIVER AT RAQUETTE FALLS, N. Y.

This station is located near the center of Raquette Falls, about 8 miles by river upstream from the settlement of Axton, which is 12 miles by road from the village of Tupper Lake. It was established August 27, 1908, and is maintained to obtain data regarding the discharge of Raquette River at this point to be used in the development of the storage possibilities of Raquette River drainage under the direction of the state water supply commission of New York.

A good rating curve has not yet been developed for this station, although fair estimates of discharge are given. The gage readings are obtained by a self-recording gage, which is checked by hydrographers and others who periodically visit the station. The zero of the gage is at elevation 1,606.16 above mean tide as based on the levels of the state water supply commission. The datum of the gage has remained the same since the establishment of the station.

Information in regard to this station is contained in the annual reports of the state water supply commission of New York.

Discharge measurements of Raquette River at Raquette Falls, near Coreys, N. Y., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 31	C. E. Allen	58.0	95.5	1.25	99.2
September 6	do	55.0	93.4	1.21	92.0
September 17	do	50.0	80.7	.90	59.8
September 23	do	49.0	79.0	.85	53.9
October 12	C. R. Adams	40.0	98.1	1.40	15.4

Daily gage height, in feet, of Raquette River at Raquette Falls, near Coreys, N. Y., for 1908.

Day.	Aug.	Sept.	Oct.	Nov.	Day.	Aug.	Sept.	Oct.	Nov.
1		1.25	1.16	1.30	16		0.96	1.32	
2		1.24	1.26	1.18	17		.94	1.31	
3		1.23	1.36	1.19	18		.90	1.29	
4		1.22	1.40	1.25	19		.85	1.26	
5		1.21	1.40		20		.85	1.22	
6		1.19	1.40		21		.85	1.18	
7		1.16	1.40		22		.85	1.13	
8		1.13	1.40		23		.85	1.10	
9		1.10	1.40		24		.84	1.11	
10		1.07	1.40		25		.83	1.12	
11		1.04	1.40		26		.82	1.14	
12		1.02	1.40		27	1.37	.81	1.18	
13		1.00	1.37		28	1.33	.88	1.23	
14		.99	1.35		29	1.29	.96	1.28	
15		.97	1.34		30	1.25	1.06	1.33	
					31	1.25		1.36	

NOTE.—Gage heights September 30 to October 10 and November 3 are based on comparison with gage readings of Bog River at Tupper Lake, N. Y.

Rating table for Raquette River at Raquette Falls, near Coreys, N. Y., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	52.5	1.20	90.0
.90	58.5	1.30	113
1.00	66.0	1.40	150
1.10	75.8		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1908 and is fairly well defined between gage heights 0.8 foot and 1.4 feet.

Monthly discharge of Raquette River at Raquette Falls, near Coreys, N. Y., for 1908.

[Drainage area, 418 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
August 27–31	138	100	114	0.273	0.05	B.
September	100	53.1	69.3	.166	.19	B.
October	150	77.1	117	.280	.32	B.
November 1–4	113	86.9	97.1	.232	.03	B.

RAQUETTE RIVER AT PIERCEFIELD, N. Y.

This station is located at the head of Black Rapids, about one-half mile downstream from the dam of the International Paper Company in the town of Piercefield. It was established August 20, 1908, to obtain data for use in studies of water power and storage problems.

Black Rapids commence about 100 feet below the station. Discharge measurements at ordinary stages are made by means of a boat held in place by a wire cable. At high stages it is proposed to use the highway bridge just above the dam. The vertical staff gage is located one-third mile upstream from the measuring section and is about 1,000 feet below the International Paper Company's tailrace. Little or no fall occurs between the gage and the measuring section. The datum of the gage has remained the same since the establishment of the station. The bed of the river is rocky and quite rough, but permanent, and a good rating curve has been developed for low stages.

Information in regard to this station is contained in the annual reports of the state water supply commission of New York.

Discharge measurements of Raquette River at Piercefield, N. Y., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Dis-charge.
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 21	C. E. Allen	96	521	2.46	627
September 3	do	96	463	1.89	426
September 11	do	87	352	.46	131
September 15	do	87	349	.45	132
November 1	C. R. Adams	86	309	.15	101

Daily gage height, in feet, of Raquette River at Piercefield, N. Y., for 1908.

[Observer, W. B. Graves.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.98	0.05	0.12	1.15	16		0.50	0.08	0.48	1.00
2		1.95	.05	.12	1.20	17		.48	.08	.50	1.25
3		1.92	.05	.12	1.20	18		.48	.08	.50	1.30
4		1.88	.02	.18	1.20	19		.48	.10	.50	1.25
5		1.82	.02	.20	1.20	20	2.50	.45	.10	.50	1.25
6		1.80	.02	.20	1.20	21	2.48	.48	.12	.50	1.50
7		1.78	.10	.30	1.80	22	2.42	.48	.12	.50	1.60
8		1.75	.02	.22	2.45	23	2.40	.50	.12	.50	2.30
9		1.50	.02	.35	2.65	24	2.35	.45	.08	.50	2.10
10		1.42	.10	.35	2.35	25	2.30	.45	.10	.50	1.45
11		.82	.10	.40	1.90	26	2.22	.45	.12	.65	1.85
12		.50	.12	.40	1.60	27	2.18	.45	.12	.80	1.60
13		.50	.15	.38	1.30	28	2.12	.45	.12	.90	1.75
14		.55	.08	.40	1.10	29	2.08	.25	.12	.88	3.00
15		.48	.08	.45	1.10	30	2.05	.00	.12	1.08	2.65
						31	2.00		.12		2.65

NOTE.—Flow at this point is not natural, being affected by storage. River partly frozen over November 17 to 26 and December 4 to 31.

Rating table for Raquette River at Piercefield, N. Y., for 1908.

Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	90	0.80	176	1.60	344	2.40	604
.10	97	.90	192	1.70	371	2.50	642
.20	106	1.00	210	1.80	400	2.60	682
.30	115	1.10	228	1.90	430	2.70	725
.40	125	1.20	249	2.00	462	2.80	770
.50	136	1.30	270	2.10	497	2.90	818
.60	148	1.40	293	2.20	532	3.00	868
.70	162	1.50	318	2.30	568		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1908 and is well defined.

Monthly discharge of Raquette River at Piercefield, N. Y., for 1908.

[Drainage area, 723 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
August 20-31	642	462	554	0.766	0.34	A.
September	456	90	220	.304	.34	A.
October	101	91	95.9	.133	.15	A.
November	224	98	133	.184	.21	A.
December	868	210	387	.535	.62	A.

NOTE.—Conditions of flow during November 17 to 26 and December 4 to 31 assumed unaffected by ice on the basis of a discharge measurement made January 5, 1909, which agreed well with the open-channel rating.

RAQUETTE RIVER AT MASSENA SPRINGS, N. Y.

This station is located at the highway bridge at Massena Springs, N. Y. It was established September 21, 1903, was temporarily discontinued October 17, 1903, and resumed April 9, 1904. It is maintained to obtain data regarding the total flow of the river.

The nearest power development is at Raymondville, about 8 miles above the station. The Sunday flow of this stream is often held back during the low water season while ponds at mills above are being refilled, and under these conditions the effect may be shown in the stream for several days.

All gage heights during 1906 and thereafter are referred to a datum which is 1 foot below that which was used previously, this change being made to obviate minus gage readings. Conditions for obtaining accurate discharge are good, and a good rating table has been developed. During the winter months the discharge is affected by ice.

Information in regard to this station is contained in the annual reports of the state water supply commission of New York and the state engineer and surveyor, State of New York.

Discharge measurements of Raquette River at Massena Springs, N. Y., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 8 [a]	C. C. Covert	171	332	4.15	556
1908.					
May 13	D. M. Wood	176	1,640	9.31	8,370
September 8	C. E. Allen	150	271	1.48	368
September 25	do	146	270	1.70	380
October 16	C. R. Adams	141	247	1.33	279

[a] Measurement made under ice conditions. Gage height to top of ice, 4.45 feet; average thickness of ice, 2.59 feet.

Daily gage height, in feet, of Raquette River at Massena Springs, N. Y., for 1907 and 1908.

[Observers, C. A. Waitt and C. M. Lincoln.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907. [a]												
1	6.3	5.6	4.0	10.2	6.5	4.8	3.9	2.5	1.8	2.6	3.9	4.3
2	7.1	5.4	4.1	9.4	6.4	4.0	4.1	2.0	2.0	2.7	3.9	7.4
3	6.9	5.4	4.5	8.4	6.1	4.7	3.9	1.6	1.9	2.8	3.9	7.4
4	6.8	5.3	4.4	7.6	6.0	4.3	3.1	1.8	1.9	2.8	3.9	7.5
5	7.1	5.6	4.5	6.6	7.8	4.1	2.7	2.3	2.1	3.0	4.0	7.5
6	7.9	4.9	5.2	5.8	7.8	4.1	3.4	2.4	2.1	1.9	4.0	6.6
7	7.5	4.4	4.9	5.6	7.2	4.2	3.0	2.7	1.9	2.4	5.5	6.4
8	6.9	5.0	4.4	6.5	6.9	4.4	2.4	2.5	1.7	2.6	5.5	5.6
9	6.4	5.1	5.0	6.1	6.7	4.2	3.5	2.1	1.8	3.2	5.5	5.6
10	6.5	5.0	4.0	6.0	6.7	4.4	3.0	2.4	2.1	3.7	5.4	5.4
11	6.2	4.9	4.1	5.7	6.7	4.4	3.1	2.3	1.9	4.1	5.2	5.4
12	6.2	4.9	4.4	6.2	6.2	3.6	3.3	2.0	1.8	4.3	5.0	5.1
13	6.2	4.9	4.5	5.9	6.4	3.4	3.3	2.0	1.8	4.3	5.0	4.9
14	5.6	3.8	4.0	5.5	6.5	3.6	2.6	2.0	1.8	4.4	4.8	5.0
15	6.3	5.0	5.1	5.7	6.5	3.3	3.1	1.8	1.7	4.7	4.8	5.6
16	5.9	4.9	5.2	5.6	6.1	3.0	3.7	1.7	1.7	4.6	4.6	6.5
17	5.6	4.7	4.5	4.7	5.8	3.2	3.4	1.7	1.6	4.4	4.7	7.6
18	5.5	4.5	7.2	4.9	5.9	3.0	3.5	1.8	1.5	4.3	4.9	7.7
19	5.5	4.6	7.0	4.8	5.8	2.7	3.5	2.0	1.5	4.2	4.6	7.7
20	7.6	4.7	6.8	4.7	5.6	2.9	3.2	1.8	1.5	4.2	4.5	7.7
21	9.1	3.9	5.7	3.9	6.5	3.2	2.7	2.1	2.3	4.3	4.5	7.4
22	6.6	4.7	5.5	4.0	6.0	3.3	3.1	2.1	2.5	4.2	4.5	7.4
23	6.4	4.7	8.0	3.8	5.8	2.8	3.5	1.8	2.4	4.0	4.4	7.5
24	6.2	4.1	9.2	3.7	5.6	3.3	3.2	1.6	2.4	4.0	4.2	7.7
25	6.1	3.9	8.0	4.3	5.5	3.5	3.1	1.7	2.3	3.8	4.0	7.7
26	5.8	4.6	8.0	4.7	5.2	3.1	3.3	2.1	2.3	3.8	3.9	7.8
27	5.5	4.7	7.4	4.8	4.9	3.0	3.3	1.9	2.4	3.9	3.9	7.8
28	4.8	4.0	8.7	4.3	5.3	3.4	2.5	2.0	2.4	3.9	4.0	10.1
29	6.0	......	12.0	4.6	5.4	3.3	2.8	2.0	1.7	3.7	4.0	10.8
30	5.5	......	11.0	4.4	5.2	2.9	2.9	1.8	2.6	3.7	4.0	10.8
31	5.5	......	11.4	......	4.7	......	2.9	1.6	......	3.9	......	8.6
1908. [b]												
1	8.6	5.9	......	......	8.0	6.4	3.0	2.1	2.0	1.0	1.3	2.4
2	8.6	5.9	......	......	8.6	6.0	2.7	1.5	2.2	1.1	1.4	2.0
3	7.9	5.6	......	......	8.6	5.5	2.4	1.7	1.6	1.1	1.4	2.0
4	7.9	5.5	......	......	8.6	5.1	2.1	1.8	1.4	1.2	1.0	1.7
5	7.9	5.5	......	......	8.7	5.0	2.0	2.0	1.4	1.2	.8	1.5
6	6.9	5.3	......	8.6	8.9	5.0	4.0	2.0	1.4	1.4	.8	2.0
7	6.9	5.4	......	7.5	8.9	4.9	3.1	2.0	1.5	1.5	1.0	2.2
8	7.1	5.4	......	7.5	9.0	4.9	2.5	1.8	1.8	1.5	1.0	2.2
9	7.0	5.2	......	7.1	9.1	4.5	2.0	1.4	1.9	1.5	1.1	2.5
10	6.4	5.2	......	6.8	9.1	4.4	2.0	1.9	1.8	1.4	1.1	2.8
11	6.4	5.0	......	7.6	9.2	4.0	1.6	2.0	1.8	1.2	1.5	2.8
12	6.9	5.0	......	6.2	9.3	3.9	1.6	1.7	1.8	1.1	1.4	3.1
13	7.0	4.8	......	7.1	9.3	3.9	2.2	1.7	1.9	1.1	1.4	3.0
14	7.0	5.0	......	6.9	8.9	4.0	2.0	2.0	1.9	1.3	1.6	2.8
15	6.8	5.0	......	6.7	8.5	4.6	1.5	2.2	1.4	1.3	1.6	2.8
16	6.8	......	......	6.7	8.4	3.9	1.9	1.6	1.3	1.2	1.4	2.7
17	6.8	......	......	6.7	8.4	3.0	2.0	2.6	1.3	1.1	1.4	2.2
18	6.9	......	......	6.6	8.1	2.9	2.0	2.6	1.2	1.4	1.6	2.4
19	6.9	......	......	6.1	8.0	2.9	2.0	2.4	1.0	.9	1.8	2.4
20	6.6	......	......	5.9	7.7	2.9	3.1	1.6	.9	1.2	1.8	2.7
21	6.6	......	......	5.8	7.5	2.8	3.1	1.6	.7	1.1	1.8	3.0
22	5.4	......	......	5.6	7.5	2.8	3.8	1.5	.7	1.1	1.6	3.0
23	5.9	......	......	5.6	7.4	2.7	3.5	1.5	.7	1.1	1.7	2.9
24	5.9	......	......	5.6	7.2	2.5	3.1	1.9	.7	1.2	2.3	2.7
25	5.9	......	......	5.8	6.9	2.5	3.1	2.0	1.5	1.2	2.6	2.6
26	6.0	......	......	6.0	6.5	2.3	2.0	2.0	1.5	1.4	2.0	2.6
27	6.0	......	......	6.3	6.5	2.3	2.1	1.8	1.4	1.4	2.7	3.0
28	6.1	......	......	6.8	6.5	2.7	2.3	1.8	1.1	1.2	2.2	2.9
29	6.0	......	......	7.3	6.4	2.9	2.4	1.8	1.1	1.2	1.6	2.9
30	6.0	......	......	7.3	6.4	3.0	2.1	1.6	1.0	1.2	2.7	2.9
31	5.9	......	......	......	6.4	......	2.1	1.8	......	1.1	......	2.7

[a] Ice conditions prevailed from January 1 to March 30, and during December, 1907. During the frozen periods 1907 gage heights are to water surface in a hole in the ice, except during the first few days in January.

[b] Discharge probably affected by ice conditions from about January 11 to April 5 and December 6–31, 1908. Gage readings during the winter months, 1908, were taken to water surface.

Rating table for Raquette River at Massena Springs, N. Y., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.70	105	2.00	605	3.30	1,500	5.20	3,200
.80	130	2.10	660	3.40	1,580	5.40	3,400
.90	155	2.20	720	3.50	1,660	5.60	3,600
1.00	185	2.30	780	3.60	1,740	5.80	3,820
1.10	215	2.40	845	3.70	1,825	6.00	4,040
1.20	250	2.50	910	3.80	1,910	6.20	4,260
1.30	285	2.60	980	3.90	1,995	6.40	4,490
1.40	325	2.70	1,050	4.00	2,080	6.60	4,730
1.50	365	2.80	1,120	4.20	2,260	6.80	4,970
1.60	405	2.90	1,195	4.40	2,440	7.00	5,230
1.70	450	3.00	1,270	4.60	2,620	8.00	6,600
1.80	500	3.10	1,345	4.80	2,800	9.00	8,050
1.90	550	3.20	1,420	5.00	3,000	10.00	9,600

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 23 discharge measurements made during 1903–1908, and is well defined between gage heights 1.0 foot and 10 feet. This rating differs materially from that published in the Fourth Annual Report of the State Water Supply Commission of New York. Revision was made on the basis of new data available since the time of the publication of the earlier table.

Monthly discharge of Raquette River at Massena Springs, N. Y., for 1907 and 1908.

[Drainage area, 1,170 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1907.						
January			3,000	2.56	2.95	D.
February			650	.556	.58	D.
March			2,000	1.71	1.97	D.
April	9,920	1,820	3,790	3.24	3.62	A.
May	6,320	2,710	4,210	3.60	4.15	A.
June	2,800	1,050	1,770	1.51	1.68	A.
July	2,170	845	1,430	1.22	1.41	A.
August	1,050	405	616	.526	.61	A.
September	980	365	606	.518	.58	A.
October	2,710	550	1,850	1.58	1.82	A.
November	3,500	2,000	2,540	2.17	2.42	A.
December			2,000	1.71	1.97	D.
The year	9,920	365	2,040	1.74	23.76	
1908.						
January	7,450		3,000	2.56	2.95	D.
February			2,000	1.71	1.84	D.
March			4,000	3.42	3.94	D.
April		3,600	5,360	4.58	5.11	A.
May	8,500	4,490	6,670	5.70	6.57	A.
June	4,490	780	1,990	1.70	1.90	A.
July	2,080	365	902	.771	.89	A.
August	980	325	545	.466	.54	A.
September	720	105	343	.293	.33	B.
October	365	155	260	.222	.26	B.
November	1,050	130	434	.371	.41	B.
December	845		673	.575	.66	D.
The year	8,500	105	2,180	1.86	25.40	

NOTE.—Discharge January to March and December, 1907, estimated on the basis of the discharge of Oswegatchie River at Ogdensburg, N. Y. The values given for these periods can only be considered as very rough estimates.

Discharge during the frozen periods, 1907–8, based mainly on the discharge of Oswegatchie River at Ogdensburg, where the flow is not affected by ice conditions. Discharge December 6–31, 1908, also based on a field inspection made January 6, 1909.

Discharge January 11–31, 1908, 1,590 second-feet; April 1–5, 1908, 8,000 second-feet: December 6–31, 1908, 692 second-feet.

The values given for these periods can only be considered as very rough estimates.

BOG RIVER NEAR TUPPER LAKE, N. Y.

This station is located above Bog River Falls and is about 300 feet below the forks of Tupper Lake Stream and Bog River, and about 2½ miles above Big Tupper Lake in the town of Piercefield. It was established August 24, 1908, to obtain data for use in water-power and storage investigations.

The bed of the stream is sandy with scattered bowlders, but it is probably permanent, and a good low-water rating curve has been developed. Discharge measurements are made at a wire cable, either by wading or from a boat. The staff gage is located about 2½ miles downstream at the head of Bog River Falls and is within a few rods of Big Tupper Lake.

There is no regular gage reader here, gage readings during 1908 being obtained either by a recording gage or by hydrographers and other engineers who periodically visit the station.

The elevation of the zero of the gage, based on the United States Geological Survey bench mark at Tupper Lake junction, according to the levels of the state water supply commission of New York, is 1,563.76 feet above mean tide.

Information in regard to this station is contained in the annual reports of the state water supply commission of New York.

Discharge measurements of Bog River near Tupper Lake, N. Y., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 24	Adams and Allen	55.0	113	1.55	97.7
August 29	C. E. Allen	54.0	108	1.50	93.4
September 4	do	54.0	97.3	1.36	63.9
September 16	do	43.0	64.5	.84	14.8
September 20	do	39.0	60.6	.74	12.2
October 7	C. R. Adams	47.0	82.0	1.15	42.8

Daily gage height, in feet, of Bog River near Tupper Lake, N. Y., for 1908.

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1		1.48	1.11	11		1.00	1.06	21		0.74	0.60
2		1.46	1.11	12		.90	1.15	22		.74	.60
3		1.44	1.18	13		.88	1.09	23		.74	.60
4		1.36	1.12	14		.86	1.03	24	1.55	.74	
5		1.36	1.12	15		.85	.97	25	1.55	.74	
6		1.34	1.10	16		.84	.91	26	1.54	.74	
7		1.32	1.09	17		.80	.85	27	1.54	.74	
8		1.32	1.13	18		.77	.79	28	1.51	.83	
9		1.24	1.11	19		.75	.73	29	1.50	.92	
10		1.11	1.10	20		.74	.67	30	1.51	1.01	
								31	1.50		

NOTE.—Gage heights September 21 to 30, and October 13 to 23 based on comparisons with Raquette River at Raquette Falls and Piercefield.

Rating table for Bog River near Tupper Lake, N. Y., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	7.5	1.20	45.6
.70	10.0	1.30	58.2
.80	14.1	1.40	72.4
.90	19.7	1.50	89.5
1.00	26.7	1.60	109
1.10	35.2		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1908, and is well defined between gage heights 0.7 foot and 1.6 feet.

Monthly discharge of Bog River near Tupper Lake, N. Y., for 1908.

[Drainage area, 132 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
August 24–31	99.0	89.5	94.2	0.714	0.21	A.
September	85.9	11.6	32.1	.243	.27	B.
October 1–23	43.4	7.5	27.1	.205	.18	B.

CHATEAUGAY RIVER DRAINAGE BASIN.

DESCRIPTION.

Chateaugay River rises in northern New York, flows northeastward, and unites with the St. Lawrence about 20 miles north of the international boundary. Its basin affords considerable opportunity for storage, principally in the Upper and Lower Chateaugay lakes, which lie on the north slope of the Adirondacks, and for its size, its total drainage area being only 199 square miles, it is rather an important stream for power, much of which is undeveloped.

The following gaging station has been maintained in this river basin: Chateaugay River at Chateaugay, N. Y., 1908.

CHATEAUGAY RIVER NEAR CHATEAUGAY, N. Y.

This temporary station was located about 1,200 feet upstream from the dam of the Chasm Power Company, which is about 3 miles by road from Chateaugay. It is about 9 miles below Lower Chateaugay Lake, and was established August 18, 1908, to obtain data regarding the low-water flow of Chateaugay River, and was discontinued December 12, 1908.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

Discharge measurements of Chateaugay River near Chateaugay, N. Y., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 18 [a]	G. M. Brett	57	62.0	1.68	112
August 19 [a]	....do	54	50.7	1.48	73.9
September 16 [b]	C. R. Adams	48	64.3	1.63	116
November 8 [a]	....do	52	35.9	1.29	37.5

[a] Measurement made by wading. [b] Measurement made from bridge.

Daily gage height, in feet, of Chateaugay River near Chateaugay, N. Y., for 1908.

[Observer, W. E. Thayer.]

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		1.45		1.60	16		1.78	1.65	
2		1.42		1.65	17		1.72	1.65	
3		1.38		1.35	18		1.42	1.65	
4		1.50		1.62	19		1.68	1.62	
5		1.42	1.52	1.50	20		1.65	1.65	
6		1.45	1.55	1.75	21	1.62	1.68	1.55	
7		1.40	1.62	1.75	22	1.45	1.60	1.65	
8		1.25	1.68	1.65	23	1.45	1.58	1.65	
9		1.35	1.55	1.40	24	1.62	1.62	1.65	
10		1.45	1.65	1.60	25	1.45	1.40	1.65	
11		1.30	1.78	1.60	26	1.38	1.72	1.62	
12		1.55	1.65	1.50	27	1.32	1.68	1.58	
13		1.55	1.65		28	1.35	1.72	1.65	
14		1.20	1.62		29	1.48	1.60	1.58	
15		1.60	1.65		30	1.50		1.65	

Rating table for Chateaugay River near Chateaugay, N. Y., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.20	38	1.60	98
1.30	48	1.70	124
1.40	61	1.80	156
1.50	77		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1908 and is well defined.

Monthly discharge of Chateaugay River near Chateaugay, N. Y., for 1908.

[Drainage area, 119 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
September 21-30	103	51	72.7	0.611	0.23	A.
October	150	38	86.8	.729	.84	A.
November	150	77	104	.874	.98	A.
December 1-12	140	54	97.3	.818	.37	A.

NOTE.—Discharge estimated October 30 to November 4.

LAKE CHAMPLAIN DRAINAGE BASIN.

DESCRIPTION.

Lake Champlain occupies a long and narrow valley, extending in a north-south direction and forming a part of the boundary between New York and Vermont. The elevation of the lake is about 95 feet above tide, and the water-surface area is 436 square miles.

The drainage basin is irregular in form, being about 75 miles wide from a point opposite Middlebury, Vt., northward to the outlet of the lake at Rouse Point, on the international boundary. South of Middlebury the average width of the basin is about 35 miles, and the lake itself is very narrow, forming virtually a drowned river.

The tributary region is rugged and mountainous, mostly covered with little depth of soil except in the stream valleys. The drainage is received almost entirely through large tributaries, there being little direct coast drainage into the lake. The outlet of the lake is Richelieu River, which flows northward from Rouse Point to St. Lawrence River. The total drainage area at the mouth of the lake is about 7,900 square miles (including lake surface).

The following gaging stations have been maintained in this river basin:

Lake Champlain at Burlington, Vt., 1907-8.
Richelieu River at Fort Montgomery, N. Y., 1875-1908.
Winooski River at Richmond, Vt., 1903-1907.
Otter Creek at Middlebury, Vt., 1903-1907.
Poultney River at Fairhaven, Vt., 1908.
Mettawee River at Whitehall, N. Y., 1908.
Lake George Outlet at Ticonderoga, N. Y., 1904-5.
Bouquet River at Willsboro, N. Y., 1904 and 1908.
Au Sable River at Keeseville, N. Y., 1904 and 1908.
Saranac River at Saranac Lake, N. Y., 1902-3.
Saranac River at Plattsburg, N. Y., 1903-1908
Big Chazy River at Mooers, N. Y., 1908.

ICE CONDITIONS ON LAKE CHAMPLAIN.

Lake Champlain does not usually close over in its wider portions until the latter part of January. Occasionally the period of closure will not occur until February, and sometimes will last only for a few days.

The date of freezing over at Rouse Point from 1897 to 1908 is as follows:

Year.	Frozen over.	Year.	Frozen over.	Year.	Frozen over.
1897	Dec. 19	1901	Dec. 5	1905	Dec. 5
1898	Dec. 14	1902	Dec. 7	1906	Dec. 3
1899	[a]Dec. 7	1903	Nov. 30	1907	Dec. 5
1900	Dec. 11	1904	Dec. 1	1908	Dec. 6

[a] Lake opened again for short time December 28.

The dates of breaking up of ice on Lake Champlain, 1897 to 1909, are as follows:[a]

Year.	Ice broke up.	Steamers commenced running between Burlington and Plattsburg.	Year.	Ice broke up.	Steamers commenced running between Burlington and Plattsburg.
1897	Apr. 7	Apr. 10	1904	Apr. 18	Apr. 19
1898	Mar. 25	Mar. 26	1905	Apr. 14	Apr. 17
1899	Apr. 19	Apr. 20	1906	..do....	Do.
1900	Apr. 20	Apr. 21	1907	Apr. 16	Apr. 18
1901	Apr. 15	Apr. 17	1908	Apr. 14	Apr. 20
1902	Apr. 5	Apr. 7	1909	Apr. 13	Apr. 19
1903	Mar. 17	Mar. 25			

CHAMPLAIN CANAL AND GLENS FALLS FEEDER, NEW YORK.

The discharge of Hudson River at both Fort Edward and Mechanicville is diminished somewhat by the water required for operating the Champlain Canal. In the northern portion of this canal—from Northumberland to Lake Champlain, at Whitehall—the summit level (between Fort Edward and Fort Ann) is supplied (1) by the Glens Falls feeder, a branch canal, leaving Hudson River about 2 miles above Glens Falls, and (2) by Wood Creek. At Northumberland the canal crosses the Hudson, and the southern portion receives its principal water supply here.

The quantity of water diverted from Hudson River for the Champlain Canal has been measured occasionally at various points, and a summary of discharges in second-feet follows, of measurements made prior to 1907, these results being compiled principally from the reports of the state engineer of New York:

Glens Falls feeder:
- (1) At guard lock near feeder dam—
  - Rafter, October 8, 1895 383
  - Horton, August 25, 1904 302
- (2) At Glens Falls, Chain bridge—
  - Rafter, October 8, 1895 364
  - Horton, September 25, 1905 (11 a. m.) 295
  - September 25, 1905 (3 p. m.) 292
- (3) Glens Falls, just above waste weir—
  - Rafter, October 9 and 10, 1895 213
- (4) At Glens Falls, ½ mile below site of previous gaging—
  - Rafter, October 10, 1895 191
- (5) At Sandy Hill, near entrance to Champlain Canal—
  - Rafter, October 11, 1895 182

Champlain Canal, north from Sandy Hill to Lake Champlain:
- (6) Just north of Glens Falls feeder entrance—
  - Rafter, October 11, 1895 74

[a] Courtesy of Mr. D. A. Loomis, general manager Champlain Transportation Company, Burlington, Vt.

Champlain Canal, south from Sandy Hill to Northumberland:
(7) Notre Dame Street Bridge, Fort Edward—
Weeks, August 29, 1905 78
Weeks, September 25, 1905 138
Champlain Canal, south from Northumberland to Mechanicville:
(8) Between locks 9 and 10—
Kuichling, October 10, 1900 131
Kuichling, October 11, 1900 139
(9) Mechanicville, Saratoga Street Bridge—
Weeks, August 29, 1905 84

During 1907 additional measurements of flow were made by the hydrographers of the geological survey for the New York state water supply commission, the results following:

Measurements of flow in Champlain Canal, etc., October 9–12, 1907.

No.	Locality.	Date.	Discharge.	Mean velocity.	Remarks.
	Below Northumberland.				
			Sec.-ft.	*Ft. per sec.*	
1	Champlain Canal at Mechanicville	Oct. 9	90.1	0.36	
2	Spillway near Mechanicville	...do...	7	....	Estimated.
3	Spillway at Bemis	...do...	13.1	1.27	
4	Spillway at Stillwater	...do...	11.3	.71	
5	Schuyler Creek opposite No. 4	...do...	10–15	....	Do.
6	Champlain Canal at Stillwater	...do...	101	.53	
7	Champlain Canal below Coveville	...do...	131	.46	
8	Spillway near Coveville	...do...	5–8	....	Do.
9	.....do	...do...	1	....	Do.
10	.....do	...do...	4 or 5	....	Do.
11	Champlain Canal at Coveville	...do...	89.5	.34	
12	Champlain Canal at Schuylerville	Oct. 10	16.2	.05	Do.
13	Lock at head of Champlain Canal, Northumberland	...do...	4–6	....	Do.
	Above Northumberland.				
14	Lock at end of Champlain Canal, Northumberland	Oct. 10	3–5	....	
15	Champlain Canal at Fort Edward	...do...	....	....	
16	Glens Falls feeder at Sandy Hill	Oct. 11	159	.67	
17	Champlain Canal at Sandy Hill	...do...	90.1	.25	
18	Spillway between Fort Edward and No. 16	...do...	1	....	Estimated.
19	Glens Falls feeder at Glens Falls	Oct. 12	176	.67	
20	.....do	...do...	213	.78	

1. Made from Saratoga Street Bridge.
2. This spillway is about 250 yards above mill of West Virginia Pulp Company at Mechanicville; is 90 feet across; water flowing over about 1 inch in depth.
5. Schuyler Creek flows into the canal opposite the Stillwater spillway; no measurement of this could be made, but estimated flow was 10 or 15 second-feet.
6. Measurement from bridge at Stillwater.
7. Measurement from Bridge No. 45, opposite W. F. Curtis.
8. Spillway between bridges Nos. 46 and 47; not sufficient flow for measurement; estimated at 5 to 8 second-feet.
9. Spillway just above Bridge No. 51; estimated flow at 1 second-foot.
10. Small spillway 75 yards below Coveville; estimated flow, 4 or 5 second-feet.
11. Measurement from footbridge behind Coveville post-office.
12. Measurement from Bridge No. 63; soundings made, but only a trace of velocity; estimated at 0.05 foot per second. There are three spillways just below this bridge. At No. 62, 250 yards below here, there is absolutely no velocity.
13. Lock not in use at this time; 4 to 6 second-feet estimated leakage.
14. Lock at end of canal; estimated leakage, 3 to 5 second-feet.
15. At East Street Bridge, Fort Edward, current while soundings were being made, but ceased before measurement; about 5 second-feet leakage through lock here.
16. From Change Bridge west of trolley line at Sandy Hill.
17. From bridge 45 feet north of entrance of Glens Falls feeder; current runs north.
18. There is but one bridge between Fort Edward and Glens Falls feeder, about 150 yards above Fort Edward lock; barely a trace of current here in canal; estimated flow over lock gates of 10 or 12 second-feet. Between Fort Edward and Glens Falls feeder is one small waste weir; estimated flow over this, 1 second-foot.
19. At plate girder highway bridge at Glens Falls.
20. At Change Bridge near feeder dam, Glens Falls.

Measurements of flow in Champlain Canal, etc., October 29–30, and November 23, 1907.

No.	Locality.	Date.	Discharge.	Mean velocity.
			Sec.-ft.	*Ft.per sec.*
1	Champlain Canal at Mechanicville	Oct. 29	130	0.52
17	Champlain Canal at Sandy Hill	...do....	125	.32
16	Glens Falls feeder at Sandy Hill	...do....	177	.88
15	Champlain Canal at Fort Edward	...do....	129	.51
19	Glens Falls feeder at Glens Falls	Oct. 30	203	.81
20	.....do	...do....	232	.88
1	Champlain Canal at Mechanicville	Nov. 23	108	.44
15	Champlain Canal at Fort Edward	...do....	140	.55
16	Glens Falls feeder at Sandy Hill	...do....	176	.73

Gagings were made by the state engineer's assistants, as follows:

Current-meter discharge measurement of Glens Falls feeder.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
	At first bridge below dam above Glens Falls.				
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
November 26	E. F. Weeks	42.5	238	8.8	223
Do	.....do	42.5	233	8.72	193
	At Ferry Street Bridge, Sandy Hill.				
November 26	E. F. Weeks	47.5	232	6.38	226
Do	.....do	47.5	231	6.4	200

From the foregoing data the following conclusions have been drawn as to conditions during 1907:

Apparently about 220 second-feet [a] enters the Glens Falls feeder from the Hudson River. About 60 second-feet returns to the river before reaching Fort Edward, leaving 160 second-feet which enters the Champlain Canal, and which should be added to the recorded flow of the Hudson River at Fort Edward. Of this amount, about 90 second-feet flows north toward Lake Champlain and is permanently diverted from the Hudson drainage; the remaining 70 second-feet flows south and probably nearly all gets back into the Hudson at or before the Northumberland crossing.

The supply of water taken for the southern part of the canal, below Northumberland is probably about 90 second-feet, which, with the 90 second-feet flowing north into Lake Champlain, makes a total of about 180 second-feet to be added to the recorded flow at Mechanicville.

[a] This is considerably less than found by Rafter in 1895, and is occasioned by the better condition of the canal and the smaller amount of leakage in the vicinity of Glens Falls.

It will be noted that the gagings have nearly all been made late in the season, when perhaps the use of the water was not at a maximum. In view of this fact the following values are assumed as applicable during the portion of the season that the canal is in operation (from about May to November inclusive): At Fort Edward add 180 second-feet to the recorded flow; at Mechanicville add 200 second-feet to the recorded flow.

LAKE CHAMPLAIN AT BURLINGTON, VT.

This station is located on the south side of the roadway leading to the docks of the Champlain Transportation Company, of Burlington, Vt., at a point about 80 feet from the roadway at the foot of King street, and readings have been obtained since May, 1, 1907.

During 1907 and 1908 gage readings were taken for comparison with those at Rouse Point. This work was done under the direction of Prof. A. D. Butterfield, of the University of Vermont, for the special purpose of transferring mean sea datum from Rouse Point to Burlington and checking the datum at the latter point as used by the topographic branch of the United States Geological Survey. These gage readings were taken and furnished through the courtesy of Mr. D. A. Loomis, general manager of the Champlain Transportation Company.

A comparison of gage readings made upon calm days during 1907 and 1908 indicates that the zero of the gage at Fort Montgomery and at Burlington are at substantially the same elevation, namely, 92.50 feet above mean sea level.

Daily gage height, in feet, of Lake Champlain at Burlington, Vt., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1					5.5	4.16		2.15	1.00	1.30	2.65	
2					5.63					1.40	2.60	2.90
3						4.0		2.10	1.00			2.80
4					5.7	3.93	2.9			1.47	2.80	2.75
5						3.8	2.9	2.10	1.25	1.47		2.90
6					5.95		2.85	2.05	1.30		2.95	2.80
7					5.95	3.71		2.00	1.40	1.50	3.10	2.75
8					5.95	3.65	2.82	2.00			3.30	
9					5.92		2.8	1.90	1.44		3.50	2.85
10						3.52			1.44	1.90		2.80
11					5.85	3.5	2.8		1.42	1.90	3.60	3.25
12						3.42	2.76	1.80		2.00	3.65	3.70
13					5.62	3.32	2.7	1.75	1.50		3.60	
14					5.62	3.2		1.75	1.60	2.17	3.64	
15					5.45	3.2	2.65	1.75		2.18	3.55	
16					5.38		2.6	1.65	1.60	2.20	3.50	
17					5.37		2.55	1.55	1.50	2.20	3.35	
18					5.3	3.0	2.55		1.50	2.20	3.40	
19							2.5	1.50	1.50		3.40	
20					5.1		2.45	1.45	1.50		3.20	3.75
21								1.40	1.40		3.20	
22					5.0	2.9	2.45	1.40			3.20	3.70
23					4.9		2.4	1.35	1.35	2.10	3.20	3.70
24					4.82	2.85	2.4	1.30	1.30	2.08		
25					4.72		2.35		1.35	2.00	3.18	
26							2.35	1.25	1.30	2.00	3.15	
27					4.5		2.3	1.20	1.30		3.15	
28						2.85		1.20	1.29		3.13	4.00
29					4.4	2.9	2.25	1.15		2.20	3.10	
30					4.3	2.9	2.2	1.10	1.30	2.50	3.05	4.25
31					4.23		2.18	1.10		2.65		4.40
1908.												
1				[a] 5.95	6.0	5.1	2.95	1.7	0.98			
2	4.5		[b] 4.45	5.85	6.15	5.1	2.9		.98	0.25		
3	4.5			5.95		5.0	2.8	1.65	.98			−.10
4	4.5			5.95	6.35	4.9		1.6	.98			−.25
5	4.3				6.3	4.85		1.5				−.18
6	4.3			5.8	6.3	4.75	2.6	1.5				
7	4.3			5.78	6.3		2.6	1.5				
8	4.3			5.8	6.3	4.5	2.55	1.4				
9	4.3				6.4	4.45	2.5			.12		
10	4.3			5.85		4.35		1.4				
11	4.3			5.9	6.45	4.3	2.3	1.4			−.18	
12			[a] 4.2			4.3		1.35		.12		
13	4.3			6.0	6.5	4.05	2.2	1.3				
14	4.2	[a] 3.5	[a] 3.75	6.0			2.2	1.25		.05		
15	4.15			6.0	6.45	4.0	2.1	1.2		.05		
16	4.1	(c)		5.9		3.9	2.0					
17	4.1	4.22		5.8		3.9	2.0	1.2			−.18	
18	4.05	4.4		5.8		3.9	2.0	1.2				−.05
19			[a] 4.5			3.9	2.0	1.2				
20	3.95			5.7		3.85	2.0	1.2		.075	−.18	
21			4.45	5.7	6.0		2.0	1.2				
22	4.0	4.55		5.7		3.6	1.95	1.2				
23	3.95		[a] 4.4			3.55	1.9				−.21	
24			[a] 4.4			3.5	1.9	1.1				
25			[a] 4.6	5.45	5.65	3.4	1.9	1.1				
26			[a] 4.6			3.3		1.05				
27		[a] 4.5	[a] 4.8	5.6	5.5	3.25	1.85	1.0				
28			[a] 5.02	5.7	5.4		1.8	.99	.27		−.15	
29				5.9	5.3		1.8	.99				−.08
30			[a] 5.75	6.0		3.0	1.8	.98				
31			[a] 5.85				1.75	.98				

[a] No ice. [b] Top of ice. [c] Heavy rain, snow gone, ice out of Winooski River.

NOTE.—The lake was frozen at the gage the greater part of the time, January 24 to March 31, 1908.

RICHELIEU RIVER AT FORT MONTGOMERY, N. Y.

This station is located in the fort, about one-half mile from the head of Richelieu River, at the outlet of Lake Champlain at Rouse Point, N. Y., where a record of gage heights has been kept by the United States Corps of Engineers since 1875. Through the courtesy of Maj. Edward Burr, the daily gage readings are reported weekly to the United States Geological Survey.

The entire surface of Lake Champlain freezes over nearly every winter, and this may affect the discharge.

The elevation of gage zero at Fort Montgomery is 92.50 feet above mean sea level, according to the adjustment in 1906 of mean sea datum in this vicinity by the topographic branch of the United States Geological Survey. High water level is at elevation 101.6, and on November 13, 1908, an elevation of 91.9 feet was recorded at Fort Montgomery, probably the lowest on record.

The daily discharge of the lake has been determined from observations of the depth and discharge over the Chambly dam, 35 miles below the head of Richelieu River, made in 1898 by the United States Board on Deep Waterways. A rating table has been derived from the observations at the Chambly dam and the gage readings taken at Rouse Point. The area tributary to the river between Rouse Point and Chambly is 310 square miles, making the total drainage basin above Chambly 8,210 square miles.

Monthly discharge is being withheld pending the verification of the rating curve previously used to determine the discharge at this point.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

Daily gage height, in feet, of Richelieu River at Fort Montgomery, N. Y., for 1907 and 1098.

[Observer, William McComb.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1.6	2.55	2.05	4.4	5.45	4.2	2.9	2.2	1.1	1.4	2.6	3.0
2	1.6	2.65	2.15	4.8	5.65	4.1	2.95	2.3	1.2	1.45	2.95	2.85
3	1.65	2.6	2.1	4.9	6.05	4.05	2.9	1.7	1.1	1.55	2.8	2.8
4	1.85	2.55	2.0	5.0	5.95	4.15	2.95	1.6	1.25	1.5	2.65	2.85
5	2.15	2.5	1.95	4.85	5.9	4.2	2.95	1.6	1.25	1.55	2.9	2.8
6	2.35	2.4	1.9	4.9	5.8	3.9	2.9	1.6	1.35	1.5	3.0	2.75
7	2.45	2.5	1.85	5.0	5.92	3.75	2.95	2.05	1.45	1.65	2.95	2.75
8	2.5	2.55	1.85	5.2	5.93	3.66	2.9	1.95	1.4	1.9	3.15	2.7
9	2.4	2.6	1.8	4.9	5.95	3.6	2.8	2.0	1.4	1.8	3.3	2.7
10	2.55	2.65	1.75	4.7	5.85	3.55	2.75	2.0	1.5	2.2	3.4	2.75
11	2.5	2.5	1.8	4.8	5.7	3.5	2.7	1.95	1.6	2.2	3.45	3.0
12	2.48	2.45	1.95	4.8	5.65	3.45	2.7	1.95	1.55	2.1	3.5	3.2
13	2.45	2.6	1.9	4.8	5.7	3.55	2.65	1.85	1.5	2.15	3.65	3.5
14	2.5	2.58	1.85	4.7	5.5	3.4	2.65	1.7	1.6	2.15	3.5	3.55
15	2.5	2.3	1.9	4.75	6.0	3.25	2.7	1.75	1.6	2.25	3.55	3.6
16	2.55	2.3	1.8	4.8	5.5	3.23	2.8	1.85	2.05	2.3	3.5	3.65
17	2.55	2.3	1.75	4.75	5.4	3.15	2.7	1.9	1.45	2.3	3.45	3.6
18	2.6	2.2	1.85	4.7	5.3	3.1	2.6	1.6	1.5	2.0	3.55	3.7
19	2.65	......	1.95	4.7	5.25	3.02	2.55	1.6	1.7	2.2	3.4	3.75
20	2.65	2.15	1.95	4.6	5.2	3.0	2.55	1.7	1.6	2.1	3.35	3.8
21	2.6	2.2	2.0	4.55	5.2	2.98	2.4	1.45	1.5	2.1	4.0	3.6
22	2.7	2.18	2.05	4.5	4.95	3.0	2.4	1.4	1.4	2.4	3.3	3.7
23	2.65	2.18	2.15	4.45	4.95	3.0	2.4	1.45	1.6	2.0	3.2	3.65
24	2.6	2.25	2.4	4.4	4.8	2.9	2.45	1.85	1.5	2.0	3.1	3.8
25	2.7	2.2	2.65	4.55	4.75	2.92	2.35	1.4	1.4	2.1	3.0	3.9
26	2.7	2.25	2.85	4.7	4.9	2.95	2.4	1.3	1.3	1.9	3.15	4.0
27	2.7	2.2	2.9	4.9	4.6	2.9	2.2	1.25	1.3	2.5	3.1	4.9
28	2.75	2.15	3.25	5.3	4.55	2.9	2.25	1.2	1.25	1.95	3.05	4.4
29	2.78	......	3.55	5.70	4.33	2.9	2.3	1.15	1.2	2.1	3.0	4.3
30	2.7	......	4.05	5.2	4.3	2.95	2.25	1.2	1.3	2.2	2.95	4.8
31	2.75	......	4.45	......	4.3	......	2.25	1.1	......	2.4	......	4.45
1908.												
1	4.45	3.9	4.2	5.8	6.2	5.1	3.05	1.7	.9	.4	−.3	−.05
2	4.4	3.75	4.2	5.85	6.15	5.05	2.9	1.7	.9	.3	−.25	−.2
3	4.4	3.7	4.1	5.8	6.1	5.05	2.9	1.65	.8	.2	−.25	−.3
4	4.6	3.6	4.05	5.8	6.25	4.9	2.85	1.65	.9	.2	−.2	.0
5	4.4	3.6	4.0	5.85	6.25	4.85	2.7	1.75	1.05	.25	−.3	−.4
6	4.5	3.7	4.05	5.8	6.3	4.8	2.8	1.5	1.1	.25	−.35	−.4
7	4.45	3.55	3.9	5.75	6.5	4.75	2.6	1.5	.75	.4	−.3	−.2
8	4.4	3.5	4.0	5.8	6.4	4.6	2.6	1.45	.7	.25	−.15	−.35
9	4.3	3.5	3.8	5.75	6.4	4.55	2.55	1.45	.85	.0	−.2	−.4
10	4.2	3.5	3.8	5.95	6.3	4.45	2.45	1.5	.7	.05	−.45	−.3
11	4.2	3.45	3.85	5.85	6.4	4.4	2.6	1.5	.7	.2	−.3	−.05
12	4.2	3.4	3.7	5.8	6.35	4.3	2.4	1.5	.6	.15	−.55	−.2
13	4.15	3.5	3.8	5.9	6.3	4.15	2.3	1.4	.55	.3	−.6	−.1
14	4.0	3.4	3.9	5.9	6.35	4.1	2.25	1.4	.50	.3	−.45	−.2
15	4.1	3.55	4.05	5.9	6.35	4.0	2.2	1.25	.45	.2	−.45	−.15
16	4.15	3.75	4.05	5.8	6.4	3.9	1.95	1.3	.45	.15	−.4	−.2
17	4.1	3.95	4.2	5.8	6.2	3.9	2.1	1.6	.5	.15	−.4	−.25
18	4.05	4.1	4.25	5.8	6.25	3.95	2.0	1.25	.5	.1	−.4	−.25
19	4.0	4.25	4.25	5.75	6.3	4.0	1.9	1.4	.3	.1	−.2	−.1
20	4.1	4.35	4.35	5.85	6.1	3.9	1.95	1.15	.4	.1	−.4	−.15
21	3.95	4.45	4.4	5.7	6.0	3.7	2.05	1.2	.65	.1	−.2	−.2
22	4.0	4.4	4.35	5.65	5.95	3.6	2.0	1.3	.45	.1	−.2	−.25
23	3.95	4.4	4.4	5.6	6.0	3.6	1.95	1.1	.3	.05	−.15	−.25
24	3.9	4.4	4.5	5.5	5.75	3.6	1.9	1.1	.45	.05	−.2	−.2
25	3.95	4.45	4.55	5.7	5.6	3.4	1.9	1.05	.4	......	−.25	−.2
26	3.85	4.4	4.8	5.6	5.65	3.35	1.9	1.0	.45	......	+.2	−.3
27	3.8	4.35	4.75	5.6	5.5	3.3	1.9	.95	.45	......	−.2	−.15
28	3.8	4.3	5.1	5.75	5.45	3.2	1.8	.9	.5	......	−.3	−.25
29	3.8	4.25	5.35	5.9	5.4	3.3	1.85	1.0	.35	......	−.2	−.2
30	3.7	......	5.6	6.0	5.3	3.1	1.8	.9	.4	......	−.1	......
31	3.9	......	5.8	......	5.2	......	1.75	.9	......	......	......	−.25

NOTE.—Gage heights recorded October 25 to 31, 1908, are omitted. They were probably incorrect owing to water not having free access to the gage. After October 31 readings were made to a reference point outside the fort and reduced to gage datum.

WINOOSKI RIVER AT RICHMOND, VT.

The headwaters of Winooski River lie in the Green Mountain district in the east-central part of Vermont; whence the stream flows in a general northwesterly direction into Lake Champlain near Burlington. The total area drained is 995 square miles. Considerable areas in the upper part of the basin are in forest. The storage, either artificial or natural, is insignificant.

This station is located at the steel highway bridge about one-fourth mile south of the railroad station at Richmond, Vt., and was established June 25, 1903, to obtain general statistical and comparative data regarding the total flow of the river.

The datum of the chain gage has remained the same during the maintenance of the station. During the winter months the river is affected by ice. Conditions for obtaining accurate discharge are fairly good and the results at this station are satisfactory. This station was discontinued May 1, 1907.

Daily gage height, in feet, of Winooski River at Richmond, Vt., for 1907.

[Observer, J. N. Buley.]

Day.	Jan.	Feb.	Mar.	Apr.	Day.	Jan.	Feb.	Mar.	Apr.
1			5.55	9.2	16				6.3
2		6.2		7.5	17				6.45
3				6.75	18	6.85			6.5
4	8.7			6.9	19				6.4
5	10.35			8.2	20				5.9
6	8.4			7.7	21				5.55
7	7.5			6.8	22		6.5	6.0	5.55
8	7.2	5.7	5.6	6.7	23				6.3
9	7.05			6.35	24				10.6
10	6.9			6.0	25	6.3			8.8
11	6.8			5.9	26				9.6
12				6.15	27				10.15
13				6.4	28			10.9	9.55
14				6.35	29			11.05	9.2
15		5.8	5.9	6.75	30			12.65	10.2
					31			11.3	

NOTE.—River frozen January 1–5, when the ice broke up at the gage. Also frozen January 10 to March 28, when the ice went out. During the frozen period gage heights were taken to water surface in a hole in the ice. March 28 to 31 may have been affected by ice jam.

Rating table for Winooski River at Richmond, Vt., for 1906 and 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.00	435	5.30	1,615	6.60	3,460	8.80	7,580
4.10	495	5.40	1,735	6.70	3,620	9.00	8,000
4.20	560	5.50	1,860	6.80	3,790	9.20	8,420
4.30	630	5.60	1,985	6.90	3,960	9.40	8,840
4.40	705	5.70	2,115	7.00	4,130	9.60	9,270
4.50	785	5.80	2,250	7.20	4,470	9.80	9,710
4.60	870	5.90	2,390	7.40	4,830	10.00	10,150
4.70	960	6.00	2,530	7.60	5,190	11.00	12,400
4.80	1,060	6.10	2,680	7.80	5,570	12.00	14,700
4.90	1,165	6.20	2,830	8.00	5,950	13.00	17,100
5.00	1,275	6.30	2,980	8.20	6,350		
5.10	1,385	6.40	3,140	8.40	6,750		
5.20	1,500	6.50	3,300	8.60	7,160		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during 1906 and the form of previous curves. It is well defined between gage heights 3.9 feet and 10 feet.

Monthly discharge of Winooski River at Richmond, Vt., for 1907.

[Drainage area, 885 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
March 28-31	16,300	12,200	13,500	15.25	2.27	B.
April	11,500	1,920	4,990	5.64	6.29	B.

NOTE.—See gage-height table footnote.

OTTER CREEK AT MIDDLEBURY, VT.

Otter Creek rises in the northern part of Bennington County, Vt., flows northward, and enters Lake Champlain about 6 miles northwest of Vergennes. It drains a total area of 925 square miles, all in Vermont, and of this 615 square miles are above Middlebury. Large tracts on the headwaters of the river are in forest. The slope of the river between Rutland and Middlebury is very small, but between Middlebury and the mouth it is greater. The slopes of the tributary streams are generally steep. Storage in the basin is insignificant.

This station is located at the railroad bridge, about one-half mile south of the railroad station at Middlebury, Vt., and was established April 1, 1903, to obtain general information of the flow of Otter Creek.

The datum of the chain gage has remained the same during the maintenance of the station. During the winter months the gage heights are somewhat affected by ice. About 800 feet below the station is a dam, largely composed of a natural reef of ledge. This has some effect upon the relation between gage height and discharge at this station, but as there is nearly always water flowing over the crest of this dam it is believed that the records are not greatly affected. Gagings have been made from the stone arch highway bridge above the dam. This station was discontinued May 1. 1907.

Daily gage height, in feet, of Otter Creek at Middlebury, Vt., for 1907.

[Observer, R. P. Bingham.]

Day.	Jan	Feb.	Mar.	Apr.	Day.	Jan.	Feb.	Mar.	Apr.
1		12.4	12.3	15.6	16	13.3			13.9
2				15.6	17				13.8
3	14.5			15.6	18				13.75
4				15.5	19				13.55
5				15.25	20				13.45
6				14.85	21				13.3
7		12.5	12.3	14.4	22		12.35	13.15	13.1
8				13.8	23				13.1
9				13.4	24				14.4
10	14.35			13.2	25	12.5			14.9
11				13.1	26				15.4
12				13.2	27				15.9
13				13.6	28			15.3	15.8
14		12.3		13.85	29			15.45	15.9
15			14.35	13.85	30			15.6	16.15
					31			15.65	

NOTE.—River frozen January 1 to March 28, when the ice went out. During the frozen period gage heights were taken to water surface through a hole in the ice.

Rating table for Otter Creek at Middlebury, Vt., for 1905–1907.

Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
13.00	945	13.90	1,780	14.80	2,730	15.70	3,720
13.10	1,030	14.00	1,880	14.90	2,840	15.80	3,830
13.20	1,120	14.10	1,980	15.00	2,950	15.90	3,950
13.30	1,210	14.20	2,080	15.10	3,060	16.00	4,070
13.40	1,300	14.30	2,180	15.20	3,170	16.20	4,310
13.50	1,390	14.40	2,290	15.30	3,280	16.40	4,550
13.60	1,480	14.50	2,400	15.40	3,390	16.60	4,790
13.70	1,580	14.60	2,510	15.50	3,500	16.80	5,030
13.80	1,680	14.70	2,620	15.60	3,610	17.00	5,270

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on discharge measurements made during 1905–6 and is well defined between gage heights 13 feet and 18 feet.

Monthly discharge of Otter Creek at Middlebury, Vt., for 1907.

[Drainage area, 615 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
March 28–31	3,660	3,280	3,500	5.69	0.85	B.
April	4,250	1,030	2,320	3.77	4.21	B.

POULTNEY RIVER NEAR FAIR HAVEN, VT.

This temporary station was located at the Delaware and Hudson Railroad bridge about one-half mile above Castleton River and about 2 miles from Fair Haven, Vt. It was established August 26, 1908, and discontinued December 3, 1908, and was maintained to obtain data regarding low-water flow.

This station would probably not be satisfactory at medium and high stages owing to backwater effect from Castleton River.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

Discharge measurements of Poultney River near Fair Haven, Vt., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 26	G. M. Brett	5.3	2.14	0.92	4.70
Do	do	8.0	3.94	.92	5.49
September 20	C. R. Adams	5.3	1.49	.64	1.53

Daily gage height, in feet, of Poultney River near Fair Haven, Vt., for 1908.

[Observer, Frank Brooks.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		0.7	0.7	1.0	0.9	16		0.6	0.9	1.0	
2		.7	0.7	1.0	.95	17		.6	.9	.9	
3		.75	1.0	.9		18		.6	.9	1.0	
4		.85	.7	.9		19		.6	.85	1.0	
5		.8	.7	1 0		20		.6	.8	1.0	
6		.8	.85	1.05		21		.55	.8	1.0	
7		.85	.8	.9		22		.5	.8	1.0	
8		.8	.8	.9		23		.5	.8	.9	
9		.8	.8	.8		24		.5	.8	1.0	
10		.7	.8	.9		25		.5	.75	1.0	
11		.6	.8	.9		26	0.9	.5	.75	.95	
12		.5	.8	.9		27	.9	.5	.8	1.0	
13		.5	.95	.95		28	.8	.5	.8	.9	
14		.6	.9	1.0		29	.75	.6	.9	1.0	
15		.6	.9	1.0		30	.7	.6	1.0	1.0	
						31	.7		1.0		

Rating table for Poultney River near Fair Haven, Vt., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	0.6	0.90	4.8
.60	1.2	1.00	7
.70	2.1	1.10	10
.80	3.2		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on three discharge measurements made during 1908 and is fairly well defined.

21635—IRR 244—10——10

Monthly discharge of Poultney River near Fair Haven, Vt., for 1908.

[Drainage area 179 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
August 26-31	4.8	2.1	3.27	0.018	0.004	B.
September	4.0	.6	1.60	.0089	.01	C.
October	7.0	2.1	3.84	.021	.02	B.
November	8.5	3.2	6.12	.034	.04	B.

METTAWEE RIVER NEAR WHITEHALL, N. Y.

This temporary station was located on the farm of Fred Foote, near the second highway bridge above the confluence of Mattawee River and Wood Creek, and about 2 miles from Whitehall. It was established August 25, 1908, to obtain data regarding the low-water flow of Mettawee River, and was discontinued December 5, 1908.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

Discharge measurements of Mettawee River near Whitehall, N. Y., in 1908.

Date.	Hydrographer.	Width.	Area of Section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 25	G. M. Brett	22	13.5	1.15	18.8
September 19	C. R. Adams	19	9.6	1.00	10.6

Daily gage height, in feet, of Mettawee River near Whitehall, N. Y., for 1908.

[Observer, B. M. Moore.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.05	1.00	1.20	1.08	16		1.00	1.10	1.08	
2		1.12	1.15	1.12	1.05	17		1.02	1.10	1.12	
3		1.05	1.08	1.18	1.10	18		1.00	1.10	1.10	
4		1.02	1.18	1.05	1.08	19		1.00	1.00	1.12	
5		1.22	1.05	1.15	1.05	20		1.00	1.02	1.12	
6		1.15	1.18	1.15		21		1.00	1.10	1.12	
7		1.02	1.15	1.10		22		.98	1.02	1.10	
8		1.10	1.10	1.08		23		1.00	1.08	1.08	
9		1.00	1.08	1.05		24		1.00	1.08	1.08	
10		1.02	1.05	1.08		25	1.15	1.00	1.05	1.08	
11		1.00	1.15	1.10		26	1.12	1.00	1.02	1.08	
12		1.02	1.05	1.12		27	1.10	1.00	1.05	1.08	
13		1.00	1.20	1.12		28	1.18	1.00	1.10	1.08	
14		1.00	1.18	1.10		29	1.20	1.00	1.20	1.05	
15		1.00	1.10	1.10		30	1.02	1.00	1.25	1.08	
						31	1.00		1.22		

NOTE.—Ice conditions December 5 to 31.

Rating table for Mettawee River near Whitehall, N. Y., for 1908.

Gage height.	Dis- charge.	Gage height.	Dis- height.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	7	1.20	23
1.00	11	1.30	33
1.10	16		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on two discharge measurements made during 1908 and is fairly well defined.

Monthly discharge of Mettawee River near Whitehall, N. Y., for 1908.

[Drainage area, 206 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accu- racy.
	Maximum.	Minimum.	Mean.	Per square mile.		
August 25-31	23	11	17.3	0.084	0.02	B.
September	25	10	12.5	.061	.07	B.
October	28	11	16.9	.082	.09	B.
November	23	14	16.4	.080	.09	B.
December 1-5	16	14	14.8	.072	.01	B.

BOUQUET RIVER AT WILLSBORO, N. Y.

This station, which has been maintained to obtain data regarding low-water flow, is located about 1,500 feet below the New York and Pennsylvania Company's mill at Willsboro, N. Y. It was established as a temporary station August 14, 1904, and discontinued September 10, 1904; was reestablished August 24, 1908, and again discontinued November 30, 1908.

About 2 miles below the station the river enters Lake Champlain, which would doubtless cause backwater at high stages of the lake. The main stream comprises two branches, the junction being about 3½ miles above the gaging station.

There is no connection between the datum used in 1904 and that used in 1908. From a comparison of discharge measurements it appears that the zero of the 1904 gage datum was about 0.38 foot above that used in 1908.

The regimen of flow at this station is little affected by the use of water at the New York and Pennsylvania Company's dam, as the one wheel installed runs continuously and additional power is furnished by steam. The discharge estimates are therefore fairly good.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

Discharge measurements of Bouquet River at Willsboro, N. Y., in 1904 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1904.					
July 30	C. C. Covert		113	1.84	188
August 2	do		96	1.42	88
August 4	Covert and Chase		94	1.38	94
August 11	E. D. Chase		88	1.10	77
August 21	Howell and Chase		206	3.00	814
August 26	E. D. Chase		88	1.23	108
September 2	do		77	1.05	71
1908.					
August 24 [a]	G. M. Brett	46	84.9	1.08	74.5
September 21 [a]	C. R. Adams	30	16.3	.49	7.1

[a] Measurements made by wading.

NOTE.—1904 gage heights are reduced to datum of new gage.

Daily gage height, in feet, of Bouquet River at Willsboro, N. Y., for 1908.

[Observer, R. S. P. Mason.]

Day.	Aug.	Sept.	Oct.	Nov.	Day.	Aug.	Sept.	Oct.	Nov.
1		0.95	0.8	0.85	16		0.8	0.85	0.8
2		1.05	.95	.85	17		.85	.8	.85
3		1.0	.95	.75	18		.8	.8	.85
4		1.05	.85	.8	19		.85	.85	.8
5		1.0	.85	.8	20		.8	.8	.75
6		.95	.85	.8	21		.7	.8	.8
7		.95	.9	.8	22		.75	.85	.8
8		.9	.9	.75	23		.75	.8	.8
9		.9	.85	.75	24	1.10	.8	.85	.85
10		1.0	.9	.8	25	.95	.8	.8	.8
11		.95	.85	.8	26	1.0	.8	.85	.8
12		1.0	.9	.85	27	1.0	.75	.8	.8
13		.9	.85	.9	28	1.1	.75	.8	.8
14		.85	.85	.8	29	1.05	.8	.8	.85
15		.85	.85	.8	30	1.1	.8	.85	.8
					31	1.0		.8	

Rating table for Bouquet River at Willsboro, N. Y., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.70	23	1.00	60
.80	33	1.10	78
.90	45		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1904 and 1908, and is well defined.

Monthly discharge of Bouquet River at Willsboro, N. Y., for 1908.

[Drainage area, 270 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
August 24–31	78	52	66.9	0.248	0.07	B.
September	69	23	42.5	.157	.18	B.
October	52	33	38.5	.143	.16	B.
November	45	28	34.1	.126	.14	B.

AU SABLE RIVER NEAR KEESEVILLE, N. Y.

This temporary station, which was maintained to obtain data regarding low-water flow of Au Sable River, was located on what is known as the old Hatch farm, owned by C. H. Baldwin, about 3½ miles upstream from Keeseville, N. Y. It was established August 1, 1904, and discontinued September 29, 1904; was reestablished August 21, 1908, and again discontinued September 19, 1908.

Two main branches unite to form Au Sable River at Au Sable Forks, about 20 miles from the mouth of the stream and 12 miles above the gaging station, and are the only tributaries of importance.

The nearest water-power developments are at Clintonville above and Keeseville below the gaging station.

There is no connection between the datum used in 1904 and that used in 1908, but from a comparison of discharge measurements it appears that the zero of the latter is about 0.31 foot above the 1904 datum.

Although but two discharge measurements were made in 1908, by using the data obtained in 1904 it is believed that the results obtained are very good.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

Discharge measurements of Au Sable River near Keeseville, N. Y., in 1904 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 4	Covert and Chase		157	0.91	239
August 17	E. D. Chase		143	.79	193
August 22	do		267	1.83	770
August 29	do		148	.81	198
September 9	Chase and Barrier		155	.90	217
1908.					
August 21	G. M. Brett	99	123	.84	202
September 18	C. R. Adams	110	96	.69	172

NOTE.—1904 gage heights are reduced to datum of new gage.

Daily gage height, in feet, of Au Sable River near Keeseville, N. Y., for 1908.

[Observer, Nellie G. Baldwin.]

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1		0.8	11		0.7	21	0.8	
2		.8	12		.7	22	.8	
3		.7	13		.7	23	.9	
4		.7	14		.7	24	.8	
5			15		.7	25	.8	
6		.8	16		.7	26	.8	
7		.8	17		.7	27		
8		.7	18		.7	28	.8	
9		.7	19			29	.7	
10		.7	20			30	.7	
						31	.7	

Rating table for Au Sable River near Keeseville, N. Y., for 1904 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.70	173	1.30	370	1.90	870	2.50	1,800
.80	194	1.40	420	2.00	1,000	2.60	1,990
.90	220	1.50	480	2.10	1,140	2.70	2,190
1.00	250	1.60	555	2.20	1,290	2.80	2,390
1.10	285	1.70	645	2.30	1,450	2.90	2,600
1.20	325	1.80	750	2.40	1,620		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during 1904 and 1908, and is well defined between gage heights 0.7 foot and 1.9 feet. The above table is also applicable to 1904 gage heights after a correction of −0.31 foot has been applied to the latter.

Monthly discharge of Au Sable River near Keeseville, N. Y., for 1908.

[Drainage area, 470 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
August 21-31	220	173	191	0.406	0.17	A.
September 1-18	194	173	178	.379	.25	A.

SARANAC RIVER NEAR PLATTSBURG, N. Y.

This station is located at the dam of the Plattsburgh Gas and Electric Company, successor to Plattsburgh Light, Heat and Power Company, commonly called the Lozier dam, about 6 miles above Plattsburg. It was established March 27, 1903, to obtain general statistical data regarding the total flow of Saranac River. (Pl. V, *A*.)

The record includes the flow over a spillway crest 171.75 feet in length, the discharge through two 5-foot waste gates when open, and the discharge through four 33-inch Victor turbines controlled by automatic governors. The records are furnished by Herbert A. Stutchbury, superintendent. Experiments have been made at Cornell University hydraulic laboratory, on a model of the ogee section of the dam, from which coefficients have been derived for the calculation of the discharge.

The datum of the gage has remained the same during the maintenance of the station.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

Daily discharge in second-feet of Saranac River near Plattsburg, N. Y., for 1907 and 1908.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	418	354	302	2,175	2,058	562	632	337	98	549	362	412
2	687	392	236	1,607	1,797	361	597	403	89	448	177	331
3	627	249	172	1,034	1,541	510	630	190	217	418	281	301
4	613	315	267	790	1,814	536	536	126	311	422	402	401
5	807	360	332	1,009	2,394	513	542	271	561	416	335	477
6	852	389	323	954	1,684	449	497	333	1,061	393	301	470
7	782	374	343	877	1,306	498	871	369	687	340	969	412
8	711	369	407	922	1,402	571	818	383	568	589	939	275
9	622	358	409	607	1,368	370	675	377	509	968	659	556
10	474	199	206	552	1,438	512	475	349	495	707	541	762
11	546	284	337	572	1,170	545	430	143	406	714	454	1,293
12	491	374	421	481	1,650	338	391	192	390	575	358	722
13	322	353	424	626	1,106	330	377	172	419	494	413	589
14	431	351	409	574	1,046	461	311	227	373	655	322	553
15	417	310	396	687	866	444	451	365	256	529	340	541
16	433	349	415	615	793	198	438	193	391	573	371	560
17	361	160	245	1,276	844	306	377	196	348	469	394	580
18	398	291	456	879	857	285	301	87	358	466	409	563
19	387	436	518	829	784	336	320	232	225	466	391	531
20	289	375	451	748	796	316	224	191	222	336	486	515
21	743	382	471	658	816	346	102	224	192	432	460	622
22	668	327	405	721	906	563	237	258	102	428	564	596
23	530	309	1,434	760	725	533	218	237	282	412	543	721
24	421	137	1,507	1,306	857	906	366	234	210	309	546	818
25	404	301	880	1,258	758	762	439	119	301	255	581	953
26	358	283	1,267	1,182	525	774	329	197	403	274	513	892
27	253	309	2,830	1,361	882	552	336	230	383	309	443	752
28	423	314	4,081	1,255	553	643	151	246	309	510	554	847
29	386	......	3,346	1,527	485	614	372	333	146	567	424	1,232
30	417	......	3,548	1,578	521	600	393	382	429	488	483	949
31	388	......	2,274	......	407	......	354	274	......	390	......	1,106
1908.												
1	941	417	660	2,520	2,010	1,560	275	205	37	160	61	277
2	855	482	533	2,420	1,950	1,280	326	128	64	181	196	245
3	895	443	610	1,970	2,380	1,420	292	82	222	172	234	203
4	787	377	596	1,550	2,830	1,120	100	15	201	140	182	166
5	719	358	628	1,660	2,400	1,050	173	130	216	252	213	123
6	652	430	592	1,940	1,950	864	288	668	89	215	180	77
7	741	360	529	2,510	1,930	975	200	477	256	226	212	262
8	729	397	582	2,310	3,170	1,020	187	312	175	186	166	176
9	620	365	634	2,110	2,160	856	182	208	175	232	222	247
10	449	459	548	1,910	1,860	810	177	255	138	214	214	250
11	523	405	525	2,520	1,720	715	189	247	138	158	243	212
12	669	407	616	2,530	1,600	593	102	178	153	352	252	250
13	693	394	608	2,060	2,360	391	338	265	123	245	270	240
14	634	380	880	1,710	2,230	259	261	256	196	174	219	289
15	472	498	1,230	1,680	1,770	813	218	201	154	208	161	226
16	620	1,190	1,540	1,800	1,480	773	218	147	144	191	250	257
17	593	1,240	1,020	1,720	1,660	682	222	267	147	192	252	272
18	649	1,070	774	1,680	1,900	677	245	358	149	128	208	207
19	587	883	686	1,720	1,990	547	540	314	145	234	259	187
20	547	805	721	1,630	1,800	537	523	313	72	120	212	171
21	623	770	735	1,500	1,780	383	457	228	206	219	262	306
22	701	795	842	1,360	1,690	542	424	228	158	187	143	236
23	643	819	1,030	1,470	1,650	591	235	96	123	155	322	217
24	561	688	1,410	1,500	1,560	622	235	217	144	145	299	172
25	500	722	1,240	1,720	1,560	509	240	95	152	139	369	145
26	547	695	1,230	1,750	1,420	372	223	187	138	253	420	319
27	591	632	2,330	2,310	1,440	355	265	139	84	180	373	157
28	480	687	2,580	2,460	1,420	149	231	145	114	250	352	294
29	483	658	4,630	2,080	1,360	216	235	191	192	205	118	224
30	487	......	3,460	1,800	1,320	238	224	82	188	230	347	167
31	400	......	2,580	......	1,550	......	232	153	......	208	......	197

Monthly discharge of Saranac River near Plattsburg, N. Y., for 1907 and 1908.

[Drainage area, 624 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1907.					
January	852	253	505	0.809	0.93
February	436	137	322	.516	.54
March	4,080	172	939	1.50	1.73
April	2,180	481	981	1.57	1.75
May	2,390	407	1,100	1.76	2.03
June	906	198	491	.787	.88
July	871	102	425	.681	.79
August	403	87	254	.407	.47
September	1,060	89	358	.574	.64
October	968	255	481	.771	.89
November	969	177	467	.748	.83
December	1,290	275	656	1.05	1.21
The year	4,080	87	582	.931	12.69
1908.					
January	941	400	626	1.00	1.15
February	1,240	358	615	.986	1.06
March	4,630	525	1,180	1.89	2.18
April	2,530	1,360	1,930	3.09	3.45
May	3,170	1,320	1,870	3.00	3.46
June	1,560	149	697	1.12	1.25
July	540	100	260	.417	.48
August	668	15	219	.351	.40
September	256	37	150	.240	.27
October	352	120	198	.317	.37
November	420	61	240	.385	.43
December	319	77	218	.350	.40
The year	4,630	15	684	1.10	14.90

BIG CHAZY RIVER NEAR MOOERS, N. Y.

This temporary station was located on the highway bridge at Thorn's Corners, between Mooers Forks and Mooers, about 1½ miles below the junction of the two branches which form Big Chazy River. It was about midway between two dams, each about three-fourths of a mile distant. It was established August 28, 1908, to obtain data regarding the low-water flow of Big Chazy River, and was discontinued December 8, 1908.

Information in regard to this station is contained in the reports of the state engineer and surveyor, State of New York.

Discharge measurements of Big Chazy River near Mooers, N. Y., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 20[a]	G. M. Brett	26.0	15.0	1.28	27.6
September 17[a]	C. R. Adams	29.0	33.9	1.12	17.0
November 9[b]	.....do	23.0	65.4	1.37	46.6

[a] Measurement made by wading. [b] Measurement made from the bridge.

Daily gage height, in feet, of Big Chazy River near Mooers, N. Y., for 1908.

[Observer, T. Vaschon.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.1	1.2	1.25	1.6	16		1.15	1.2	1.40	
2		1.1	1.2	1.25	1.3	17		1.15	1.15	1.35	
3		1.1	1.2	1.25	1.15	18		1.15	1.1	1.35	
4		1.1	1.35	1.2	1.4	19		1.15	1.1	1.35	
5		1.1	1.25	1.25	1.35	20	1.3	1.15	1.2	1.35	
6		1.0	1.3	1.55	1.0	21	1.3	1.1	1.1	1.3	
7		1.25	1.1	1.25	1.45	22	1.2	1.1	1.1	1.35	
8		1.15	1.15	1.15		23	1.2	1.15	1.2	1.3	
9		1.15	1.15	1.35		24	1.2	1.15	1.2	1.4	
10		1.15	1.2	1.35		25	1.2	1.15	1.1	1.45	
11		1.3	1.25	1.5		26	1.15	1.1	1.15	1.5	
12		1.1	1.3	1.55		27	1.25	1.1	1.3	1.5	
13		1.0	1.2	1.5		28	1.2	1.1	1.15	1.3	
14		1.2	1.2	1.45		29	1.15	1.25	1.3	1.4	
15		1.05	1.2	1.35		30	1.0	1.25	1.2	1.3	
						31	1.25		1.3		

Rating table for Big Chazy River near Mooers, N. Y., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	10	1.40	48
1.10	15	1.50	72
1.20	22	1.60	104
1.30	32		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1908 and is fairly well defined.

Monthly discharge of Big Chazy River near Mooers, N. Y., for 1908.

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
August 20-31	32	10	22.8	B.
September	32	10	17.7	B.
October	40	15	22.5	B.
November	88	18	45.0	B.
December 1-7	104	10	44.6	B.

MISCELLANEOUS MEASUREMENTS IN ST. LAWRENCE RIVER DRAINAGE BASIN.

The following miscellaneous discharge measurements were made in St. Lawrence River drainage basin during 1908:

Miscellaneous measurements in St. Lawrence River basin in 1908.

Date.	Stream.	Locality.	Gage height.	Dis-charge.
			Feet.	*Sec.-ft.*
July 23	Canaseraga Creek	Near West Sparta, N. Y	[a] 11.10	142
September 8	Grass River	Chase Mills, N. Y	[b] 22.4	194

[a] Reference point is top of downstream end of second floor beam from right end of truss.
[b] Reference point is a small crowfoot at middle of highest part of upstream edge of upstream spandrel.

SUMMARIES OF DISCHARGE PER SQUARE MILE.

The following tables of summaries of discharge per square mile are given to allow of ready comparison of relative rates of run-off from different areas in the St. Lawrence River drainage basin.

They show in a general way the seasonal distribution of run-off and the effect of snow, ground, surface, and artificial storage. But the most important fact worth noting is the almost entire lack of uniformity or agreement between any two stations. It indicates that the discharge of each stream is a law unto itself, and that all projects dependent upon stream flow, if they are to be developed along the safest and most economical lines, must be based on records of stream flow collected with great care over a long series of years as near the location of the project under consideration as possible.

Summary of discharge, in second-feet per square mile, for river stations in the St. Lawrence River drainage basin in 1907 and 1908.

Station.	Drainage area.	1907.													1908.												
		Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
	Sq. miles.																										
Escanaba River near Escanaba, Mich.	800	....	....	....	3.02	5.49	1.45	0.66	0.52	0.97	1.04	0.68	....	....	....	....	....	....	3.02	1.38	0.77	0.51	0.28	0.37	0.30	....	....
Menominee River near Iron Mountain, Mich.	2,420	....	....	....	2.39	4.03	1.64	.98	.61	.95	.91	.69	0.54	....	0.46	0.41	0.41	2.36	2.17	1.19	.78	.57	.46	.70	.56	0.63	0.89
Menominee River at Koss, Mich.	3,780	....	....	....	....	....	....	.85	.57	1.12	.76	.64	.62	....	.52	.48	.48	1.87	2.10	1.33	.99	.56	.38	.58	.50	.60	.86
Oconto River near Gillett, Wis.	814	....	....	....	1.43	1.51	1.04	.64	.36	.84	.58	.58	.41	....	.39	.41	.60	1.29	1.78	.71	.90	.32	.35	.43	.45	.34	.66
Wolf River at Keshena, Wis.	797	....	....	....	....	....	1.00	1.02	.87	1.24	.87	.80	.75	....	.64	.50	.76	1.71	1.63	1.14	1.18	.71	.59	.77	.72	.56	.91
Kalamazoo River near Allegan, Mich.	1,470	1.24	0.90	1.20	1.11	1.04	.76	.68	....	.56	.70	.69	.91	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Manistee River near Sherman, Mich.	900	1.27	1.00	1.49	1.61	1.52	1.38	1.06	1.02	1.08	1.14	1.14	1.11	1.24	1.05	1.08	1.37	1.88	1.54	1.20	1.14	.99	.94	.99	1.01	1.05	1.19
Thunder Bay near Alpena, Mich.	1,260	1.05	.66	1.46	1.29	1.34	.90	.42	.36	.37	.35	.50	.53	.77	.45	.55	1.04	2.60	1.63	.76	.58	.18	.14	.41	.52	.56	.78
Au Sable River at Bamfield, Mich.	1,420	....	....	....	1.80	1.61	1.73	.96	.80	.85	.89	.84	.82	....	....	....	....	1.72	1.37	1.17	.92	.81	.75	.79	.81	.89	....
Cass River at Frankenmuth, Mich.	863	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1.74	1.62	.16	.13	.10	.05	.04	.06	.09	....
Huron River at Geddes, Mich.	757	1.29	.51	.95	1.13	1.06	.54	.32	.18	.29	.42	.48	.60	.65	.89	1.27	2.72	1.16	.83	.35	.13	.36	.19	.19	.20	.31	.72
Huron River at Flat Rock, Mich.	1,000	1.49	.70	1.29	.90	.91	.61	.36	.25	.31	.48	.52	.69	.71	1.03	1.49	2.86	1.34	1.00	.55	.23	.31	.21	.23	.26	.34	.82
Genesee River at St. Helena, N. Y.	1,030	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.11	.11	.16	.16	....
Genesee River at Mount Morris, N. Y.	1,070	2.59	.65	2.79	1.99	1.31	1.07	.86	.20	.22	.60	.79	2.21	1.27	1.04	2.29	4.22	1.95	2.76	1.20	.96	.32	.16	.15	.20	.22	1.29
Genesee River at Jones Bridge near Mount Morris, N. Y.	1,410	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.12	.11	.15	.16	....
Genesee River at Rochester, N. Y.	2,360	2.69	.64	2.29	1.78	1.22	.78	.60	.17	.16	.43	.65	2.09	1.12	1.61	2.52	3.85	1.69	2.55	1.03	.75	.31	.12	.11	.15	.16	1.24
Canadice Lake Outlet at Hemlock, N. Y.	12.6	2.19	1.04	1.37	1.70	.89	.61	.61	.47	.35	.27	.49	1.35	.94	2.10	1.84	2.67	1.31	2.54	.81	.89	.68	.34	.23	.32	.29	1.17
Seneca River at Baldwinsville, N. Y.	3,100	1.80	1.12	1.41	1.47	1.49	1.05	.78	.49	.47	.72	1.08	1.25	1.09	1.35	1.28	1.92	1.66	1.76	1.16	.80	.54	.41	.54	.53	.51	1.04
Skaneateles Lake Outlet at Willow Glen, N. Y.	74.2	.94	.80	.83	.46	.60	.70	.82	.78	.96	1.00	1.01	1.00	.82	1.01	1.01	1.40	1.66	2.04	1.51	1.46	1.50	1.37	1.37	1.36	.96	1.39
Oneida River near Euclid, N. Y.	1,400	4.27	1.81	2.10	2.87	....	....	.87	.66	.44	.62	1.56	1.69	....	2.95	3.30	4.01	....	3.79	1.91	1.21	.87	.52	.64	.88	.74	....
Salmon River near Pulaski, N. Y.	259	4.48	....	....	4.02	3.45	2.46	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.47	.59	1.96	....	....
Black River near Felts Mills, N. Y.	1,850	....	....	....	3.39	2.95	1.05	.74	.42	.89	1.88	2.58	2.82	....	....	....	3.39	4.76	3.73	1.22	.79	.54	.41	.60	.80	.80	....
Moose River at Moose River, N. Y.	346	2.86	.79	2.18	4.13	4.19	1.66	1.17	.68	1.52	2.85	3.09	3.58	2.39	2.46	2.41	4.34	8.64	5.92	1.44	.93	.88	.84	.78	.95	.88	2.54
Oswegatchie River near Ogdensburg, N. Y.	1,580	3.41	.72	2.14	3.04	2.47	.79	.58	.40	.54	1.06	2.49	2.25	1.66	2.80	2.31	4.15	4.49	4.39	1.08	.87	.72	.50	.41	.44	.51	1.89
Racquette River at Piercefield, N. Y.	723	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.30	.13	.18	.54	....
Raquette River at Massena Springs, N. Y.	1,170	2.56	.56	1.71	3.24	3.60	1.51	1.22	.53	.52	1.58	2.17	1.71	1.74	2.56	1.71	3.42	4.58	5.70	1.70	.77	.47	.29	.22	.37	.58	1.86
Poultney River near Fair Haven, Vt.	179	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.01	.02	.03	....	....
Mettawee River near Whitehall, N. Y.	206	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.06	.08	.08	....	....
Bouquet River at Willsboro, N. Y.	270	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.16	.14	.13	....	....
Saranac River near Plattsburg, N. Y.	624	.81	.52	1.50	1.57	1.76	.79	.68	.41	.57	.77	.75	1.05	.93	1.00	.99	1.89	3.09	3.00	1.12	.42	.35	.24	.32	.38	.35	1.10

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