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OPERATIONS AT RIVER STATIONS, 1899.—PART II

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1900

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

OPERATIONS AT RIVER STATIONS, 1899

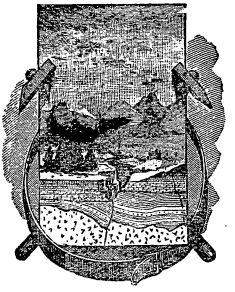
A REPORT OF THE

DIVISION OF HYDROGRAPHY

OF THE

UNITED STATES GEOLOGICAL SURVEY

PART II



WASHINGTON

GOVERNMENT PRINTING OFFICE

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OPERATIONS AT RIVER STATIONS, 1899.

PART II.

MEASUREMENTS AT RIVER STATIONS.[1]

ROANOKE RIVER AT ROANOKE, VIRGINIA.

This river rises in Montgomery County, Virginia. Its headwaters are near those of New River on the west. This stream lower down is known as Staunton River, and joins the Dan at Danville to form the main lower Roanoke River. There are a number of fine water powers along its length, described more fully in the Nineteenth Annual Report, Part IV, page 176. The drainage area is mapped on the Roanoke and Christiansburg sheets. The gaging station was established by Prof. D. C. Humphreys July 10, 1896, and is located on the edge of the town of Roanoke, Virginia, on the Walnut street car line. The gage is of wire, with the rod fastened to the floor of the bridge. The top of the lower end of the first floor beam is 21.99 feet above gage datum. The length of gage wire is 24.39 feet. The right bank is above high water, but the left is liable to overflow in extreme high stages. The channel is nearly straight and the current good. The results of discharge measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 42; 1897–98, Twentieth Annual Report, Part IV, page 140. The following measurements were made during 1899 by D. C. Humphreys: The first, on May 29, at a gage height of 2.51 feet, gave a discharge of 1,123 second-feet; the second one, on June 27, at a gage height of 1.32 feet, gave a discharge of 290 second-feet; the third, on August 7, at a gage height of 0.88 foot, gave a discharge of 135 second-feet.

[1] Continued from Water-Supply and Irrigation Paper No. 35.

Daily gage height, in feet, of Roanoke River at Roanoke, Virginia, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.80	2.25	3.20	2.00	1.43	1.15	1.00	0.90	0.75	0.65	1.20	0.80
2	1.80	2.20	2.95	1.88	1.40	1.30	1.05	.80	.85	.65	1.17	.80
3	1.75	2.05	2.85	1.79	1.39	1.18	1.03	.80	1.00	.65	1.25	.75
4	2.00	3.10	6.15	1.75	1.35	1.06	1.00	.70	.85	.65	1.30	.75
5	1.90	3.50	8.15	1.73	1.32	1.00	1.00	.70	.75	.65	1.10	.75
6	3.13	3.75	4.70	1.67	1.32	.98	1.00	.80	.75	.63	1.05	.75
7	5.85	4.08	3.68	1.62	1.41	.97	1.05	.90	.70	.60	1.00	.77
8	3.55	3.90	3.10	2.10	1.80	.95	.98	.85	.65	.85	.95	.80
9	2.90	3.85	3.00	1.90	2.03	.90	.93	.85	.70	.90	.90	.78
10	2.40	3.60	2.80	1.80	1.85	.95	.90	.85	.65	.80	.85	.75
11	2.50	3.50	2.70	1.75	1.76	1.00	.85	.75	.60	.85	.83	.75
12	2.40	2.45	a3.10	1.70	1.70	1.75	.82	.75	.57	.80	.80	1.50
13	2.30	2.25	a3.50	1.66	1.82	2.25	.80	.95	.70	.75	.80	1.55
14	2.80	a2.22	3.90	1.63	1.85	1.90	.80	1.00	.65	.70	.80	1.30
15	2.70	2.20	4.75	1.60	1.75	1.65	.95	1.00	.65	.70	.80	1.15
16	2.55	2.20	4.25	1.55	1.66	1.45	.83	.95	.65	.80	.78	1.05
17	2.45	3.55	3.70	1.52	1.57	1.30	.75	.90	.65	.77	.78	.95
18	2.30	3.25	3.45	1.47	1.46	1.18	1.05	.80	.65	.75	.75	.90
19	2.20	3.50	7.10	1.45	1.40	1.15	.90	.75	1.46	.73	.75	.90
20	2.15	3.95	4.90	1.40	1.31	1.10	.85	.72	2.05	.70	.73	.90
21	2.10	4.50	3.90	1.40	1.28	1.08	.82	.70	1.25	.70	.73	.88
22	2.07	4.40	3.55	1.37	1.25	1.05	.78	.67	1.00	.68	.70	.85
23	2.05	3.75	3.35	1.36	1.35	1.00	.80	.65	.85	.68	.75	.80
24	2.50	3.25	3.15	1.34	1.27	1.00	.85	.63	.80	.68	.75	1.10
25	2.25	2.90	3.00	1.38	1.20	1.10	.90	.60	.80	.68	.75	1.05
26	2.15	2.70	2.35	1.75	1.16	2.15	.85	.65	.75	.65	.73	.95
27	2.10	5.00	2.40	1.70	1.15	1.45	1.15	.75	.85	.65	.73	.90
28	2.05	3.65	2.45	1.60	1.13	1.15	1.00	.85	.75	.65	.75	1.25
29	a2.10	.....	2.30	1.50	1.10	1.05	.85	1.00	.70	.65	1.00	1.30
30	a2.20	.....	2.15	1.48	1.20	1.00	.82	.85	.65	.73	.85	1.45
31	2.25	.....	2.10	.....	1.13	.....	1.05	.80	.....	.80	.....	1.60

a Interpolated.

Main Roanoke River is formed by the junction of Dan and Staunton rivers at Clarksville, Virginia, and flows southerly, entering Albemarle Sound. The United States Weather Bureau has a station on Dan River at Danville, Virginia, 55 miles above the mouth of Staunton River. The gage is of timber, and is attached to the first pier of the iron bridge between North and South Danville. The highest water was 13.0, on September 13, 1893; lowest, 0.02, on January 26, 1894. The danger line is at 8 feet. The drainage area above the station is 1,900 square miles, according to the United States Weather Bureau.

A second gaging station is maintained by the United States Weather Bureau on Roanoke River at Clarksville, Virginia, 65 miles above Weldon, North Carolina. The river gage is on the south side of the river, attached to a tree leaning over the water. The highest recorded water was 13.5 feet, on September 14, 1893, and the lowest—0.2 foot, on July 19, 1894. It is reported that on November 27, 1877, a height of 27 feet was reached. The danger line is at 12 feet. The drainage area above the station is 6,900 square miles, according to the United States Weather Bureau.

The third station maintained by the Weather Bureau on this river is erected at Weldon, North Carolina, 30 miles above Neal and 90 miles above Albemarle Sound. The river gage is located below the Atlantic Coast Line Railroad bridge, on the south side of the river. The gage is of white pine and is made of three sections, the lowest section, 4 feet to 17 feet, is of detached pieces fastened to trees which lean over the river; the second section, 17 feet to 47 feet, is attached to the fore bay of the Roanoke mills; above 47 feet the gage is painted

on the mill building. The zero of the gage is 4 feet below a large rock, known as "Big Cuba." It is 31 feet below the railroad crossing. The highest recorded water is 46.8 feet, on November 26, 1877; the lowest, —0.3, on August 21, 1893. The danger line is at 27 feet. The drainage area above Weldon, according to the United States Weather Bureau, is 8,180 square miles.

ROANOKE RIVER AT NEAL, NORTH CAROLINA.

This station, described in the Eighteenth Annual Report, Part IV, page 47, was established July 27, 1896, and is on the Norfolk and Carolina Railroad bridge, near Neal, North Carolina. The bench marks for the gage rod are described in Water-Supply Paper No. 15, page 28. The length of the gage wire is 44.66 feet. The section is a fairly good one, the course of the river being straight for some distance above and below the station and the bottom smooth. Being muddy, however, the bed is apt to cut out in seasons of high water and both banks are subject to overflow. The observer is the bridge watchman, Mr. W. M. Adams, of Neal, North Carolina. Records of measurement may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 48; 1897, Nineteenth Annual Report, Part IV, page 181; 1898, Twentieth Annual Report, Part IV, page 142. The measurements made by E. W. Myers during 1899 are as follows:

February 5, gage height, 20.80 feet; discharge, 23,998 second-feet.
May 25, gage height, 6.41 feet; discharge, 6,045 second-feet.
June 7, gage height, 6.45 feet; discharge, 6,110 second-feet.
October 12, gage height, 8.60 feet; discharge, 7,973 second-feet.
November 28, gage height, 4.13 feet; discharge, 4,439 second-feet.

Daily gage height, in feet, of Roanoke River at Neal, North Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.40	9.10	22.80	20.60	10.50	8.10	8.40	7.30	11.00	3.60	4.30	4.00
2	7.60	10.20	23.40	19.10	9.50	10.30	7.20	6.50	8.20	3.00	10.50	4.20
3	10.50	10.70	22.80	17.40	9.00	12.20	5.70	5.90	5.70	2.70	12.30	4.30
4	14.20	11.00	21.80	16.00	9.10	12.60	4.70	5.10	4.10	2.50	12.00	4.20
5	13.10	20.75	22.70	15.20	9.00	10.50	4.20	3.80	3.90	2.30	13.40	4.10
6	11.35	22.35	24.00	14.90	8.80	8.30	4.20	3.50	5.70	2.80	14.15	3.95
7	10.80	23.95	25.25	15.00	8.70	6.50	4.60	3.60	5.00	5.30	12.10	3.80
8	17.25	25.55	26.08	17.70	8.60	5.40	7.10	4.20	4.00	6.90	9.50	3.50
9	23.25	26.80	26.10	21.40	8.70	4.90	11.10	5.60	3.10	7.80	7.60	3.30
10	25.50	27.05	25.10	23.00	8.90	4.60	11.20	6.70	2.70	9.10	6.30	3.20
11	27.75	26.40	23.20	23.60	10.80	5.00	9.80	6.20	3.70	9.90	5.50	3.10
12	26.80	24.50	21.20	22.30	11.30	8.10	7.50	5.00	5.80	8.70	5.10	3.20
13	24.55	21.30	19.20	20.20	13.00	17.80	5.50	5.40	6.00	6.90	4.60	3.50
14	22.25	17.50	17.60	18.30	12.60	21.50	4.20	7.30	5.50	5.50	4.30	7.00
15	21.80	14.30	17.70	16.80	11.90	22.40	3.50	5.40	4.30	4.50	4.10	11.50
16	21.00	12.50	22.80	15.40	11.40	22.40	3.20	4.50	3.40	3.90	4.00	11.50
17	19.05	12.90	23.80	14.30	10.40	21.00	3.10	6.50	2.90	3.60	3.90	9.20
18	18.00	19.50	25.70	13.40	9.20	18.10	3.30	10.90	2.40	3.45	3.80	7.20
19	16.90	19.60	26.80	12.60	8.10	15.20	3.40	9.20	2.10	3.30	3.70	6.00
20	15.80	24.70	26.10	11.90	7.50	12.40	4.20	7.20	2.00	3.25	3.60	5.10
21	14.40	26.80	26.10	11.40	7.10	10.20	4.50	5.40	2.00	3.00	3.50	4.70
22	13.20	27.25	27.80	10.50	6.90	8.60	4.80	4.30	11.25	3.20	3.40	4.40
23	12.20	26.90	30.00	10.00	6.60	7.30	3.90	3.30	14.00	2.90	3.35	4.30
24	11.30	26.20	29.35	9.70	6.30	6.30	3.80	2.80	10.60	2.80	3.35	4.45
25	10.80	25.20	27.40	9.40	6.40	5.20	4.70	2.40	7.55	2.70	3.60	6.40
26	10.30	23.60	25.50	9.10	6.90	4.80	4.80	2.10	5.40	2.60	3.80	8.40
27	10.10	22.00	22.80	9.40	7.00	4.40	7.20	1.80	4.70	2.60	4.00	8.60
28	9.90	21.80	20.70	11.80	6.40	4.30	7.30	1.60	4.90	2.60	4.10	8.10
29	8.70	.....	19.60	12.30	5.90	6.30	11.80	1.70	5.10	2.70	3.80	6.80
30	8.20	.....	20.10	11.60	5.60	6.70	11.90	13.70	4.60	2.70	3.70	5.60
31	8.60	.....	21.00	.....	5.90	.....	9.50	12.90	.....	3.00	.....	3.50

TAR RIVER AT TARBORO, NORTH CAROLINA.

Tar River rises in the north-central part of North Carolina and flows in a southeasterly direction into Pamlico River. It crosses the fall line at Rocky Mount, North Carolina, where is located the principal power on the river. The fall below this point is from 1 to 1½ feet per mile. The fall above this point is about 2 feet per mile, concentrated at a number of points where small powers can be developed. The drainage basin is largely covered with forest. The stream is subject to violent freshets and periods of very low flow. The gaging station, as described in the Eighteenth Annual Report, Part IV, page 50, is on the Atlantic Coast Line bridge, crossing the river at Tarboro, North Carolina, and was established by E. W. Myers on July 24, 1896. The length of the wire gage is 38.30 feet. The channel is straight, the current moderately swift, the banks low and flooded in high water. The bed is sandy and fairly constant. Sand bars slightly obstruct the flow of the river. The observer is R. H. Williams, who reads the gage once a day. Measurements of discharge are made at the highway bridge which crosses the stream about 200 yards above, this point furnishing a better station. Records of flow may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 52; 1897, Nineteenth Annual Report, Part IV, page 184; 1898, Twentieth Annual Report, Part IV, page 143. The following measurements were made by E. W. Myers during 1899:

February 5, gage height, 9.10 feet; discharge, 5,165 second-feet.
May 24, gage height, 2.60 feet; discharge, 1,125 second-feet.
June 7, gage height, 2.00 feet; discharge, 798 second-feet.
October 16, gage height, 2.95 feet; discharge, 1,150 second-feet.
November 28, gage height, 2.20 feet; discharge, 875 second-feet.

Daily gage height, in feet, of Tar River at Tarboro, North Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.20	6.30	15.00	8.60	4.60	2.40	1.00	10.00	0.60	1.70	4.30	3.70
2	3.10	7.20	14.80	7.80	4.10	3.50	1.00	10.60	.50	1.30	6.50	2.80
3	3.40	8.30	15.40	7.20	3.90	3.00	.95	9.60	.40	1.40	9.30	2.70
4	3.70	8.50	16.70	6.30	4.00	2.90	1.00	7.70	.30	.90	9.70	3.00
5	3.50	8.90	16.50	7.00	3.90	3.00	.95	5.50	.60	.80	6.50	3.20
6	3.30	12.50	17.80	8.00	3.80	2.50	.70	4.50	.50	1.40	5.70	2.80
7	3.40	15.70	18.30	8.90	3.60	2.00	3.20	4.00	.40	2.20	5.20	2.60
8	3.50	18.60	18.60	11.70	3.50	1.60	2.50	3.70	.50	7.00	4.60	2.50
9	3.40	21.90	18.40	14.50	3.60	1.50	2.00	4.50	.70	8.70	4.20	2.30
10	4.30	24.10	16.40	16.50	3.70	3.00	1.50	4.90	3.00	7.30	3.60	2.30
11	3.40	25.00	13.80	17.80	3.80	2.80	1.60	3.80	1.60	6.80	3.40	2.00
12	3.30	Ice.	11.10	18.30	3.60	2.50	2.50	3.10	3.60	6.00	3.00	2.20
13	3.70	Ice.	9.00	17.00	3.50	5.40	1.60	2.60	5.00	5.20	2.70	2.40
14	4.80	Ice.	8.20	14.40	4.30	7.60	1.40	3.00	3.30	4.30	2.60	3.00
15	6.80	14.75	9.80	10.70	4.00	9.30	1.10	4.10	2.10	3.50	2.40	3.70
16	8.80	11.70	13.80	8.00	4.30	10.60	1.00	3.80	1.60	3.00	2.30	3.50
17	10.30	11.80	16.70	7.00	3.70	9.50	.90	4.30	1.50	2.70	2.40	2.90
18	10.40	14.10	19.00	6.20	3.10	9.80	1.10	5.20	1.10	2.40	2.20	2.60
19	9.10	17.00	20.90	5.80	2.80	8.80	1.40	6.00	1.00	2.20	2.00	2.50
20	8.30	19.00	21.00	5.40	2.60	5.30	3.80	5.40	.80	2.00	1.80	2.40
21	7.00	22.00	19.70	5.50	2.80	3.70	3.20	4.80	.70	.80	2.10	2.30
22	5.90	23.00	17.50	5.30	2.60	3.00	2.30	4.20	.62	1.60	2.00	2.50
23	5.30	23.40	16.30	5.00	2.70	2.40	1.70	3.00	.50	1.50	1.90	2.10
24	4.90	23.10	13.70	4.60	2.70	2.00	1.30	2.80	.60	1.40	1.80	2.90
25	4.50	22.00	10.00	4.30	2.80	1.50	1.50	2.50	1.30	1.80	1.90	5.40
26	4.40	20.50	8.60	4.10	2.70	1.40	2.60	1.80	1.00	1.40	2.00	7.80
27	4.50	18.20	7.80	4.30	2.50	1.50	3.90	1.70	.50	1.30	1.90	8.50
28	4.70	16.30	7.50	5.40	2.30	1.40	6.90	1.50	3.50	1.10	2.20	6.80
29	4.10	.....	7.40	7.50	1.90	1.00	8.20	1.40	3.80	1.30	2.40	5.40
30	4.20	.....	7.90	6.20	2.10	.98	8.50	1.10	2.60	2.50	2.70	5.00
31	4.30	.....	8.50	.....	1.70	.....	9.45	.80	.....	3.20	.....	4.10

NEUSE RIVER AT SELMA, NORTH CAROLINA.

Neuse River rises in the north-central part of North Carolina, and flows in a southeasterly direction, emptying into Pamlico Sound. The stream crosses the fall line at Smithfield, below which point there is no power. The elevation of the river at Smithfield is about 106 feet. At the crossing of the Seaboard Air Line Railroad, some 35 miles above, the elevation is about 175 feet, making the fall in this part of the river about 2 feet per mile. Above this point the fall is much greater. A large part of the area drained by this stream is forest covered. The river is subjected to violent freshets and to periods of low flow. The minimum flow per square mile decreases rapidly as the stream is ascended. A weir measurement of Eno River where the drainage area was about 100 square miles, gave a flow of 3,000,000 gallons per twenty-four hours, or 4.64 second-feet, or at the rate of 0.046 cubic feet per second per square mile. This measurement was made during the severe drought of the summer of 1897. There are a number of localities where power can be developed. The gaging station described in the Eighteenth Annual Report, Part IV, page 52, is located on the Southern Railway bridge, about 3 miles from Selma, North Carolina. It was established by E. W. Myers, July 29, 1896. The bed of the river here is sandy and muddy and is liable to change in high water. The flow is obstructed by one pier of the bridge; the channel is straight, the current moderately swift and confined to one channel. The gage rod was moved February 6, 1899, to the highway bridge, crossing the river about 200 yards below. The zero of the gage rod is 33.7 feet west of the center rod of the truss of the bridge, and on the downstream side. The outer rim of the pulley wheel is 4.75 feet east of the zero of the gage rod, and the distance from the end of the weight to the marker on wire is 35.00 feet. When this station was visited on May 23, 1899, the gage was measured, and this distance was found to be 35.35 feet. When visited in June this length was found to be 35.37 feet; in October 35.48 feet, and at the November visit it was found to be 35.50 feet. This error has been allowed to accumulate, and gage heights on the attached sheet have been adjusted by these measurements. The observer is C. Richardson, engineer at pumping station, Selma, North Carolina. Records of flow may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 53; 1897, Nineteenth Annual Report, Part IV, page 186; 1898, Twentieth Annual Report, Part IV, page 144. The following measurements were made by E. W. Myers during 1899:

February 6, gage height, 15.68 feet; discharge, 7,807 second-feet.
May 23, gage height, 4.28 feet; discharge, 1,262 second-feet.
June 5, gage height, 3.10 feet; discharge, 773 second-feet.
October 12, gage height, 1.79 feet; discharge, 574 second-feet.
November 26, gage height, 1.30 feet; discharge, 356 second-feet.

Daily gage height, in feet, of Neuse River at Selma, North Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.40	6.50	13.39	4.79	1.84	4.44	1.21	10.68	0.95	1.43	10.50	1.10
2	1.30	5.90	12.99	4.99	1.69	3.54	1.21	9.58	.85	1.23	11.20	1.50
3	1.30	5.60	14.19	4.99	2.69	3.14	1.11	7.98	.75	1.02	11.40	1.60
4	2.00	6.00	15.48	5.78	2.89	3.23	1.11	6.18	.75	.72	11.20	1.40
5	2.50	11.30	18.28	6.28	3.13	3.13	1.21	2.18	.85	.52	4.20	1.20
6	2.00	13.40	17.98	8.48	2.38	2.63	1.31	2.28	.65	.62	3.30	1.20
7	2.10	19.90	17.87	9.77	2.48	1.83	1.40	2.68	.45	3.92	2.70	1.20
8	7.10	20.09	16.47	13.97	3.13	1.83	2.50	3.18	.55	6.82	2.30	1.20
9	6.50	20.98	13.97	16.67	3.42	2.63	3.00	3.67	.65	7.12	2.10	1.20
10	6.40	20.28	10.06	14.76	4.02	5.23	2.60	3.57	.55	7.42	2.10	1.20
11	3.50	18.97	8.16	11.76	4.77	7.03	2.40	3.47	.44	3.92	2.00	1.20
12	3.40	12.37	9.26	7.06	4.47	7.83	1.60	2.57	.84	2.72	1.50	1.40
13	3.20	10.36	9.15	4.95	3.76	9.73	1.40	2.47	.94	2.12	1.40	1.90
14	3.70	9.96	10.35	4.75	5.26	6.27	1.10	3.07	1.04	1.51	2.00	3.80
15	8.90	9.55	11.95	4.55	5.31	3.22	1.00	3.17	.94	1.31	2.00	3.20
16	8.90	6.45	18.05	4.54	4.46	2.62	1.00	2.57	.84	1.11	1.80	2.40
17	8.00	13.55	16.94	4.34	3.26	2.42	1.60	1.67	.74	.71	1.60	1.30
18	6.20	15.54	14.94	4.24	3.05	2.32	4.39	1.77	.64	1.01	1.50	1.20
19	5.20	17.34	18.23	4.03	4.10	2.02	5.59	1.67	.64	1.21	1.50	1.00
20	4.20	18.13	17.73	3.73	5.90	1.82	4.79	1.06	.74	1.31	1.50	1.00
21	3.20	18.73	12.53	3.63	5.35	1.72	2.79	.96	.64	1.31	1.40	1.50
22	2.40	17.02	9.32	3.52	4.80	1.62	2.39	.96	.63	1.31	1.30	1.90
23	2.50	17.32	8.02	3.32	4.40	1.52	1.59	.86	.73	1.31	1.20	3.00
24	2.50	15.32	6.82	3.12	3.74	1.42	1.29	.86	.83	1.11	1.10	3.00
25	2.40	14.21	5.41	3.21	3.44	1.42	3.59	.96	.83	1.01	1.00	2.20
26	3.10	15.51	5.21	3.41	2.84	1.31	6.59	.96	1.43	.80	1.00	1.90
27	3.10	15.20	5.11	4.21	2.44	1.31	10.19	.96	1.67	.70	.90	1.40
28	3.00	14.00	5.60	4.70	2.14	1.31	7.71	.96	2.53	.70	.80	1.20
29	2.30	.....	6.50	5.50	1.94	1.21	5.68	.86	2.87	.80	.70	1.20
30	2.40	.....	6.90	1.95	3.04	1.21	6.58	.96	1.53	.80	.70	1.20
31	2.40	.....	7.60	.....	5.04	.....	8.28	.95	.....	10.70	.....	1.30

HAW RIVER AT MONCURE, NORTH CAROLINA.

This station, established May 6, 1898, by E. W. Myers, is located 1¾ miles north of Moncure, Chatham County, North Carolina, at the bridge of the Seaboard Air Line, which crosses the river here, and about 2 miles from the junction of the river with Deep River to form the Cape Fear. The observer is M. A. Moore, Moncure, North Carolina, who also attends the station on Deep River. The gage is a horizontal rod well painted, divided into feet and tenths, securely nailed to the outer side of the guard rail of the bridge on the upstream side. The 2-foot mark on the rod is over the center of the second floor beam from the south end of the second span from the south end of the bridge. The length of gage was last verified November 26, 1899. The initial point for sounding is a notch cut in the guard rail opposite the south end of the bridge and on the upstream side, the section here being better than that on the downstream side. The channel is straight for some distance above and below the station. The velocity is good and uniformly distributed across the stream. Both banks are rather low and subject to overflow in time of flood. The bed of the stream is of coarse sand and gravel, and is probably not subject to any decided change in high water. The current here is somewhat modified by a fish dam about 150 yards above the bridge. The station is reached by private conveyance from Moncure. When the station was established in May, 1898, the distance from the end of the weight to the pointer on the wire was 43.45 feet. When it was visited in

August, 1898, the wire was measured and this distance was found to be 43.67 feet. In February, 1899, the gage was measured and found to be 43.75 feet. This length remained the same at the subsequent visits during the year, in June, October, and November. The error was not corrected on the gage at each visit, it being considered preferable to change the gage heights after the stretch was found to have become fixed. The gage heights for 1899, as published below, have been corrected. The following measurements were made during 1899 by E. W. Myers:

February 4, gage height, 8.96 feet; discharge, 5,594 second-feet.
May 26, gage height, 2.20 feet; discharge, 751 second-feet.
June 5, gage height, 2.99 feet; discharge, 1,275 second-feet.
October 12, gage height, 1.85 feet; discharge, 756 second-feet.
November 26, gage height, 1.37 feet; discharge, 358 second-feet.

Daily gage height, in feet, of Haw River at Moncure, North Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.03	4.98	15.70	5.54	2.94	2.62	1.43	4.16	1.07	1.04	10.53	1.28
2	3.68	4.48	9.06	4.68	2.70	2.60	1.31	3.42	.96	1.02	6.87	1.16
3	3.30	4.30	9.98	4.46	2.60	3.94	1.20	2.68	.91	.82	3.96	1.54
4	2.86	8.70	15.66	3.92	2.42	3.56	1.18	2.26	1.04	.82	4.61	1.52
5	2.84	16.40	18.48	3.86	2.38	2.98	7.90	1.48	1.02	.85	3.54	1.48
6	2.48	22.42	14.84	8.84	2.44	2.20	2.24	1.42	1.03	7.65	2.66	1.32
7	12.08	24.66	13.56	4.86	1.98	1.84	2.08	4.85	.98	5.62	2.09	1.30
8	10.32	26.13	9.41	11.12	7.86	1.62	2.22	4.92	.98	7.37	1.64	1.12
9	8.62	26.62	6.68	13.42	6.14	1.40	1.22	4.90	1.00	5.98	1.67	1.06
10	4.98	17.70	5.16	7.08	4.50	1.52	1.04	4.46	2.51	4.13	1.62	1.12
11	3.84	12.34	4.52	5.98	4.42	2.45	1.70	2.02	2.84	2.97	1.57	1.22
12	3.62	6.92	4.34	4.64	4.98	5.18	1.46	1.56	3.40	1.80	1.57	3.12
13	3.94	6.62	4.06	4.12	8.06	4.44	1.38	1.58	1.70	1.62	1.33	1.84
14	5.14	5.84	6.34	3.70	8.62	4.12	1.20	1.20	1.90	1.35	1.31	1.82
15	11.62	5.46	22.07	3.38	5.04	2.94	1.30	1.14	1.24	1.29	1.43	1.68
16	7.96	7.42	23.36	3.62	4.10	2.55	1.23	1.80	1.20	1.34	1.15	1.36
17	6.88	18.92	17.18	3.08	3.86	2.40	1.14	1.52	1.16	1.11	1.08	1.52
18	5.04	18.38	8.62	2.95	2.90	1.72	1.32	1.26	1.12	1.29	1.32	1.48
19	4.44	18.41	14.93	2.82	2.92	1.60	1.34	1.42	1.98	1.24	1.42	1.44
20	3.70	14.72	14.34	2.70	2.86	1.62	1.28	1.06	1.02	1.21	1.44	1.28
21	4.16	11.62	10.98	2.80	2.00	1.54	1.30	1.04	1.07	1.22	1.40	1.32
22	2.90	9.18	7.61	2.64	1.92	1.33	1.36	.92	1.46	1.20	1.38	1.26
23	2.98	8.26	5.44	3.44	2.94	1.59	1.34	.90	1.18	1.07	1.34	1.18
24	3.08	7.28	4.92	2.40	2.96	1.48	1.23	1.08	1.08	.94	1.26	1.54
25	3.16	5.40	4.72	2.42	2.62	1.36	1.28	1.08	2.04	.94	1.28	1.56
26	3.18	6.18	4.62	4.84	2.32	1.30	1.50	1.30	1.38	1.13	1.32	1.52
27	3.15	6.84	4.07	5.08	2.06	1.20	7.14	.92	1.24	1.17	1.98	1.38
28	3.10	13.58	6.34	4.10	1.90	1.38	6.30	1.00	1.06	1.04	2.84	1.32
29	2.50	.....	10.58	3.52	1.84	1.10	3.48	1.06	1.09	1.19	2.90	1.24
30	3.32	.....	7.46	2.98	2.20	1.54	2.02	1.40	.98	1.92	2.56	1.14
31	3.98	.....	6.34	.....	3.16	.....	5.68	1.18	.....	3.46	.....	2.38

DEEP RIVER AT MONCURE, NORTH CAROLINA.

This station, established May 5, 1898, by E. W. Myers, is located about one-fourth of a mile south of Moncure, Chatham County, North Carolina, at the covered wooden bridge of the Seaboard Air Line, which crosses the river here. It is about 2 miles above the junction with the Haw River to form the Cape Fear. The observer is M. A. Moore, of Moncure, North Carolina, a farmer and bridge watchman living about 100 yards from the bridge. The gage is a horizontal rod, well painted, divided into feet and tenths, and securely nailed to the guard rail of the bridge. The zero of the rod is 50 feet south of the

north end of the second span of the bridge from the north. The initial point of sounding is a notch cut in the guard rail opposite the south end of the bridge and on the downstream side. The channel is straight for some distance above and below the station. The banks are low and the bed probably slightly shifting during high water. The velocity is not great, but sufficient for proper measurement, and is well distributed across the stream. When the station was established on May 5, 1898, the distance from the end of the weight to the pointer on the wire was 45.16 feet. At every subsequent trip the gage wire has been measured, and it was discovered that the length was gradually increasing. When the station was visited on August 20, 1898, the length of the wire was found to be 45.27 feet. February, 1899, the length was found to be 45.38 feet; in May, 45.40 feet; in June, 45.45 feet; in October, 45.57 feet, and in November, 45.60 feet. These errors were allowed to accumulate to see if the wire had any definite fixed rate of stretch under a constant weight. The gage heights as published below have been adjusted from the measurements noted above. Records of flow may be found in the Twentieth Annual Report, Part IV, page 146. The following measurements were made during 1899 by E. W. Myers:

February 4, gage height, 7.03 feet; discharge, 4,590 second-feet.
May 27, gage height, 2.16 feet; discharge, 447 second-feet.
June 5, gage height, 2.51 feet; discharge, 610 second-feet.
October 12, gage height, 1.89 feet; discharge, 449 second-feet.
November 26, gage height, 1.32 feet; discharge, 290 second-feet.

Daily gage height, in feet, of Deep River at Moncure, North Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.03	4.58	6.91	7.12	2.99	2.84	1.52	4.54	0.85	0.83	12.74	2.77
2	3.21	5.00	6.25	4.70	2.85	2.61	1.36	4.36	.79	.78	5.86	1.85
3	3.41	6.78	6.39	4.52	2.56	3.45	1.34	3.46	.75	.88	4.23	1.83
4	3.27	7.06	13.25	5.16	2.51	3.13	1.18	3.08	.91	.79	3.48	2.19
5	2.79	16.40	14.43	8.64	2.29	2.49	4.20	1.46	.73	.87	3.04	2.15
6	2.47	20.48	15.77	6.18	2.25	1.95	2.42	1.20	.71	7.20	2.74	1.49
7	10.27	23.21	15.67	6.40	2.47	1.65	2.72	4.54	.89	6.49	2.24	1.27
8	9.13	25.92	13.62	17.76	8.85	1.49	2.11	4.11	1.19	6.70	1.91	1.19
9	7.71	30.96	10.61	15.04	6.09	1.58	2.19	4.15	1.10	7.11	1.86	1.11
10	5.59	18.70	7.39	8.28	4.43	2.55	2.10	3.37	1.82	3.96	.84	1.19
11	4.99	12.26	5.05	6.16	3.85	3.23	1.79	1.39	2.10	3.19	.89	4.03
12	5.83	7.19	4.41	5.40	5.89	4.72	1.67	1.41	2.55	1.97	1.09	5.95
13	6.07	6.98	4.67	4.86	7.99	3.78	1.34	1.25	2.04	1.72	1.02	4.69
14	9.79	6.06	3.91	4.48	9.23	3.40	1.19	1.21	4.86	1.59	1.09	3.39
15	13.07	5.10	21.19	3.76	5.99	2.56	1.09	1.29	1.96	1.31	.96	2.35
16	8.61	6.76	22.51	3.98	4.46	2.42	1.28	1.31	1.04	1.17	.98	1.39
17	7.91	16.20	16.21	4.10	3.97	2.40	.90	1.17	.93	1.27	1.08	1.34
18	6.93	21.26	9.99	4.04	3.75	1.68	1.14	1.09	.84	1.04	1.26	1.47
19	5.99	19.34	14.69	3.54	3.69	1.58	1.11	1.25	.87	1.06	1.14	1.39
20	4.73	15.30	15.31	3.32	3.05	1.49	1.02	.88	1.71	1.12	1.02	.63
21	3.15	9.92	9.02	3.46	2.89	1.50	1.02	.74	1.99	.97	.98	1.27
22	3.36	9.05	7.15	2.97	2.67	1.47	1.02	.78	1.49	.90	1.10	1.13
23	3.08	8.22	5.87	3.10	3.25	1.77	1.19	.90	1.17	.87	1.05	1.07
24	3.17	7.92	5.43	2.96	2.85	1.37	1.11	.95	.87	.85	1.04	1.19
25	3.25	6.24	4.91	2.97	2.75	1.55	1.52	1.06	2.34	.91	1.00	1.13
26	3.27	6.92	4.41	5.60	2.51	1.57	1.67	.84	1.53	.92	1.32	1.11
27	3.54	12.94	4.14	5.54	2.25	1.71	5.19	1.00	1.35	1.01	1.92	1.07
28	3.19	18.22	7.07	4.46	2.02	2.15	4.35	.96	1.09	.98	1.83	.95
29	2.55	-------	11.65	3.50	1.91	1.68	3.77	1.20	1.17	.94	3.78	1.03
30	2.21	-------	10.31	3.04	2.54	1.60	2.11	1.22	1.04	.89	2.84	.97
31	3.23	-------	8.44	-------	2.96	-------	6.28	.89	-------	1.13	-------	1.03

CAPE FEAR RIVER AT FAYETTEVILLE, NORTH CAROLINA.

Cape Fear River is formed by the junction of the Haw and Deep rivers near Moncure, Chatham County, North Carolina, and flows in a southeasterly direction, emptying into the Atlantic Ocean near Wilmington. Its watershed for the most part is flat and well covered with forest growth. Measurements are made on both the Haw and the Deep at Moncure, and on the Cape Fear at Fayetteville. The measurements are of value in the study of the valuable water powers of the Cape Fear and its tributaries. The gaging station described in the Eighteenth Annual Report, Part IV, page 54, is at the bridge of the Alantlc Coast Line, about a mile east of Fayetteville, North Carolina. The Weather Bureau has a gage fastened on the lower side of the east abutment of the covered highway bridge, this being about 400 feet above the railroad bridge, from which discharge measurements are made. The lower 29 feet of this gage consists of a rod divided into feet and tenths and firmly fastened to the abutment. Above the 29-foot mark the scale is painted on the rock. The observer is Frank Glover, who has charge of the steamboat landing just below the railroad bridge. For his convenience he has placed a subsidiary gage at the steamboat landing reading about the same as the official gage, and from this observations are taken. The channel is straight and the current moderately swift and not influenced by dams or other obstructions. The banks are high and the total flow of the river is in one channel, even during the highest floods. The bed is fairly constant. Records of flow may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 56; 1897, Nineteenth Annual Report, Part IV, page 93; 1898, Twentieth Annual Report, Part IV, page 145. The following measurements were made by E. W. Myers during 1899:

February 7, gage height, 46.50 feet; discharge, 61,921 second-feet.
May 24, gage height, 6.40 feet; discharge, 3,142 second-feet.
June 6, gage height, 4.20 feet; discharge, 1,577 second-feet.
October 13, gage height, 6.00 feet; discharge, 2,132 second-feet.
November 29, gage height, 9.65 feet; discharge, 7,742 second-feet.

Daily gage height, in feet, of Cape Fear River at Fayetteville, North Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.50	11.00	30.80	17.80	7.20	6.00	2.90	11.50	2.40	2.00	11.00	8.00
2	4.60	18.10	25.00	17.00	6.00	6.40	6.40	10.00	2.20	1.70	21.40	6.40
3	6.50	14.00	21.00	14.00	6.00	8.00	8.00	8.80	1.90	1.70	17.50	6.50
4	6.50	12.80	28.60	12.20	5.50	7.60	7.60	7.00	1.60	1.50	12.80	7.00
5	5.80	23.00	34.40	15.60	5.50	6.10	6.10	5.50	1.50	1.40	10.40	6.70
6	5.50	31.90	33.20	21.00	5.50	4.20	4.20	4.20	1.60	2.10	8.30	5.50
7	5.50	41.00	27.40	17.60	5.60	4.20	4.20	3.20	1.40	14.40	6.50	5.10
8	17.00	50.80	25.00	23.20	8.60	3.80	3.80	2.60	2.00	13.50	5.00	4.90
9	21.40	52.00	20.00	35.50	14.20	3.50	8.30	7.00	1.80	17.00	5.00	4.70
10	14.90	47.30	15.00	30.30	13.00	4.50	9.30	10.20	1.90	13.20	5.00	4.30
11	10.20	37.40	11.50	23.00	9.80	7.50	6.40	7.00	1.80	10.00	4.80	4.30
12	8.00	30.00	10.20	19.40	10.90	8.10	5.00	5.50	5.70	7.00	4.50	4.50
13	9.30	20.80	9.40	15.80	11.00	10.00	3.60	4.60	4.00	5.00	4.60	4.00
14	10.00	12.30	8.70	13.50	15.40	11.10	3.10	3.70	4.00	4.50	4.30	14.00
15	19.00	10.00	18.60	10.20	17.30	8.00	2.60	3.00	4.60	3.80	4.00	10.00
16	23.60	12.50	38.60	9.80	12.00	5.80	2.40	2.70	4.00	3.50	4.00	7.50
17	17.20	24.00	42.00	9.00	9.70	5.00	2.40	2.50	2.50	3.50	4.00	6.00
18	14.50	36.50	38.00	10.00	7.20	4.60	4.50	2.40	1.80	3.00	3.90	5.40
19	13.40	42.60	28.00	9.20	5.50	4.10	4.00	2.70	1.60	3.30	3.80	5.00
20	11.00	43.00	28.80	9.40	5.30	3.70	3.50	2.70	1.80	3.00	3.60	4.80
21	9.20	38.50	32.00	9.00	5.20	3.20	3.00	2.30	2.50	2.70	3.50	4.50
22	8.00	34.00	25.00	8.50	5.00	3.20	2.40	2.20	4.00	2.50	3.30	4.00
23	7.00	28.30	18.00	8.40	5.30	3.00	2.30	5.00	3.70	2.20	3.30	4.20
24	6.20	23.00	14.70	8.00	6.30	3.10	2.80	3.70	3.20	2.30	3.80	5.40
25	6.20	18.20	12.00	6.60	6.00	2.90	4.00	2.50	2.60	2.10	4.00	10.00
26	6.00	16.40	10.00	7.00	5.50	2.50	6.40	2.70	2.90	2.10	4.00	12.00
27	7.00	17.00	10.00	10.00	5.30	2.80	7.00	2.10	3.70	2.10	4.50	9.70
28	6.80	28.40	12.00	11.40	4.70	3.10	12.80	1.60	3.90	2.10	5.60	7.30
29	6.60	.....	17.80	10.00	4.20	3.50	11.70	1.60	3.00	2.10	10.00	6.00
30	6.60	.....	21.70	8.80	4.20	3.20	9.90	1.50	2.50	2.10	9.50	5.90
31	7.00	.....	19.20	.....	5.00	.....	7.60	2.90	.....	4.20	.....	.....

YADKIN RIVER AT SALISBURY, NORTH CAROLINA.

This river rises in the west-central part of North Carolina, flows easterly, and then turning abruptly south continues across the central part of North Carolina and through the northeastern part of South Carolina into the Atlantic Ocean. Throughout the upper part of its course the topography of its watershed is rough and mountainous, but as it approaches the ocean the land becomes flat and marshy. The upper portion of its watershed is well timbered. The drainage area is partly mapped on the Statesville, Hickory, Wilkesboro, Yadkinville, and Hillsville atlas sheets. There are a number of places where water powers may be developed, and measurements have been made to determine the available amount. A station has been established near Salisbury, North Carolina, and another one about 50 miles nearer its mouth, at Norwood, North Carolina. The Salisbury station, described in the Eighteenth Annual Report, Part IV, page 57, was established by C. C. Babb September 24, 1895, and is located at the Southern Railway bridge near Holtsburg, near the mouth of Grant Creek, and about 6 miles from Salisbury, North Carolina. The length of the wire gage is 55.10 feet. The observer is W. L. Owen, fireman of pumping station, located just below the bridge. The station is easily reached by private conveyance from Salisbury. Discharge measurements are made from the lower side of the deck bridge, the zero point being on the left bank. The channel is obstructed by three piers

with large rafts of driftwood lodged against each and sand bars below each. The channel is straight, current swift, and the bed rough and rocky. The banks are rather low, but all of the water passes beneath the bridge during floods. Records of discharge may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 59; 1897, Nineteenth Annual Report, Part IV, page 201; 1898, Twentieth Annual Report, Part IV, page 146. The following measurements were made by E. W. Myers during 1899:

Measurements of Yadkin River at Salisbury, North Carolina.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.	*Feet.*	*Sec.-feet.*	1899.	*Feet.*	*Sec.-feet.*
February 9	6.60	14,781	June 9	2.38	4,264
March 20	18.80	115,085	October 4	1.70	1,847
April 14	3.75	8,795	November 24	1.70	1,957
June 8	2.30	4,264	December 14	3.00	5,952

Daily gage height, in feet, of Yadkin River at Salisbury, North Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.00	3.20	4.70	4.30	3.10	2.40	2.20	2.80	2.00	1.60	2.00	1.90
2	2.00	3.00	4.00	3.90	3.10	2.90	2.10	2.30	2.10	1.60	2.20	1.90
3	2.10	2.90	6.10	3.80	3.10	2.60	2.10	2.20	2.20	1.60	2.20	1.90
4	2.00	2.90	8.00	4.10	3.10	2.60	2.50	2.00	2.10	1.60	2.40	1.80
5	3.10	7.50	8.00	4.20	3.00	2.50	3.20	2.00	2.10	1.70	2.20	1.80
6	4.00	8.75	7.15	4.70	2.90	2.40	2.50	1.80	1.90	1.70	2.00	1.80
7	10.20	10.10	5.90	4.80	3.20	2.40	2.30	1.80	1.80	1.80	1.90	1.80
8	5.90	9.20	4.10	7.80	4.40	2.40	2.30	2.30	1.70	2.90	1.90	1.70
9	4.80	6.30	3.90	5.90	4.00	2.40	2.20	2.10	1.70	3.00	1.80	1.70
10	4.00	4.00	3.70	4.70	3.50	3.10	2.20	2.00	2.20	2.40	1.70	1.70
11	3.00	3.30	3.50	4.20	3.40	3.30	2.10	2.00	2.00	2.10	1.70	1.70
12	4.40	3.40	3.40	3.80	3.30	3.80	2.10	1.90	1.90	1.90	1.70	2.00
13	4.00	2.90	3.30	3.80	4.10	4.80	2.00	2.10	1.90	1.90	1.70	3.80
14	4.50	2.90	5.20	3.80	4.10	3.90	2.00	2.00	1.70	2.00	1.70	3.40
15	4.40	2.20	8.50	3.70	3.60	3.20	1.90	1.90	1.70	1.90	1.70	2.90
16	4.10	3.00	12.40	3.70	3.10	2.60	1.90	1.90	1.60	1.80	1.70	2.10
17	3.70	5.10	7.90	3.60	3.00	2.50	1.90	1.80	1.60	1.80	1.70	2.00
18	3.50	6.00	6.70	3.50	3.00	2.40	2.30	1.70	1.60	1.80	1.70	1.90
19	3.20	5.00	12.00	3.40	2.90	2.40	2.20	1.70	1.50	1.80	1.70	1.90
20	3.10	4.60	17.80	3.40	2.80	2.30	2.10	1.80	4.20	1.80	1.70	1.90
21	2.80	4.00	13.75	3.40	2.70	2.30	1.90	1.60	2.90	1.80	1.70	1.70
22	2.90	3.90	6.50	3.30	2.70	2.30	1.90	1.60	2.20	1.80	1.70	1.70
23	2.80	3.60	5.30	3.20	2.90	2.30	1.90	1.60	1.90	1.70	1.70	1.70
24	2.90	3.10	4.80	3.20	3.00	2.20	1.90	1.50	1.70	1.70	1.70	2.00
25	2.80	3.10	4.40	3.30	2.80	2.20	2.00	1.50	1.70	1.70	1.70	2.40
26	2.80	3.00	4.30	4.10	2.70	2.80	2.70	1.50	1.70	1.70	1.70	2.40
27	2.80	5.40	5.40	4.10	2.70	3.00	4.30	1.60	1.70	1.70	1.80	2.10
28	2.90	7.80	5.40	3.80	2.60	2.00	3.20	2.00	1.60	1.70	1.80	1.90
29	2.80	.....	6.30	3.40	2.60	2.40	3.00	2.20	1.60	1.70	1.90	1.80
30	2.70	.....	5.30	3.30	2.60	2.20	2.80	2.20	1.50	1.70	1.90	1.80
31	3.30	.....	4.50	.....	2.50	.....	3.50	1.90	.....	1.70	.....	1.70

Yadkin River, after passing the State line into South Carolina, is known as Pedee River. The United States Weather Bureau has maintained a station at Cheraw, South Carolina, on Pedee River. The gage is a pine timber attached to the Cheraw toll bridge. The top of the rail on the Cheraw and Darlington Railroad bridge is 58 feet above zero of gage. The highest water was 37.3 feet on March 11, 1875; lowest, 0.0 feet, in August, 1866. The danger line is at 27 feet. The drainage area at this point is 6,960 square miles, according to

the United States Weather Bureau. The second river-height station maintained by the United States Weather Bureau at Smiths Mills, South Carolina, is 100 miles below Cheraw and 45 miles above the mouth of the river. The gage is a 1 by 6 inch pine timber attached to the central front wooden pier of the E. P. Smith wharf. The zero of the gage is 25 feet below the doorsill of the house adjoining the wharf. The highest water was 16 feet in September, 1893; the lowest, —0.4 foot, on October 22, 1895. The danger line is at 16 feet.

YADKIN RIVER AT NORWOOD, NORTH CAROLINA.

This station, described in the Eighteenth Annual Report, Part IV, page 60, was established by E. W. Myers September 1, 1896. It is at Blalocks Ferry, 1 mile above Richland Creek and about 2 miles from Norwood, North Carolina. The gage is a vertical rod divided into feet and tenths, and is securely spiked and braced to an overhanging tree near the ferry. The rod is referred to a bench mark consisting of a large nail driven into the root of a birch tree about 50 feet northwest of the rod. The zero of the gage rod is 5.93 feet below the bench mark. The river here is broad and shallow with smooth bottom of sand and gravel, giving a good section for discharge measurements, which are taken from the ferryboat. The channel is straight and free from all obstructions. The current is swift and the depth of the water uniform, except at a point about 100 feet from the right bank where the water is deep and very sluggish. The banks are low, and at the time of highest flood are overflowed for a distance of half a mile. The observer is W. B. Nichols, of Norwood, North Carolina, a farmer, who also carries the mail. Records of discharge may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 61; 1897, Nineteenth Annual Report, Part IV, page 203; 1898, Twentieth Annual Report, Part IV, page 147. Measurements made by E. W. Myers during 1899 are as follows:

April 9, gage height, 3.40 feet; discharge, 10,581 second-feet.
June 8, gage height, 1.95 feet; discharge, 4,474 second-feet.
June 9, gage height, 1.95 feet; discharge, 4,474 second-feet.
October 6, gage height, 1.35 feet; discharge, 2,629 second-feet.
October 6, gage height, 1.33 feet; discharge, 2,619 second-feet.
December 15, gage height, 2.23 feet; discharge, 6,299 second-feet.

The following table, computed by E. W. Myers, shows the comparative run-off of the Yadkin River at Salisbury and Norwood. At the former point the area drained is 3,399 square miles, and at the latter station 4,614 square miles. The table is of interest on account of the close results, especially in the run-off of second-feet per square mile between the two stations, which are about 50 miles apart and have a difference in drainage area of 1,215 square miles. The footnotes at the bottom of the table should be studied in the same connection, as

the two stations were not established at the same time, and in the first part of the record are not entirely comparable. The table should be compared with a similar table for the Catawba River at Catawba and Rock Hill stations, given on page 122.

Table showing comparative minimum flows for Yadkin River at Salisbury and Norwood, North Carolina.

Year.	Driest month.		Mean flow for driest month.		Mean flow for driest month per square mile.		Minimum flow for year.		Minimum flow for year per square mile.	
	Salisbury.	Norwood.	Salisbury.	Norwood.	Salisbury.	Norwood.	Salisbury.	Norwood.	Salisbury.	Norwood.
			Sec.-ft.	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*
1895	Oct.	(*a*)	1,426	(*a*)	0.42	(*a*)	1,400	(*a*)	0.41	(*a*)
1896	Aug.	Sept. *b*	2,411	*b*2,409	.71	*b*0.52	1,000	*b*1,450	.29	*b*0.31
1897	Sept.	Sept.	1,727	1,822	.51	.39	900	1,310	.26	.28
1898	June	June	1,832	2,626	.54	.57	1,100	*c*1,380	.32	.30
1899	Sept. *d*	Oct.	2,332	2,836	.69	.61	1,300	1,790	.38	.39

a Station not established during this year.

b Not directly comparable. Station not established until September.

c Minimum flow not in month of lowest mean flow, but in July.

d Figures for Norwood station for September are as follows: Mean flow, 3,346 cubic feet per second, 0.725 second-feet per square mile; minimum flow, 2,080 second-feet, 0.451 second-feet per square mile.

NOTE.—For 1897, where the difference is most marked, there is a higher stage of water reported from the Salisbury station than at the Norwood station, the crest of the flood probably passing the latter station at night. Had this been noted, it would further increase the mean flow for this station.

Daily gage height, in feet, of Yadkin River at Norwood, North Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.80	3.00	4.50	.....	2.60	2.10	1.90	2.70	1.50	1.30	1.70	1.20
2	4.30	2.90	3.70	.....	2.50	2.20	1.80	2.20	1.70	1.20	1.90	1.20
3	3.30	2.50	4.30	.....	2.70	2.50	1.70	2.70	1.20	1.20	1.80	1.50
4	2.30	2.70	6.70	.....	2.60	2.10	1.70	1.70	1.80	1.20	1.70	1.50
5	2.50	8.00	7.50	.....	2.50	2.10	3.00	1.20	1.80	1.10	1.90	1.50
6	2.40	10.50	6.10	.....	2.40	2.00	3.00	1.60	1.70	1.30	1.80	1.40
7	7.80	10.20	4.10	.....	2.60	2.00	2.20	1.50	1.50	1.40	1.70	1.40
8	9.00	9.60	4.00	.....	3.20	1.90	2.00	1.50	1.40	2.00	1.70	1.30
9	7.00	7.40	3.80	3.40	3.50	2.00	2.00	1.80	1.80	2.20	1.80	1.30
10	3.80	4.60	3.40	3.00	3.00	2.10	1.90	1.70	1.70	2.40	1.40	1.40
11	3.10	3.20	2.00	2.90	3.00	3.40	1.90	1.60	1.90	2.10	1.40	1.40
12	3.00	3.10	2.10	2.80	2.80	3.50	1.60	1.50	1.70	1.70	1.40	2.40
13	2.90	3.00	2.40	2.80	4.50	3.40	1.60	1.80	1.50	1.40	1.40	3.10
14	4.20	2.40	3.10	2.70	4.00	3.80	1.60	1.70	1.60	1.30	1.40	3.10
15	4.50	2.30	8.10	2.70	3.50	3.00	1.50	1.60	1.50	1.50	1.40	2.40
16	3.90	5.60	10.40	3.40	2.80	2.50	1.50	1.50	1.40	1.50	1.40	2.10
17	3.80	5.80	10.30	3.00	2.50	2.20	1.50	1.50	1.20	1.50	1.30	1.80
18	3.30	6.90	8.80	2.80	2.40	2.10	1.60	1.40	1.50	1.40	1.30	1.30
19	3.10	5.60	(*a*)	2.80	2.20	2.00	1.80	1.40	1.30	1.40	1.20	1.20
20	2.80	5.00	.....	2.70	2.50	2.00	1.50	1.30	1.20	1.40	1.30	1.20
21	2.60	4.20	.....	2.70	2.30	1.90	1.50	1.30	3.00	1.40	1.40	1.50
22	2.50	3.60	.....	2.50	2.20	1.90	1.40	1.40	2.80	1.30	1.30	1.50
23	2.40	3.60	.....	2.50	2.40	1.90	1.40	1.30	1.70	1.30	1.40	1.50
24	2.30	3.40	.....	2.40	2.60	1.80	1.50	1.20	1.70	1.20	1.40	1.80
25	2.50	2.90	.....	2.30	2.50	1.70	1.70	1.20	1.40	1.30	1.30	2.10
26	2.40	3.80	.....	2.80	2.30	1.70	1.60	1.20	1.30	1.20	1.30	2.10
27	2.40	5.90	.....	3.50	2.20	2.40	4.00	1.20	1.30	1.20	1.30	1.70
28	2.30	7.60	.....	3.10	2.10	2.30	2.00	1.20	1.40	1.20	1.50	1.80
29	2.30	.....	.....	2.80	2.10	2.10	2.50	1.60	1.30	1.20	1.70	1.20
30	2.20	.....	.....	2.70	2.20	2.00	2.30	1.80	1.20	1.20	1.70	1.20
31	2.70	.....	.....	.....	2.20	.....	2.10	2.00	.....	1.70	.....	.....

a No readings March 19 to April 8; gage washed out by flood.

CATAWBA RIVER AT CATAWBA, NORTH CAROLINA.

This river rises in the west-central part of North Carolina and flows in a general southerly direction into South Carolina, where it empties into Santee River. At a number of points along this river there are water powers which may be developed. Near its source Catawba River flows through a mountainous country, which becomes flatter as the South Carolina line is approached. The greater part of its watershed is covered with woodland or forest. The drainage area above Catawba is entirely mapped on the Hickory, Morganton, Wilkesboro, Mount Mitchell, and Cranberry atlas sheets. Systematic measurements have been made on the Catawba at Catawba, North Carolina, and near Rockhill, South Carolina. The station at Catawba, as described in the Eighteenth Annual Report, Part IV, page 64, was established by E. W. Myers, July 4, 1896, at the Southern Railway bridge, about one-half mile from Catawba, North Carolina. The river is straight for several miles above and below the bridge; the current is swift and evenly distributed across the stream. The channel is obstructed by three piers, riprap, and two trestles of false work. At time of highest water the west bank overflows slightly and the sandy bed cuts out in places. The observer is C. A. Reed, jr., a clerk in the post-office at Catawba, North Carolina. Discharge measurements are made from the plank walk underneath the bridge. The railway bridge here is a deck bridge, and the gage was located on a footway which was laid along the lower system of bracing. When the station was visited, in October, 1899, it was discovered that the span on which the gage was located was to be removed, so it became necessary to move the gage rod, which was done as follows:

A small temporary gage was installed to discover any change in the stage of the river while the gage was being removed. The distance from the weight to the pointer on the wire was measured and found to be correct when the gage-reading was taken and recorded, as was also the reading of the temporary gage. The rod was then moved to the position which was chosen for it, and securely fastened to the guard rail on the downstream side and on the second span of the bridge from the west. The zero of the rod is over the center of the second floor beam from the west end of the second span from the west end of the bridge. From the zero of the rod to the outer rim of the pulley wheel is 2.6 feet. The small temporary gage was then read and it was found that the reading was unchanged, so the gage in its new position was given the same reading as it had before. The length of the wire rope from the end of the weight to the pointer on the wire was then measured and found to be 55.25 feet. Records may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 65; 1897, Nineteenth Annual Report, Part IV, page 214; 1898, Twentieth

Annual Report, Part IV, page 149. The following measurements were made by E. W. Myers during 1899:

February 24, gage height, 3.26 feet; discharge, 3,598 second-feet.
February 24, gage height, 3.28 feet; discharge, 3,690 second-feet.
June 10, gage height, 2.94 feet; discharge, 2,820 second-feet.
October 9, gage height, 2.36 feet; discharge, 1,716 second-feet.
November 23, gage height, 2.20 feet; discharge, 1,118 second-feet.
December 16, gage height, 2.66 feet; discharge, 2,153 second-feet.

Daily gage height, in feet, of Catawba River at Catawba, North Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.50	2.70	5.45	4.65	3.40	2.95	2.40	2.20	2.40	1.95	2.10	2.10
2	3.10	2.70	4.30	4.40	3.40	2.00	2.35	2.25	2.90	1.95	2.15	2.15
3	3.00	2.80	4.00	3.90	3.35	2.90	2.30	2.20	2.75	1.95	2.10	2.15
4	2.80	10.00	4.00	3.95	3.30	2.80	2.30	2.15	2.60	1.90	2.15	2.15
5	2.80	8.60	7.40	4.60	3.30	2.75	2.35	2.10	2.40	1.90	2.20	2.15
6	5.20	9.60	5.90	4.40	3.25	2.70	2.40	2.10	2.20	2.00	2.18	2.15
7	8.00	9.10	4.30	5.70	4.90	2.65	2.50	2.30	2.20	2.10	2.18	2.10
8	4.70	6.50	4.15	8.90	4.70	2.60	2.60	2.40	2.25	2.20	2.15	2.10
9	4.40	5.60	4.00	5.75	4.25	3.35	2.50	2.35	2.30	2.36	2.10	2.10
10	4.00	4.30	3.80	5.10	3.85	2.92	2.40	2.80	2.50	2.30	2.10	2.10
11	3.90	3.60	3.70	4.50	3.60	2.90	2.40	2.60	2.40	2.25	2.10	2.15
12	3.90	3.30	3.60	4.30	3.75	3.35	2.35	2.40	2.20	2.20	2.10	6.50
13	3.80	2.90	3.55	4.10	5.10	3.25	2.30	2.40	2.00	2 18	2.10	6.10
14	3.50	2.90	3.50	4.00	3.80	3.15	2.20	2.00	2.00	2.15	2.10	3.30
15	3.80	2.90	16.50	3.90	3.60	3.05	2.20	2.10	2.00	2.10	2.10	2.90
16	3.60	4.20	11.10	3.80	3.40	2.95	2.20	2.00	2.00	2.05	2.10	2.60
17	3.30	7.30	6.70	3.70	3.20	2.90	2.20	2.00	2.00	2.05	2.05	2.55
18	3.10	5.00	6.80	3.60	3.05	2.90	2.25	2.00	2.00	2.05	2.05	2.50
19	3.00	4.30	22.80	3.50	3.00	2.80	2.20	2.00	2.85	2.10	2.05	2.50
20	2.90	4.00	15.80	3.50	2.95	2.70	2.18	2.00	2.30	2.10	2.05	2.45
21	2.80	3.75	7.30	3.50	2.90	2.60	2.15	2.00	2.15	2.10	2.00	2.35
22	2.70	3.50	6.90	3.50	2.95	2.50	2.15	2.00	2.00	2.10	2.00	2.25
23	2.70	3.40	5.90	3.50	3.00	2.40	2.15	2.00	2.00	2.10	2.00	3.00
24	2.70	3.25	5.30	3.50	2.90	2.30	2.15	2.00	2.00	2.10	2.00	3.10
25	3.00	3.20	4.80	3.70	2.85	2.30	2.15	2.05	2.00	2.08	2.00	3.10
26	2.85	3.70	4.70	4.50	2.80	2.60	3.70	2.03	1.95	2.08	2.05	3.08
27	2.70	13.30	6.50	4.25	2.80	2.50	3.30	2.05	1.95	2.05	2.05	3.05
28	2.70	6.00	6.50	3.60	2.80	2.40	2.70	2.10	2.00	2.05	2.05	3.05
29	2.70	-------	6.00	3.40	2.80	2.40	2.40	2.25	2.00	2.03	2.10	3.00
30	2.70	-------	5.50	3.80	2.80	2.40	2.35	2.35	1.95	2.00	2.10	3.50
31	2.70	-------	5.00	-------	2.80	-------	2.30	4.00	-------	2.05	-------	3.65

CATAWBA RIVER AT ROCKHILL, SOUTH CAROLINA.

This station, described in the Eighteenth Annual Report, Part IV, page 61, was established by C. C. Babb September 3, 1895. It is located at the bridge of the Southern Railway, 3 miles south of Fort Mill, South Carolina, and is about 60 miles below the Catawba station. The gage is fastened to the upper side of the guard rail, the 2-foot mark of the rod being over the center of the second vertical of the second truss from the south end of the bridge. The bench mark is described in Water-Supply Paper No. 15, page 35. The length of the gage was verified December 18, 1899, when it was found to have stretched 0.4 foot. The gage heights as published are corrected for this error. This station is reached from Rockhill by private conveyance. The channel is straight, current swift, and flow uninterrupted. The banks are not subject to overflow and all of the water is confined to one channel. The bed of the stream is solid rock and very rough. The current is at an angle with the bridge. Altogether the section

is a poor one. W. A. Morris, a farmer at Rockhill, is the observer. Records of flow can be found as follows: 1896, Eighteenth Annual Report, Part IV, page 63; 1897, Nineteenth Annual Report, Part IV, page 214; 1898, Twentieth Annual Report, Part IV, page 150. The following measurements were made by E. W. Myers during 1899:

February 23, gage height, 3.10 feet; discharge, 8,086 second-feet.
June 13, gage height, 2.45 feet; discharge, 6,065 second-feet.
October 3, gage height, 1.60 feet; discharge, 2,104 second-feet.
December 18, gage height, 2.00 feet; discharge, 2,848 second-feet.

The table below was computed by E. W. Myers, and shows the comparative minimum flows of Catawba River at Catawba and Rockhill stations, which are about 60 miles apart. The drainage area at Catawba, North Carolina, is 1,535 square miles, and at the lower point, or Rockhill, South Carolina, it is 2,987 square miles. This table is comparable with the one for Yadkin River, shown on page 119, and it will be seen that the run-off per square mile does not vary to any greater extent than one would expect. The Catawba station was not established until the year following the one at Rockhill, so that the results can not be compared in the early part of the record. These facts are brought out in the footnotes at the bottom of the tables.

Table showing the comparative minimum flows for Catawba River, Catawba and Rockhill stations.

Year.	Driest month.		Mean flow for driest month.		Mean flow, driest month, per square mile.		Minimum flow for year.		Minimum flow for year per square mile.	
	Rockhill.	Catawba.	Rockhill.	Catawba.	Rockhill.	Catawba.	Rockhill.	Catawba.	Rockhill.	Catawba.
			Sec.-ft.	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*
1895	Sept.[a]	.....	1,318	.....	0.441	.....	1,300	.....	0.435	.....
1896	Aug	Oct	1,604	865	.54	0.56	[b]1,330	770	.445	0.501
1897	Sept	Sept	1,817	1,017	.61	.66	[c]1,575	[d]850	.526	.553
1898	June	June	2,091	1,069	.70	.69	1,600	910	.535	.592
1899	Nov	Nov	2,492	1,340	.835	.873	2,300	1,220	.770	.793

[a] Seven days' record.
[b] Also in July, August, and September.
[c] Minimum occurred in January. September minimum was 1,700 second-feet, or 0.569 second-foot per square mile.
[d] Minimum in October. September minimum 900 second-feet, or 0.579 second-foot per square mile.

Daily gage height, in feet, of Catawba River at Rockhill, South Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.20	2.40	6.20	4.00	2.80	2.20	2.10	2.10	2.00	1.70	1.90	1.70
2	2.80	2.50	4.10	3.70	2.80	2.20	2.00	2.00	3.50	1.60	1.80	1.70
3	2.60	2.30	3.40	3.40	2.70	2.40	2.00	1.90	2.50	1.60	1.70	1.60
4	2.30	2.30	3.40	3.25	2.70	2.40	1.85	1.90	2.10	1.60	2.10	1.60
5	2.30	7.90	4.80	4.30	2.60	2.25	1.80	1.90	2.10	1,50	1.80	1.60
6	2.20	10.75	4.10	4.20	2.60	2.20	1.80	1.80	2.00	1.50	1.70	1.60
7	8.30	11.70	4.30	3.80	2.60	2.20	1.80	1.70	2.00	1.80	1.60	1.60
8	8.00	10.20	3.70	6.20	3.30	2.15	1.90	1.70	2.60	2.40	1.60	1.60
9	5.10	6.20	3.20	6.90	3.80	2.10	2.00	1.80	1.90	2.10	1.60	1.60
10	3.30	4.20	3.10	4.80	3.10	2.10	2.00	2.00	2.30	1.80	1.60	1.70
11	2.80	3.50	2.90	4.00	2.90	2.50	1.90	2.20	2.60	1.80	1.60	1.60
12	2.85	3.10	2.90	3.70	2.80	2.50	1.90	2.40	2.10	1.70	1.60	2.80
13	2.70	2.80	2.80	3.50	2.70	2.40	1.80	2.20	1.80	1.70	1.60	3.30
14	3.10	2.50	2.60	3.40	4.30	2.90	1.80	1.90	1.80	1.70	1.60	3.60
15	3.60	2.60	7.55	3.30	3.40	2.60	1.80	1.80	1.80	1.70	1.60	2.60
16	3.30	3.10	14.05	3.15	2.90	2.35	1.80	1.80	1.70	1.70	1.60	2.20
17	2.95	5.80	12.00	3.20	2.70	2.20	1.80	1.80	1.70	1.70	1.60	2.10
18	2.80	6.60	5.70	3.10	2.60	2.05	1.80	1.80	1.55	1.70	1.50	2.00
19	2.70	4.80	5.30	3.10	2.55	2.05	1.80	1.80	1.50	1.70	1.50	2.20
20	2.60	3.90	16.85	3.00	2.55	2.05	1.80	1.70	1.80	1.70	1.50	2.10
21	2.50	3.40	14.20	2.90	2.50	2.00	2.10	1.70	2.00	1.70	1.50	2.10
22	2.40	3.30	5.70	2.85	2.40	2.00	1.80	1.60	1.90	1.70	1.50	2.10
23	2.40	3.10	4.40	2.80	2.40	2.00	1.80	1.60	1.70	1.70	1.70	2.00
24	2.20	3.10	4.40	2.80	2.50	2.00	1.70	1.60	1.70	1.60	1.70	2.70
25	2.40	2.90	4.00	2.80	2.50	2.00	1.80	1.60	1.60	1.60	1.70	2.70
26	2.40	2.80	3.70	3.50	2.40	2.00	1.90	1.60	1.60	1.60	1.90	2.70
27	2.40	5.99	4.55	3.85	2.35	2.00	2.50	1.50	1.60	1.60	1.80	2.40
28	2.30	10.40	5.50	3.30	2.35	2.15	2.70	1.60	1.60	1.60	1.70	2.10
29	2.30	.....	6.20	3.00	2.35	2.20	2.05	2.20	1.70	1.60	1.70	2.10
30	2.30	.....	5.30	2.90	2.30	2.10	2.00	2.10	1.70	1.60	1.70	2.10
31	2.20	.....	4.40	.....	2.30	.....	2.20	1.90	.....	1.80	.....	2.00

Catawba River in South Carolina is known as Wateree River. It unites with Congaree River to form the Santee. The United States Weather Bureau has maintained a station at Camden, South Carolina, on Wateree River, 43 miles above its mouth. The gage is a pine timber attached to the central granite pier of the South Carolina and Georgia Extension Railroad bridge. The top of the rail on the bridge is 47.0 feet above zero of gage. The highest water recorded was 31.5 feet, in September, 1886; the lowest, 0.0 feet, in June, 1884. The danger line is at 24 feet. The drainage area at this point, according to the Weather Bureau, is 2,635 square miles.

BROAD RIVER AT GAFFNEY, SOUTH CAROLINA.

Broad River rises on the eastern slope of the Blue Ridge Mountains, near Hickorynut Gap, in the west-central part of North Carolina, and flowing in a general southeasterly direction unites with Saluda River above Columbia, South Carolina, to form the Congaree. The drainage area comprises about 4,950 square miles, of which 3,550 are in South Carolina and 1,400 in North Carolina, and is partly mapped on the Morganton, Mount Mitchell, and Saluda atlas sheets. The upper part of its basin is rough, broken country largely covered with forests. In South Carolina the topography is flatter and for the greater part the land is under cultivation. Broad River receives a number of important tributaries, but there are no towns of importance along it. There are a number of sites for the possible development of water

power along its course, the most important of which are described in the Nineteenth Annual Report, Part IV, page 215. Systematic measurements of the flow have been made at Gaffney, South Carolina, 15 miles below the North Carolina line, and at Alston, 20 miles above Columbia, South Carolina. The station at Gaffney, described in the Eighteenth Annual Report, Part IV, page 65, was established by E. W. Myers July 1, 1896, and was located at the Southern Railway bridge, about 3 miles from Gaffney, South Carolina. This station was maintained until October 25, 1898, when the gage rod was moved to Gaffneys Ferry, 200 yards above the bridge, as described in Water-Supply Paper No. 27, page 27. The bench mark is described in the same paper. The velocity is quite rapid, well distributed all the way across, and the channel is straight for some distance above and below the station. The ferryman, John W. Gaffney, Gaffney, South Carolina, was employed to take charge of the gage. The results of discharge measurements are found as follows: 1896, Eighteenth Annual Report, Part IV, page 66; 1897, Nineteeth Annual Report, Part IV, page 220. The following measurements were made by E. W. Myers during 1899:

February 10, gage height, 3.70 feet; discharge, 4,702 second-feet.
February 22, gage height, 2.25 feet; discharge, 4,497 second-feet.
April 15, gage height, 3.20 feet; discharge, 3,510 second-feet.
June 12, gage height, 2.40 feet; discharge, 2,496 second-feet.
October 4, gage height, 1.70 feet; discharge, 692 second-feet.
October 4, gage height, 1.70 feet; discharge, 662 second-feet.
December 17, gage height, 1.65 feet; discharge, 1,485 second-feet.

Daily gage height, in feet, of Broad River at Gaffney, South Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.50	2.40	5.00	3.90	2.80	2.10	1.80	1.90	2.50	1.30	1.60	1.40
2	2.40	2.40	3.90	3.50	2.80	2.10	1.80	1.80	2.00	1.20	1.70	1.40
3	2.20	2.30	3.50	3.40	2.60	2.00	1.70	1.80	1.90	1.40	1.80	1.50
4	2.10	2.30	3.40	3.60	2.50	2.10	1.70	1.70	1.70	1.30	1.60	1.50
5	2.00	5.80	3.40	4.90	2.70	2.10	1.70	1.60	1.60	1.30	1.60	1.40
6	2.80	8.20	3.50	3.60	2.70	1.90	1.60	1.60	1.50	1.70	1.50	1.30
7	8.40	10.20	3.30	4.50	2.60	2.00	1.70	1.50	1.20	1.60	1.60	1.40
8	5.40	7.20	3.10	6.40	2.50	2.00	1.70	1.50	2.00	1.70	1.50	1.40
9	4.60	-------	3.00	4.50	2.50	2.00	1.80	1.50	2.20	1.80	1.40	1.30
10	3.00	-------	3.00	4.00	2.40	2.00	1.80	2.00	1.90	1.80	1.50	1.30
11	3.10	-------	2.90	3.70	2.40	2.00	1.70	2.50	2.00	1.70	1.50	1.40
12	3.00	3.70	2.90	3.50	2.40	2.00	1.60	2.10	1.60	1.70	1.40	2.60
13	3.00	3.50	2.90	3.40	4.50	3.20	1.60	1.90	1.30	1.60	1.35	3.50
14	3.00	3.40	3.50	3.20	3.70	2.30	1.60	1.80	1.30	1.40	1.40	2.20
15	3.20	3.10	9.20	3.20	2.80	2.20	1.60	1.90	1.20	1.40	1.60	1.90
16	3.10	3.90	10.00	3.30	2.70	2.10	1.50	1.70	1.20	1.50	1.40	1.80
17	2.90	6.80	8.30	3.20	2.40	2.00	1.50	1.60	1.20	1.50	1.50	1.70
18	2.80	4.30	5.80	3.10	2.40	2.20	1.60	1.50	1.30	1.60	1.40	1.80
19	2.60	3.70	12.20	3.00	2.40	1.80	1.60	1.40	1.30	1.50	1.30	1.60
20	2.50	3.40	11.50	3.00	2.20	1.80	1.90	1,40	1.40	1.40	1.30	1.70
21	2.30	3.10	5.60	2.90	2.50	1.80	1.80	1.30	1.70	1.40	1.30	1.60
22	2.20	3.10	5.60	2.90	2.20	1.70	1.70	1.40	1.60	1.30	1.40	1 50
23	2.30	3.00	4.80	2.90	2.20	1.70	1.70	1.40	1.40	1.30	1.50	1.60
24	2.20	2.80	4.50	2.60	2.20	1.60	1.60	1.50	1.20	1.40	1.50	2.80
25	2.40	2.80	4.20	3.30	2.20	2.00	1.60	1.50	1.40	1.30	1.50	2.40
26	2.20	2.80	4.00	4.10	2.10	1.70	1.90	1.50	1.60	1.30	1.60	2.30
27	2.20	9.80	4.50	3.20	2.10	2.20	2.60	2.60	1.50	1.20	1.60	2.00
28	2.10	7.00	4.60	3.10	1.90	2.10	1.90	1.90	1.30	1.30	1.60	1.70
29	2.20	-------	5.50	2.90	2.00	2.00	1.90	2.00	1.40	1.30	1.50	1.60
30	2.20	-------	4.00	2.80	2.20	1.80	1.80	1.90	1.70	1.40	1.50	1.60
31	2.30	-------	4.00	-------	2.10	-------	1.80	2.30	-------	1.50	-------	1.50

BROAD RIVER AT ALSTON, SOUTH CAROLINA.

This station, described in the Eighteenth Annual Report, Part IV, page 67, was established by E. W. Myers, July 3, 1896, and is located at the Southern Railway bridge near Alston, South Carolina, and 60 miles below the Gaffney station. The length of the wire gage is 42.65 feet. The gage was verified December 19, 1899. The section here is not a good one, being broken by the foundations of an old bridge crossing at the same place as the present one. The bed is flat, muddy, and somewhat shifting. The river is straight for a long distance above and below the station. The current is swift and the velocity fairly uniform across the section. The observer is D. R. Elkin, a farmer of Alston, South Carolina. Records of discharge may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 68; 1897 and 1898, Twentieth Annual Report, Part IV, page 151. The following measurements were made by E. W. Myers in 1899:

February 19, gage height, 10.15 feet; discharge, 28,930 second-feet.
June 14, gage height, 4.33 feet; discharge, 6,289 second-feet.
October 2, gage height, 2.14 feet; discharge, 1,645 second-feet.
December 19, gage height, 2.91 feet; discharge, 3,319 second-feet.

Daily gage height, in feet, of Broad River at Alston, South Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.42	4.78	11.50	8.83	4.30	3.32	2.77	3.10	4.50	2.20	4.47	2.90
2	3.88	4.60	8.00	6.74	4.10	3.30	2.74	3.00	4.45	2.12	3.10	3.16
3	3.90	4.30	6.54	5.51	4.09	3.20	2.50	2.55	3.55	1.97	2.87	3.14
4	3.43	4.30	7.42	5.30	4.00	3.10	2.76	3.08	3.65	2.20	3.88	2.80
5	3.35	6.90	7.42	6.10	3.99	3.10	2.53	2.50	3.00	2.34	2.74	2.66
6	3.47	13.00	10.51	6.10	3.99	2.80	2.63	3.00	2.90	6.28	2.62	2.82
7	9.50	18.00	6.20	5.61	4.11	2.90	2.60	2.80	2.78	3.52	2.37	2.70
8	14.00	18.50	5.53	8.33	4.20	2.89	2.62	2.10	3.45	4.18	2.64	2.65
9	9.40	12.90	5.11	9.00	3.98	2.90	2.73	2.80	3.43	3.22	2.58	2.71
10	7.10	9.50	4.90	7.14	3.82	2.88	2.90	2.65	3.52	2.90	2.51	2.66
11	5.78	6.78	4.79	6.13	3.63	2.89	2.60	2.75	9.30	2.86	2.50	2.53
12	7.20	5.80	4.71	5.88	3.69	3.40	2.48	4.50	4.40	2.68	2.56	6.48
13	7.35	5.40	4.42	5.40	3.70	3.10	2.43	3.34	3.60	2.58	2.78	8.13
14	6.71	4.86	4.59	5.20	3.88	4.28	2.30	2.80	2.81	2.60	2.23	5.13
15	7.51	4.54	6.28	5.03	4.68	3.70	2.34	2.55	2.62	2.58	2.50	4.42
16	6.10	8.33	14.40	4.90	3.98	3.35	2.33	2.55	2.60	2.43	2.60	3.70
17	6.20	15.30	15.39	4.87	3.62	3.00	2.24	2.55	2.40	2.21	2.57	3.34
18	5.32	12.69	10.50	4.65	3.52	3.40	2.09	2.23	2.30	2.52	2.58	3.07
19	4.70	10.10	8.00	4.69	3.40	3.10	2.28	2.20	2.35	2.54	2.51	2.91
20	4.33	6.84	15.30	4.68	3.45	2.92	2.10	2.00	2.60	2.49	2.43	3.22
21	4.11	6.23	13.94	4.54	3.30	2.84	2.83	2.15	2.63	2.57	2.29	3.08
22	4.00	6.52	8.94	4.41	3.40	2.82	2.52	2.14	2.60	2.42	2.52	2.90
23	3.82	5.61	7.00	4.30	3.43	2.79	2.30	2.40	2.50	2.20	4.71	3.60
24	4.10	5.11	7.12	4.40	3.88	2.73	2.17	2.30	2.39	2.15	3.61	7.32
25	4.20	4.61	6.40	4.13	3.72	2.51	2.40	3.40	2.30	2.45	3.10	8.20
26	4.55	4.62	5.90	6.61	3.32	2.60	2.95	2.35	2.08	2.40	5.54	4.44
27	4.00	13.72	5.80	6.64	3.30	2.70	6.25	3.55	2.60	2.39	4.25	3.00
28	3.80	17.98	7.30	5.30	3.30	3.78	4.72	5.55	2.35	2.41	3.50	3.76
29	3.90	.....	7.72	4.70	3.28	3.30	3.80	4.70	2.29	2.40	3.30	3.75
30	4.10	.....	7.43	4.40	3.11	2.93	2.09	4.28	2.47	2.30	3.04	.....
31	4.50	.....	6.84	.....	3.11	.....	3.15	4.50	.....	4.57	.....	.....

Broad River joins Saluda River at Columbia, South Carolina, to form Congaree River. The United States Weather Bureau has maintained river-height observations at Columbia, South Carolina. The gage rod is painted on the first stone pier from the eastern shore

of the Gervais street toll bridge. The bench mark is the track of the South Carolina and Georgia Extension Railroad at the Union Station, and is at an elevation of 102.59 feet above the zero of the gage. The high-water mark is 34.4 feet, and was reached in September, 1852; the lowest, —0.4 foot, on January 20, 1893. The danger line is 15 feet. The drainage area above the station, according to the United States Weather Bureau, is 7,300 square miles.

Santee River is formed by the junction of Wateree and Congaree rivers. The United States Weather Bureau has maintained a gage on Lower Santee River at St. Stephen, South Carolina, 50 miles above its mouth. The gage rod is attached to the downstream side of the central granite pier of the railroad bridge. The top of the rail on this bridge is 31 feet above zero of gage. The high-water mark is 20.2 feet, and was reached on September 18, 1888; the lowest, 1.3 feet, on October 6, 1895. The danger line is at 12 feet. The area drained at this point, according to the United States Weather Bureau, is 13,600 square miles.

SALUDA RIVER AT WATERLOO, SOUTH CAROLINA.

Saluda River rises in the mountains between North and South Carolina, flows in a southeasterly direction, and unites, near Columbia, South Carolina, with the Broad, to form the Congaree. The drainage area is partly mapped on the Saluda, Pickens, Pisgah, and Abbeville atlas sheets. Measurements have been made on the Saluda to determine the available water power. The station was established by E. W. Myers, August 30, 1896, and is described in the Eighteenth Annual Report, Part IV, page 68. It is 1 mile below the mouth of Reedy River, at the Charleston and Western Carolina Railway bridge, about 3 miles from Coronaca Station, South Carolina. The length of the gage wire is 47.00 feet. The length of the gage was verified December 19, 1899. The river here is straight for several hundred yards above and below the bridge. The flow is probably influenced by dams some miles above. The bed of the stream is of sand and mud and liable to change during high water. The banks are low, the right bank being subject to overflow. The observer is R. N. Cunningham, storekeeper and farmer at Waterloo, South Carolina. The locality is reached by private conveyance from Greenwood, South Carolina. The discharge measurements are made from the railroad bridge. Records of results may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 68; 1897, Nineteenth Annual Report, Part IV, page 221; 1898, Twentieth Annual Report, Part IV, page 153. The following measurements were made by E. W. Myers during 1899:

February 20, gage height, 7.60 feet; discharge, 3,350 second-feet.
June 14, gage height, 5.30 feet; discharge, 1,740 second-feet.
October 1, gage height, 3.65 feet; discharge, 604 second-feet.
December 19, gage height, 4.00 feet; discharge, 995 second-feet.

Daily gage height, in feet, of Saluda River at Waterloo, South Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.00	5.75	12.80	8.75	6.00	4.75	4.95	3.80	3.90	3.65	4.75	4.60
2	4.65	5.40	8.90	7.55	5.90	4.40	3.95	3.70	5.20	2.85	4.50	4.45
3	5.05	5.60	7.65	7.05	5.80	5.15	3.85	3.65	5.25	3.60	4.65	3.80
4	4.90	6.25	7.60	7.15	5.60	4.35	4.20	3.70	3.25	4.35	4.40	3.05
5	4.80	6.85	8.00	7.30	6.00	4.15	3.20	4.75	3.95	4.20	3.80	3.90
6	5.00	10.60	8.10	7.60	5.95	5.05	3.75	4.00	3.85	5.50	2.90	4.25
7	14.00	18.50	7.25	7.20	6.15	4.10	3.80	3.30	3.70	4.50	4.35	3.80
8	14.30	17.35	6.70	7.95	5.80	4.00	4.85	3.90	4.10	5.65	4.30	3.85
9	6.05	12.70	6.50	8.35	5.85	3.80	4.65	4.60	4.85	4.00	4.35	4.25
10	7.05	8.60	6.70	7.40	6.55	3.70	3.45	4.00	3.85	4.00	4.35	3.45
11	6.50	7.60	6.30	6.90	5.50	3.75	3.70	5.50	6.60	4.10	4.15	3.00
12	6.90	7.10	6.45	6.95	5.30	5.85	3.70	4.90	5.50	4.00	3.70	5.90
13	7.50	7.00	6.45	6.75	5.20	5.50	3.60	4.50	3.95	4.00	2.90	7.10
14	7.80	5.60	6.25	6.65	4.95	5.55	3.60	3.20	3.80	4.65	4.00	5.85
15	7.45	6.50	10.30	6.30	4.80	4.45	4.75	3.65	4.50	4.10	4.45	5.00
16	6.95	12.55	15.35	6.55	4.60	4.25	4.50	3.65	4.10	3.00	4.35	4.85
17	6.65	15.20	13.85	6.35	4.70	4.90	3.60	3.55	3.50	4.20	4.05	4.45
18	6.25	13.10	10.30	6.25	4.55	4.60	3.50	4.55	2.85	4.00	4.25	4.10
19	6.30	8.60	9.75	6.45	4.50	4.65	3.60	4.15	3.95	4.75	3.70	4.75
20	5.90	7.40	11.98	6.30	5.15	4.05	3.55	3.45	3.90	4.70	2.95	3.90
21	5.40	7.60	13.18	6.20	4.60	4.10	4.45	2.70	3.90	5.45	3.95	4.50
22	5.85	7.45	8.75	5.55	5.05	3.75	4.50	4.20	3.90	3.20	4.05	4.55
23	5.70	9.85	8.65	5.90	4.50	3.65	3.60	3.70	4.80	3.00	6.45	4.30
24	5.45	6.55	8.90	6.15	4.40	4.90	2.90	3.75	3.60	4.15	4.40	7.15
25	5.50	6.35	7.80	7.90	4.35	4.10	4.75	3.70	2.90	4.35	4.85	5.15
26	5.20	6.70	7.55	8.10	4.30	3.60	5.10	4.35	3.90	4.55	5.25	4.75
27	5.00	17.55	7.05	7.15	5.15	4.15	5.40	5.00	4.35	4.55	4.15	4.95
28	6.75	15.60	7.35	6.55	5.10	4.05	5.00	4.75	4.45	4.20	5.05	4.55
29	6.55	-------	7.95	6.00	3.75	4.20	5.45	4.35	3.80	3.83	5.00	4.15
30	4.10	-------	7.25	6.10	4.15	3.80	5.40	4.80	4.00	2.95	4.15	4.75
31	5.30	-------	9.35	-------	4.15	-------	3.80	4.40	-------	4.40	------	4.40

TUGALOO RIVER AT MADISON, SOUTH CAROLINA.

This river is formed by the junction of the Tallulah and Chattooga rivers, which have their sources in the Blue Ridge Mountains. The basin is largely covered with an original growth of oak, and is extremely wild and picturesque. The drainage area is mapped on the following atlas sheets: Nantahala, Dahlonega, Walhalla, and Cowee. There are many beautiful falls in this watershed, the most noted of which are Tallulah Falls, with a drop of 335 feet in four successive leaps, the total fall in $2\frac{3}{5}$ miles being 525 feet; and Toccoa Falls, on Toccoa Creek, with a vertical drop of about 190 feet. This latter stream should not be confused with Toccoa River, a tributary of Hiwassee River, and on which a gaging station is maintained at Blue Ridge, Georgia. The gaging station on Tugaloo River was established July 19, 1898, at Cooks Ferry, about one-half a mile from Madison, South Carolina, one mile below the Southern Railway bridge over Tugaloo River and 2 miles above the mouth of Chauga Creek. The gage is a 2 by 4 inch scantling 10 feet long, nailed to a sycamore tree on the right bank at the ferry landing. The bench marks are on the left bank of the river, the first being on a willow tree at the ferry landing, and consisting of three large nails 3.00 feet above zero of gage; the second is on the same tree, being one nail 6.00 feet above zero of gage; the third is a large nail in a sycamore tree at the ferry landing 12.00 feet above the zero of the gage. Discharge measurements are made from a boat held in place by the ferry rope stretched across the

river. The results of the measurements are given in the Twentieth Annual Report, Part IV, page 162. The following measurements were made by Max Hall and others in 1899:

April 21, gage height, 4.50 feet; discharge, 2,604 second-feet.
May 22, gage height, 3.20 feet; discharge, 1,687 second-feet.
June 20, gage height, 2.10 feet; discharge, 1,325 second-feet.
September 12, gage height, 1.00 foot; discharge, 734 second-feet.
October 4, gage height, 0.70 foot; discharge, 512 second-feet.

A number of discharge measurements were made on various tributaries of Tugaloo River during the fall of 1899. A measurement of Tallulah River above the falls at the wagon bridge at Tallulah Falls, Georgia, was made October 3, when the discharge was found to be 153 second-feet; a second measurement was made November 25, giving a discharge of 188 second-feet. Two discharge measurements were made on Toccoa Creek, above the falls, 2½ miles from Toccoa, Georgia, on October 4; they were made at different sections on the river, and gave 5.7 and 5.9 second-feet, respectively. Chauga Creek enters the Tugaloo about 2 miles below the gaging station. A measurement was made on this stream at the wagon bridge near its mouth at Madison, South Carolina, on October 4, when the discharge was found to be 99 second-feet.

Daily gage height, in feet, of Tugaloo River at Madison, South Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.10	3.90	6.60	6.40	4.30	2.50	1.70	1.40	3.10	0.70	0.90	1.00
2	3.40	3.40	5.90	5.90	4.20	2.40	1.60	1.40	2.70	.70	.80	1.10
3	3.30	3.50	5.80	5.70	4.10	2.40	1.60	1.30	3.30	.70	.80	1.10
4	3.20	7.60	5.40	5.90	4.00	2.30	1.50	1.20	1.90	.70	.80	1.00
5	3.20	6.80	6.90	6.00	4.30	2.50	1.50	1.10	1.70	.80	.80	.90
6	6.45	11.85	6.00	5.60	4.10	3.30	1.60	1.10	1.40	.90	.70	.90
7	5.80	12.70	5.50	7.80	4.80	2.20	1.90	1.10	1.30	.80	.70	.90
8	4.60	8.80	5.20	8.70	4.00	2.20	1.60	1.00	1.20	3.30	.70	.80
9	4.20	6.80	5.20	6.80	3.80	2.10	1.60	1.00	1.20	2.50	.70	.80
10	3.90	5.80	4.90	6.20	3.70	2.00	1.60	1.40	1.10	1.50	.70	.80
11	4.20	5.50	4.80	5.80	3.70	2.20	1.50	1.30	1.10	1.00	.70	.90
12	4.10	5.30	4.70	5.50	3.60	3.90	1.40	1.00	1.00	.90	.70	12.30
13	3.90	8.40	4.20	5.30	3.60	5.30	1.30	.90	.90	.90	.70	8.45
14	4.00	4.40	8.05	5.20	3.40	3.50	1.30	1.00	.90	.80	.70	3.10
15	4.50	4.50	16.15	5.00	3.30	2.80	1.30	1.00	.80	.80	.70	2.50
16	4.00	5.60	13.80	5.10	3.20	2.40	1.20	1.00	.80	.80	.70	2.00
17	3.90	5.60	8.40	4.90	3.20	2.50	1.20	1.20	.80	.80	.70	1.80
18	3.70	5.00	6.90	4.80	3.10	2.40	1.20	1.00	.80	.90	.70	1.60
19	3.40	4.80	16.15	4.80	3.20	2.20	1.10	.90	.80	1.00	.70	1.60
20	3.40	4.60	11.60	4.60	3.00	2.10	1.20	.80	.90	1.00	.70	1.90
21	3.30	4.50	8.40	4.50	2.90	2.00	1.20	.80	.90	.90	.70	1.60
22	3.20	4.50	7.60	4.40	3.10	2.90	1.40	.80	.80	.90	.80	1.40
23	3.10	4.40	8.40	4.30	3.00	2.90	1.30	.90	.80	.90	.90	1.30
24	3.20	4.30	7.30	4.20	2.80	2.80	1.70	.80	.80	.80	1.10	5.00
25	3.40	4.10	6.80	6.80	2.70	2.00	1.40	.90	.80	.80	.90	3.00
26	3.20	6.50	6.40	6.00	2.70	1.80	4.10	.80	.90	.80	1.60	2.40
27	3.20	9.80	6.20	5.20	2.60	2.10	4.20	1.20	.90	.80	2.60	2.00
28	3.10	8.10	6.10	4.80	2.60	2.10	2.40	1.00	.80	.80	1.70	1.90
29	3.00	.....	6.80	4.60	2.60	2.00	2.90	.90	.80	.90	1.30	1.80
30	2.90	.....	6.00	4.40	2.50	1.80	1.90	1.40	.70	.90	1.10	1.60
31	3.10	.....	6.90	.....	2.50	.....	1.60	6.50	.....	.80	.....	1.40

SAVANNAH RIVER AT CALHOUN FALLS, SOUTH CAROLINA.

Savannah River is formed by the junction of Seneca and Tugaloo rivers about 100 miles above Augusta, Georgia. The headwater tributaries have their sources in the Blue Ridge Mountains in North and South Carolina and Georgia, where more than one-fifth of the territory is in original oak forest. The drainage area is partly mapped on the following atlas sheets; Pisgah, Cowee, Dahlonega, Walhalla, Pickens, Abbeville, Elberton, Nantahala, and Carnesville. A large number of fine water powers occur on the tributaries and along the main river, the most noted being at Tallulah Falls on Tallulah River, 335 feet in height, there being a total fall of 525 feet in a distance of $2\frac{2}{3}$ miles. In order to determine the value of these waterpowers, systematic measurements were begun at Calhoun Falls, South Carolina, on August 4, 1896. This station, described in the Eighteenth Annual Report, Part IV, page 73, is at the Seaboard Air Line bridge, across Savannah River, above the mouth of Beaverdam Creek and below Rocky River, and about 3 miles west of the town of Calhoun Falls, South Carolina. The river here is divided into two channels by a large island containing several hundred acres. The east channel is a good section at ordinary stages, but at lowest water the current is very sluggish. The west channel, which is the main river, is obstructed by some very small islands and old cofferdams about the two piers, otherwise the section is a good one. The bed is rocky and constant. The wire gage is on the west channel, center span; its length is 65.40 feet. One bench mark on the top of the iron stringer under the cross-ties near the gage is 54.00 feet above the datum of the gage; the other is on the top of the first pier on east side of west channel, and is 30.85 feet above zero of gage. Zero of gage is 354.5 above sea level. The gage was verified on March 4, 1899. The observer is Peter J. Pfeiffer, a farmer at Calhoun Falls, South Carolina. Records of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 75; 1897, Nineteenth Annual Report, Part IV, page 224; 1898, Twentieth Annual Report, Part IV, page 164. The following measurements were made by B. M. Hall and Max Hall during 1899:

March 4, gage height, 4.77 feet; discharge, 12,076 second-feet.
May 16, gage height, 3.45 feet; discharge, 5,258 second-feet.
September 28, gage height, 2.30 feet; discharge, 2,057 second-feet.
November 10, gage height, 2.25 feet; discharge, 2,039 second-feet.

Daily gage height, in feet, of Savannah River at Calhoun Falls, South Carolina, for 1899.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.60	4.00	3.30	3.20	3.30	3.00	2.20	2.60	2.70
2	.....	5.00	3.90	3.20	3.00	3.10	2.90	2.10	2.50	2.80
3	.....	4.85	3.80	3.20	2.90	3.00	2.90	2.10	2.50	2.90
4	4.75	4.90	3.80	3.20	2.70	2.90	2.80	2.20	2.40	2.70
5	4.95	4.75	3.70	3.10	2.70	2.80	2.70	2.40	2.40	2.60
6	4.65	4.70	3.90	3.00	2.60	2.70	2.90	3.00	2.40	2.60
7	4.40	4.75	3.90	2.90	2.70	2.60	2.90	2.80	2.50	2.60
8	4.35	4.65	3.80	3.00	2.70	2.60	3.00	3.90	2.40	2.50
9	4.25	5.60	3.80	3.30	3.00	3.00	3.00	3.50	2.30	2.50
10	4.20	5.10	3.70	3.20	2.90	2.90	2.90	3.20	2.20	2.40
11	4.05	4.95	3.70	3.40	2.80	2.80	3.20	3.00	2.20	2.50
12	3.90	4.80	3.70	3.50	2.80	2.80	3.00	2.70	2.10	4.90
13	4.00	4.70	3.60	5.00	2.70	2.70	3.00	2.50	2.10	5.00
14	4.00	4.50	3.60	3.90	2.60	2.70	2.90	2.40	2.00	3.80
15	5.25	4.30	3.50	3.70	2.50	2.60	2.90	2.30	2.10	3.50
16	13.60	4.00	3.40	3.60	2.40	2.60	2.80	2.40	2.10	3.30
17	9.00	3.90	3.40	3.60	2.40	2.60	2.70	2.40	2.10	3.10
18	6.90	3.70	3.40	3.50	2.30	2.60	2.60	2.30	2.00	3.00
19	7.00	3.70	3.50	3.30	2.40	2.50	2.60	2.30	2.00	3.00
20	9.00	3.50	3.50	3.20	2.30	2.50	2.90	2.40	2.00	2.90
21	7.05	3.40	3.40	3.10	2.20	2.60	2.90	2.30	2.10	2.90
22	5.00	3.20	3.50	3.00	2.30	2.80	2.80	2.30	2.10	2.80
23	5.00	3.00	3.70	3.00	2.30	3.00	2.60	2.30	2.30	2.70
24	4.90	2.90	3.55	2.90	2.30	2.90	2.50	2.20	2.30	3.90
25	5.00	4.00	3.50	2.90	2.40	2.70	2.40	2.20	2.40	3.80
26	5.10	4.60	3.40	3.00	2.70	2.70	2.60	2.20	4.00	3.50
27	4.95	5.10	3.25	3.90	2.70	2.80	2.40	2.10	3.40	3.50
28	4.85	5.00	3.20	4.00	5.00	3.00	2.30	2.10	3.20	3.60
29	6.95	4.70	3.20	3.60	3.50	2.90	2.30	2.20	2.90	3.70
30	5.10	4.10	3.10	3.30	3.60	3.50	2.20	2.30	2.80	3.60
31	7.00	.....	3.30	.....	3.40	3.20	.....	2.50	.....	2.90

SAVANNAH RIVER AT AUGUSTA, GEORGIA.

Observations of river height have been maintained since 1875 by the city of Augusta, at the city highway bridge. The results have been printed in a volume entitled "Stages of water at river stations," prepared by the United States Weather Bureau. Those for 1875 to 1889 are given in Part III, those for 1890 to 1892 in Part IV, and for 1893 to 1895 in Part V of the above-mentioned publication. The gage consists of a vertical timber fastened to the pier and graduated to feet and inches. Readings are made four times a day by J. M. Youngblood, keeper of the city bridge, usually at 6 a. m., 12 m., 6 p. m., and 9 p. m. The 6. a. m. readings are those used by the Weather Bureau, and are here given, excepting September, October, and November, when the average of all four readings is given, since at that season nearly all of the water passes through the factory wheels above the gage. The channel is straight and without obstructions; the banks are moderately high, but are liable to overflow at the highest floods. Bed is fairly constant. Records of measurement may be found as follows: 1875 to 1891, Fourteenth Annual Report, Part II, page 147; 1891 to 1896, Eighteenth Annual Report, Part IV, page 75; 1897, Nineteenth Annual Report, Part IV, page 227; 1898, Twentieth Annual Report, Part IV, page 165. The following measurements have been made by B. M. Hall and his assistants during 1899:

Measurements of Savannah River at Augusta, Georgia.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.	*Feet.*	*Sec.-feet.*	1899.	*Feet.*	*Sec.-feet.*
March 17	25.20	60,716	May 29	7.60	6,271
March 18	20.60	35,971	July 1	7.22	5,391
May 8	9.70	10,860	August 3	6.68	4,226
May 9	9.50	9,908	October 10	12.48	14,613

Daily gage height, in feet, of Savannah River at Augusta, Georgia, for 1899. (*a*)

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.5	12.7	28.8	19.5	9.6	7.9	7.2	7.4	13.9	5.0	6.2	7.3
2	10.8	13.0	21.0	18.9	9.5	8.4	6.7	6.7	10.9	5.0	6.4	6.9
3	10.3	14.3	16.2	15.3	9.3	7.6	6.2	6.3	9.1	5.5	6.3	5.8
4	9.0	15.8	14.2	13.2	9.3	7.5	6.0	6.3	8.0	5.6	5.8	7.0
5	8.5	14.5	13.7	12.9	9.2	7.2	6.0	6.0	7.5	5.8	5.6	8.7
6	8.5	20.7	16.2	13.0	9.8	7.3	6.0	5.9	6.9	11.8	5.8	6.7
7	12.8	28.0	15.2	12.2	10.3	7.3	5.8	5.7	6.6	9.6	5.9	6.3
8	22.9	31.0	13.3	12.4	10.4	7.0	6.7	5.5	7.4	10.5	5.8	6.3
9	19.2	29.9	12.2	15.5	9.7	7.0	7.0	5.7	7.0	14.1	5.9	6.1
10	14.3	22.9	11.8	14.2	9.1	6.9	8.3	6.0	7.0	12.1	5.8	6.0
11	12.8	18.3	11.5	12.8	8.8	7.3	7.8	5.7	8.7	8.5	5.5	5.9
12	17.3	14.7	11.2	12.0	8.5	6.9	6.5	8.0	9.3	7.3	5.6	5.9
13	17.4	13.7	11.2	11.5	8.5	7.5	6.0	8.3	8.6	6.9	5.6	6.3
14	15.3	12.9	11.1	11.2	8.5	9.7	6.0	6.4	6.9	6.4	5.7	10.7
15	15.4	12.3	11.0	11.0	8.3	9.7	6.0	6.0	6.3	6.0	6 1	14.5
16	14.5	14.4	18.8	10.8	8.2	8.2	6.0	5.5	5.8	6.3	5.8	10.5
17	17.3	25.0	25.5	10.5	8.2	8.0	5.7	5.4	5.6	6.0	5.8	8.5
18	16.8	24.3	21.5	10.5	8.0	8.7	5.6	5.0	5.2	6.0	5.8	7.5
19	13.9	19.1	17.1	10.2	8.0	7.9	5.8	5.0	5.4	6.3	5.4	7.3
20	11.7	15.3	20.0	10.5	7.9	7.3	5.7	5.8	5.7	6.1	5.7	7.0
21	10.7	13.5	22.5	10.4	7.9	7.3	5,5	4.0	6.0	6.5	5.7	6.8
22	10.0	14.7	17.1	10.0	7.8	7.0	5.3	4.7	6.6	6.7	5.8	6.9
23	9.9	14.3	15.8	9.9	7.7	6.7	5.8	5.3	6.0	6.0	5.8	7.4
24	11.4	13.0	15.5	9.6	8.2	6.7	5.8	4.8	5.4	6.0	7.0	9.3
25	11.9	11.7	15.5	10.0	8.0	6.5	5.7	5.7	5.9	5.8	8.3	13.8
26	10.8	11.5	13.8	11.5	7.8	6.3	6.0	5.6	5.6	5.8	9.2	12.3
27	10.3	17.7	14.0	13.0	7.6	6.7	7.0	7.0	5.3	5.6	11.3	9.8
28	10.0	29.6	13.5	11.2	7.4	7.5	11.7	13.3	5.8	5.7	9.8	8.3
29	11.0	-------	14.0	10.3	7.4	7.7	11.6	11.3	5.8	5.6	8.4	5.0
30	11.2	-------	15.0	10.0	7.4	7.5	9.3	9.2	5.6	5.8	7.5	8.3
31	10.5	-------	13.5	-------	7.3	-------	8.5	11.4	-------	5.9	-------	7.7

a For the months of September, October, and November the figures given are an average of four readings daily—6 a. m., 12 m., 6 p. m., and 8 p. m. For the other months the readings are those taken at 6 a. m.

BROAD RIVER AT CARLTON, GEORGIA.

Broad River rises in the northeastern part of Georgia and flows in a southeasterly direction, passing between Elbert and Wilkes counties and emptying into Savannah River 8 miles below Calhoun Falls station. The watershed is a rolling country largely covered with timber. Measurements were begun on Broad River at Carlton on May 27, 1897, this station being established by Max Hall. It is located on the bridge of the Seaboard Air Line, 3 miles east of Carlton, Georgia, and 3 miles above the mouth of the South Fork. The iron bridge is 250 feet long and is approached on each side by wooden trestles. The initial point of soundings is the end of the iron bridge at right bank, upstream. The length of the wire gage is 56.30 feet. Bench mark is top of upstream iron girder under cross-tie at 30 feet from initial point and is 51.00 feet above datum. Zero of gage is 384.5 feet above sea level. The gage was last verified April 25, 1899. The

channel is straight and the flow uninterrupted except by one pier in the center of the river. The banks are rather low and subject to overflow in time of high water. The bed is fairly constant. The observer is S. P. Power, jr., a farmer at Carlton, Georgia. The results of measurements may be found as follows: 1897, Nineteenth Annual Report, Part IV, page 227; 1898, Twentieth Annual Report, Part IV, page 163. The following discharge measurements were made during the year 1899 by Max Hall and assistants:

Measurements of Broad River at Carlton, Georgia.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.	*Feet.*	*Sec.-feet.*	1899.	*Feet.*	*Sec.-feet.*
February 28	9.05	8,281	June 28	2.80	1,063
March 1	5.28	3,205	September 27	2.00	514
April 25	3.65	1,841	November 11	2.05	485
May 15	2.60	919	December 21	2.25	591

A measurement of Broad River was made June 28 below the junction of South Broad, 3 miles below the station and 4 miles from Carlton, Georgia, which gave a discharge of 1,135 second-feet. On the same date a measurement of South Broad was made at its mouth, when the discharge was found to be 145 second-feet. On September 22 a second measurement of South Broad was made 4 miles above the mouth above Fork Creek and 1.5 of a mile from Carlton, Georgia, and gave 103 second-feet. On November 11 a third measurement of this latter river was made one-half a mile from mouth, below Fork Creek, and 3 miles from Carlton, giving a discharge of 139 second-feet. The drainage area of South Broad River at its mouth is 215 square miles.

Daily gage height, in feet, of Broad River at Carlton, Georgia, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.10	3.45	5.20	5.80	3.00	2.60	2.30	2.40	3.80	1.90	2.15	2.35
2	2.95	3.00	4.10	4.45	3.00	2.55	2.25	2.35	3.00	1.90	2.10	2.40
3	2.75	3.75	3.80	3.60	2.95	2.50	2.20	2.25	2.50	1.90	2.10	2.30
4	2.70	3.70	3.60	3.65	2.95	2.50	2.20	2.20	2.30	1.90	2.05	2.30
5	2.65	4.30	3.95	3.70	3.00	2.45	2.20	2.20	2.20	2.00	2.05	2.25
6	4.45	7.20	4.20	3.45	3.20	2.40	2.20	2.15	2.15	2.20	2.05	2.20
7	6.45	13.18	3.65	3.60	3.15	2.40	2.25	2.10	2.10	2.15	2.05	2.20
8	6.40	10.60	3.45	4.40	3.00	2.50	2.40	2.10	2.10	4.30	2.05	2.20
9	3.90	5.45	3.40	4.20	2.95	2.60	2.30	2.10	2.10	3.40	2.05	2.20
10	3.30	4.30	3.35	3.60	2.95	2.45	2.40	2.10	2.10	2.50	2.05	2.20
11	3.80	3.75	3.30	3.50	2.90	2.40	2.30	2.15	2.50	2.35	2.05	2.20
12	4.05	3.60	3.30	3.40	2.85	2.60	2.25	2.10	2.10	2.25	2.05	3.40
13	3.70	3.45	3.25	3.30	2.80	3.70	2.20	2.15	2.50	2.20	2.05	3.60
14	3.45	3.35	3.50	3.30	2.80	3.00	2.20	2.05	2.00	2.15	2.05	2.95
15	3.75	3.30	4.40	3.25	2.75	2.40	2.15	2.00	2.00	2.10	2.10	2.50
16	3.50	4.40	13.88	3.25	2.75	2.50	2.10	1.95	1.95	2.10	2.10	2.45
17	3.50	5.05	11.30	3.20	2.70	2.65	2.10	1.90	1.95	2.10	2.05	2.35
18	3.25	4.45	4.70	3.15	2.70	2.65	2.25	1.90	1.95	2.10	2.05	2.30
19	3.10	3.80	4.50	3.25	2.65	2.55	2.15	1.90	1.95	2.10	2.05	2.30
20	3.00	3.50	8.10	3.20	2.65	2.45	2.10	1.90	2.05	2.10	2.05	2.30
21	2.90	3.55	5.20	3.15	2.60	2.40	2.10	2.00	2.00	2.10	2.05	2.25
22	2.85	3.60	4.00	3.10	2.65	2.35	2.05	1.95	2.00	2.05	2.05	2.25
23	2.95	3.50	4.15	3.05	2.70	2.30	2.20	2.00	2.00	2.05	3.65	2.20
24	3.05	3.30	4.55	3.10	2.65	2.30	2.25	1.95	1.95	2.05	3.45	4.40
25	3.00	3.20	3.75	3.20	2.60	2.30	2.15	2.00	1.95	2.05	2.45	4.30
26	2.95	3.15	3.60	3.50	2.60	3.70	2.45	2.05	1.95	2.05	3.60	3.00
27	2.85	15.78	3.50	3.20	2.60	3.00	6.50	3.95	2.00	2.05	3.70	2.60
28	2.80	11.15	3.45	3.15	2.55	2.80	5.30	2.45	1.95	2.05	2.90	2.60
29	2.80	-------	4.20	3.10	2.55	2.80	3.50	2.10	1.95	2.05	2.55	2.60
30	2.75	-------	3.70	3.10	2.50	2.50	2.80	3.50	1.90	2.10	2.40	2.50
31	3.10	-------	5.00	-------	2.70	-------	2.50	4.10	-------	2.15	-------	2.45

OCONEE RIVER AT DUBLIN, GEORGIA.

Oconee River rises in the northern part of Georgia, near Gainesville, on the southern slope of Chattahoochee Ridge, which separates the headwaters of this stream from the tributaries of Chattahoochee River. It flows in a southeasterly direction and joins the Ocmulgee at the southern border of Montgomery County to form the Altamaha. The watershed is for the most part hilly, and is made up of cultivated ground broken by extensive tracts of forest. A station was maintained for a time at Cary, Georgia, immediately below the mouth of Apalachee River. The rating was evidently affected by the dam several miles below, and for this reason the station was abandoned on March 31, 1898. The results of measurements at this station can be found as follows: 1897, Nineteenth Annual Report, Part IV, page 227; 1898, Twentieth Annual Report, Part IV, page 170. A single discharge measurement was made at this station in 1899 on October 19: Gage height, 2.03 feet; discharge, 898 second-feet.

A station was established by the United States Weather Bureau in 1894, at Dublin, Georgia, about 60 miles above the junction of the Oconee with the Ocmulgee, 45 miles below Milledgeville, and 85 miles below the old Cary station. The station was discontinued on April 30, 1897, but was reestablished by the Georgia geological survey, February 11, 1898. Since October 15, 1898, the station has been maintained by the United States Weather Bureau. The station is located about one-half mile east of Dublin, Georgia. The gage is a vertical rod fastened to the lower side of the middle pier of the Wrightsville and Tennille Railroad bridge. The gage is referred to a secondary gage on a hemlock tree on the right bank, 150 feet above, and to a bench mark on the same tree which consists of three large nails 3.00 feet above the zero of the gage, and a second bench mark on another hemlock tree 100 feet above the first, which consists of three large nails 3.00 feet above datum. The channel is straight and without obstructions except the bridge piers. The current is swift, the banks high and not subject to overflows. Discharge measurements are made from the upper side of the county highway iron bridge, which is about 100 yards above the railroad bridge at which the gage is located. The initial point for soundings is the end of the bridge on right bank of the river. Records of measurement may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 77; 1897, Nineteenth Annual Report, Part IV, page 228; 1898, Twentieth Annual Report, Part IV, page 170. The following measurements were made by B. M. Hall and his assistants during 1899:

February 2, gage height, 8.20 feet; discharge, 9,689 second-feet.
April 28, gage height, 8.00 feet; discharge, 9,033 second-feet.
June 8, gage height, 0.80 foot; discharge, 1,937 second-feet.
September 15, gage height, 0.80 foot; discharge, 1,997 second-feet.
September 15, gage height, 0.50 foot; discharge, 1,903 second-feet.
December 14, gage height, 3.90 feet; discharge, 4,028 second-feet.

A discharge measurement was also made on Oconee River at Milledgeville, Georgia, 45 miles above Dublin, on November 21, 1899, when the discharge was found to be 957 second-feet.

Daily gage height, in feet, of Oconee River at Dublin, Georgia, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.80	7.70	11.30	8.30	5.40	1.70	0.50	2.90	2.50	—1.30	—0.40	2.40
2	3.60	8.10	13.80	8.00	4.70	1.80	.60	2.30	2.90	—1.30	— .40	1.10
3	5.20	9.10	16.50	8.50	3.80	1.70	.40	2.00	2.70	—1.30	— .40	2.00
4	5.80	9.90	17.00	9.00	3.70	1.50	.20	1.70	2.10	—1.30	— .50	1.90
5	5.00	10.70	16.90	9.80	3.50	1.40	.10	1.50	1.50	— .80	— .50	1.70
6	4.70	12.70	16.20	9.50	4.10	1.20	.00	.90	1.10	.50	— .50	1.60
7	5.00	13.10	14.50	9.00	5.00	1.00	.20	.80	.80	2.40	— .50	1.30
8	7.80	15.00	12.70	8.60	4.80	.80	.40	.70	.30	5.10	— .60	1.10
9	8.60	20.10	11.00	8.00	4.40	.70	.00	.20	.20	7.20	— .60	.90
10	10.40	22.50	9.80	7.80	3.60	.60	—.10	—.30	.10	8.10	— .70	.70
11	12.20	21.70	8.60	7.50	3.00	.50	—.10	—.40	.00	8.60	— .70	.50
12	14.10	18.90	7.60	7.00	2.70	.40	—.20	—.20	.10	6.80	— .70	1.20
13	14.40	17.50	7.00	6.40	2.70	.30	—.30	—.10	.70	4.10	— .80	2.60
14	15.30	16.80	6.80	5.60	2.40	.30	—.40	—.10	1.50	1.70	— .80	3.30
15	14.80	15.50	6.70	5.20	2.30	.90	—.40	—.20	.80	1.10	— .10	4.10
16	14.50	13.70	7.30	5.00	2.10	1.20	—.40	—.30	.10	.60	.70	3.20
17	14.30	12.40	7.90	4.90	2.00	.70	—.50	—.50	— .30	.50	.10	2.50
18	13.70	12.50	8.30	4.80	1.90	.30	—.60	—.60	— .40	.50	.80	1.90
19	13.30	12.70	9.20	5.30	1.80	.30	—.60	—.70	— .50	.50	.10	1.50
20	13.10	13.30	10.10	5.80	1.70	.60	—.60	—.80	— .60	.40	— .20	1.30
21	12.80	13.60	10.90	5.60	1.60	.90	—.70	—.80	— .70	.40	— .30	1.20
22	12.60	13.00	12.60	5.50	1.50	.50	—.70	—.90	— .80	.20	— .40	1.20
23	11.30	12.00	14.20	5.20	1.50	.30	—.70	—.70	— .90	.00	— .30	1.40
24	8.30	10.80	13.40	5.00	1.80	.20	—.80	—.30	— .90	— .10	.10	1.40
25	7.80	9.80	11.90	4.80	2.10	.20	—.80	—.20	—1.00	— .30	1.50	2.30
26	7.30	9.00	10.00	5.90	1.80	.00	.30	2.50	—1.00	— .40	1.30	5.30
27	7.10	9.70	9.60	7.40	1.70	—.10	.70	3.00	—1.10	— .50	2.10	5.60
28	6.80	9.60	8.90	8.00	1.60	—.20	.90	3.00	—1.10	— .60	3.20	4.60
29	7.00	.....	8.30	7.20	1.60	—.20	1.80	5.10	—1.10	— .70	4.40	3.90
30	7.40	.....	8.10	6.10	1.60	.40	4.70	4.50	—1.20	— .70	3.30	2.80
31	7.60	.....	8.00	.....	1.60	.....	5.00	2.90	.....	— .30	.....	2.60

YELLOW RIVER AT ALMON, GEORGIA.

This river is an important tributary of the Ocmulgee. Its headwaters are in Gwinnett County, only a short distance from Chattahoochee River. About one-third of the watershed is under cultivation, the ground being well terraced on the hillsides. The drainage area is entirely mapped on the Monroe, Gainesville, Suwanee, and Atlanta atlas sheets of the United States Geological Survey. There are a number of falls along the river capable of development for water power. A gaging station was established at Almon, 3 miles west of Covington, Georgia, September 12, 1897. It was at the low wagon bridge crossing the stream, 600 feet below the Georgia Railroad bridge. Results of measurements at this station may be found as follows: 1897, Nineteenth Annual Report, Part IV, page 230; 1898, Twentieth Annual Report, Part IV, page 170. No current-meter measurements were made during 1898, nor were the gage heights recorded. An attempt was made, however, to ascertain the fluctuations of discharge for comparison with the observations made at Macon. A rating table published on page 229 of the Nineteenth Annual Report, Part IV, was constructed from discharge measurements made during the autumn of 1897. A rating table for 1898 is published in Water-Supply Paper No. 27, of the United States Geo-

logical Survey. The application of such a table involves the assumption that the fluctuations at Almon are coincident with those at Macon, and as it is of uncertain accuracy, the old station at Almon has been abandoned and a new station was established May 9, 1899, by B. M. Hall, about 1 mile above the old station. It is intended to maintain this station for six months or more, in order to study the water powers above and below. The gage rod is fastened to a small tree on the left bank below the bridge, and referred to a bench mark on top of the downstream end of floor beam, 90 feet from the initial point of soundings, which is the right-bank end of the hand rail on the downstream side of the bridge. The elevation of bench mark is 20.81 feet above datum. The gage was verified May 9, 1899. The channel is straight, the current swift and not influenced by obstructions except at very low water, when the current is entirely under the west half of the bridge. The banks are high but are overflowed at the highest waters. The bed is rocky and constant. The following measurements were made by B. M. Hall and assistants during 1899:

May 3, gage height 2.97 feet; discharge 481 second-feet.
May 9, gage height 3.16 feet; discharge 561 second-feet.
May 16, gage height 2.30 feet; discharge 364 second-feet.
June 6, gage height 1.80 feet; discharge 235 second-feet.
June 27, gage height 2.42 feet; discharge 427 second-feet.
August 7, gage height 1.40 feet; discharge 218 second-feet.
October 19, gage height 1.70 feet; discharge 200 second-feet.

Daily gage height, in feet, of Yellow River at Almon, Georgia, for 1899.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.40	1.60	1.90	2.10	1.20	1.60	2.00
2	.....	2.10	1.50	1.80	2.00	1.20	1.60	2.70
3	.....	2.00	1.40	1.70	1.80	1.20	1.50	2.50
4	.....	1.90	1.30	1.60	1.60	1.20	1.50	2.30
5	.....	1.80	1.40	1.60	1.50	1.70	1.50	2.00
6	.....	1.80	1.50	1.40	1.50	2.00	1.50	1.90
7	.....	1.70	1.80	1.40	1.50	2.50	1.50	1.90
8	.....	1.70	1.60	1.40	1.50	4.00	1.50	1.90
9	3.20	1.70	1.80	1.30	1.40	2.80	1.50	1.90
10	2.80	1.70	1.60	1.30	1.40	2.20	1.50	1.90
11	2.80	1.70	1.40	1.30	2.50	1.80	1.50	1.90
12	2.70	2.00	1.40	1.30	2.00	1.80	1.50	4.00
13	2.70	2.56	1.30	1.20	1.70	1.80	1.50	3.00
14	2.50	2.10	1.30	1.20	1.50	1.80	1.50	2.50
15	2.50	1.90	1.20	1.20	1.50	1.70	1.50	2.30
16	2.50	1.80	1.20	1.10	1.40	1.70	1.60	2.00
17	2.30	1.80	1.20	1.10	1.40	1.70	1.50	2.00
18	2.10	1.80	1.80	1.00	1.40	1.70	1.50	2.00
19	2.30	1.70	1.40	1.00	1.30	1.70	1.50	2.00
20	2.10	1.60	1.40	1.00	1.30	2.00	1.50	2.00
21	2.00	1.50	1.60	1.00	1.30	1.90	1.50	2.00
22	2.30	1.50	1.80	1.00	1.30	1.70	1.50	2.00
23	2.80	1.50	2.00	1.00	1.30	1.50	2.20	2.00
24	2.50	1.40	1.40	1.00	1.20	1.50	2.20	5.50
25	2.20	1.40	1.60	1.00	1.20	1.50	1.90	4.60
26	2.00	3.20	2.40	3.60	1.20	1.50	4.50	3.40
27	2.00	2.60	5.80	3.00	1.20	1.50	4.00	2.50
28	2.00	2.00	5.00	2.80	1.20	1.50	3.20	2.50
29	1.90	2.00	3.70	2.70	1.20	1.60	2.50	2.50
30	1.80	1.80	2.80	2.50	1.20	1.70	2.00	2.50
31	3.30	.....	2.00	2.30	.....	1.70	.....	2.30

TOWALIGA RIVER AT JULIETTE, GEORGIA.

The drainage basin of this stream occupies a small area in central Georgia, its headwater tributary adjoining those of Flint River on the west, and small creeks draining into the Ocmulgee on the east. The river is a tributary of Ocmulgee River, entering it 25 miles above Macon. The area drained is a rolling country and extensively cultivated. A gaging station was established by B. M. Hall near its mouth, at the Southern Railway bridge, 2½ miles north of Juliette, Georgia, on May 5, 1899, but observations of gage heights were not started until November 2. The rod is 1 by 4 inches and 7 feet long, nailed to the timber crib at base of left bank pier of the iron single-span bridge. Bench mark No. 1 is at top of downstream iron girder under cross-ties at 40 feet from left end of bridge, and is 37.00 feet above gage datum. Bench mark No. 2, top of rail at same point, gage height 38.80 feet. At low stages measurements are made at the wagon bridge a half mile above the railroad bridge. Thomas Pittman, a farmer living one-half mile from the bridge, is the observer. His address is Berner, Georgia. The following measurements were made by B. M. Hall and assistants in 1899:

May 5, gage height 3.15 feet; discharge 581 second-feet.
May 17, gage height 1.80 feet; discharge 255 second-feet.
November 2, gage height 1.20 feet; discharge 167 second-feet.
November 2, gage height 1.20 feet; discharge 163 second-feet.
December 16, gage height 1.90 feet; discharge 184 second-feet.

Daily gage height, in feet, of Towaliga River at Juliette, Georgia, for 1899.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1	.....	1.70	9	1.20	1.60	17	1.60	1.80	25	1.20	3.80
2	1.20	1.65	10	1.10	1.55	18	1.30	1.70	26	3.35	2.50
3	1.20	1.65	11	1.20	1.50	19	1.30	1.70	27	3.20	2.10
4	1.10	1.75	12	1.10	3.70	20	1.20	1.70	28	2.20	1.10
5	1.10	1.75	13	1.10	3.60	21	1.30	1.70	29	1.95	2.00
6	1.10	1.65	14	1.10	2.50	22	1.20	1.50	30	1.80	1.90
7	1.10	1.55	15	1.10	2.00	23	1.30	1.60	31	.....	1.90
8	1.10	1.50	16	1.70	1.90	24	1.20	4.00			

OCMULGEE RIVER AT MACON, GEORGIA.

The Ocmulgee River rises in the north-central part of Georgia and flows in a southeasterly direction, joining the Oconee south of Mount Vernon to form the Altamaha River, which empties into the Atlantic Ocean. The drainage area has the same general features as that of the Oconee. A station was established by the United States Weather Bureau January 21, 1893, and measurements were begun by the United States Geological Survey in 1895. This station is described in the Eighteenth Annual Report, Part IV, page 79. The wire gage on the Macon, Dublin and Savannah Railroad bridge having been twice stolen in the spring of 1897, the observations were taken on the Weather Bureau gage referred to the same data, which is a vertical

rod bolted to the stone pier of the Central Railroad bridge. Bench mark, top of track on Central Railroad bridge, is 54.85 feet above zero of gage. Measurements of discharge are made from the wagon bridge, a short distance above. The channel is straight and without obstructions except two bridge piers. The current is over 1 foot per second at low water; the banks high and not subject to overflow. The bed of the river is soft and changeable. W. T. Bass, a clerk in a store near the gage, was observer for the United States Geological Survey and the Georgia geological survey until June 1, 1899, when the station was resumed by the United States Weather Bureau, in charge of Mr. T. S. Collins, observer. Records of measurement may be found as follows: 1893–96, Eighteenth Annual Report, Part IV, page 82; 1897, Nineteenth Annual Report, Part IV, page 232; 1898, Twentieth Annual Report, Part IV, page 171. The following measurements were made by B. M. Hall and his assistants during 1899:

Measurements of Ocmulgee River at Macon, Georgia.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.	*Feet.*	*Sec.-feet.*	1899.	*Feet.*	*Sec.-feet.*
February 1	9.72	6,302	June 21	1.22	1,009
February 3	13.75	14,954	August 2	1.98	1,345
February 3	13.75	14,781	September 14	1.70	1,314
February 3	12.81	12,687	September 16	.80	793
April 14	4.50	2,587	October 21	2.30	1,814
April 29	5.00	3,094	December 13	4.50	3,009
June 7	1.60	1,015	December 15	2.50	1,540
June 9	1.48	983			

Daily gage height, in feet, of Ocmulgee River at Macon, Georgia, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.42	9.60	14.72	11.30	4.05	4.40	1.50	2.50	2.60	0.30	0.80	1.70
2	6.60	8.41	11.14	8.71	3.80	2.80	1.50	2.10	1.80	.30	.60	1.50
3	5.96	13.70	9.11	7.97	3.60	2.60	1.20	1.40	2.00	.30	.60	1.20
4	5.21	11.98	8.32	7.86	3.50	2.60	.90	1.40	1.80	.40	.50	2.10
5	3.70	9.94	8.11	8.11	3.45	1.90	.90	1.20	1.80	.50	.50	1.90
6	4.12	10.80	7.62	7.85	8.10	1.80	1.00	1.00	1.10	2.30	.50	1.50
7	15.20	15.83	6.81	6.89	6.72	1.60	1.10	.80	.70	2.00	.40	1.30
8	12.65	13.42	6.72	6.50	5.30	1.60	1.50	.70	.70	10.00	.40	1.10
9	10.21	12.13	6.40	5.97	3.80	1.60	2.00	.60	.50	6.40	.40	1.10
10	9.23	10.80	6.11	5.63	3.55	1.40	1.30	.50	.40	3.20	.40	1.00
11	12.14	9.78	5.81	5.42	3.28	1.60	1.10	2.10	2.20	2.20	.40	1.10
12	11.87	8.21	5.74	5.01	3.10	1.50	.90	1.00	2.50	1.80	.50	3.70
13	9.38	7.60	5.69	4.71	2.96	2.30	.80	1.20	2.20	1.30	.50	4.70
14	8.96	7.13	5.58	4.58	2.90	2.90	.80	.80	1.70	1.00	.50	3.90
15	8.21	6.10	5.51	4.40	2.82	2.20	.70	.70	.90	1.00	.80	2.60
16	9.67	12.30	8.51	5.01	2.69	1.70	.60	.70	.60	.90	.70	2.00
17	12.91	11.98	7.21	4.42	2.52	1.50	.60	.60	.60	.80	.70	1.80
18	10.87	11.12	9.38	4.33	2.45	2.30	.50	.60	.50	.80	.70	1.50
19	9.34	9.76	12.94	10.38	2.33	1.40	.70	.50	.50	.80	.60	1.40
20	5.91	8.32	10.72	7.82	2.20	1.30	.90	.40	.40	2.00	.60	1.40
21	5.11	8.27	9.42	5.52	2.18	1.30	1.00	.40	.30	2.80	.60	1.30
22	5.42	8.16	8.11	4.72	2.48	1.20	.80	a.00	.30	3.20	.50	1.30
23	5.10	8.10	6.42	4.61	3.67	1.00	1.30	3.30	.30	2.40	.60	1.40
24	5.37	7.13	8.65	5.48	3.35	.90	3.20	3.10	.20	1.60	1.00	6.40
25	5.31	6.28	8.85	11.87	3.01	.90	2.00	2.10	.20	1.20	1.40	5.90
26	5.01	6.13	6.93	12.41	2.40	1.20	2.00	1.20	.40	1.00	4.40	5.20
27	4.71	12.13	6.01	8.22	2.18	3.20	2.30	.80	.40	.80	5.30	3.50
28	4.69	14.91	7.87	5.84	2.12	3.20	4.30	3.00	.40	.70	4.20	2.60
29	5.03	------	7.30	5.16	2.06	1.60	5.10	2.30	.30	1.40	3.10	2.30
30	4.90	------	6.91	4.71	2.03	1.70	4.20	1.80	.30	1.00	2.00	2.10
31	5.07	------	6.28	------	2.15	------	3.20	2.40	------	1.10	------	1.60

a Mud around gage.

FLINT RIVER, AT ALBANY, GEORGIA.

This river, known to the Indians as the "Thronateeska," rises in the west-central part of Georgia and flowing in a southerly direction cuts through Pine Mountain Range just below Molena. It joins the Chattahoochee to form Apalachicola River. Its drainage area is hilly and rolling on the headwaters and level at the lower end. It is largely cultivated, but most of the ground is well terraced. A station was established at Molena, Georgia, June 7, 1897. Measurements were made during 1897 and 1898, and a rating table constructed by Prof. B. M. Hall. The alternate accumulation and washing out of sediment in an eddy one-half mile below so affected the gage height that it has not been possible to establish a definite relation between them and the discharge measurements, and the station was discontinued June 2, 1898. Records of measurement made at Molena may be found as follows: 1897, Eighteenth Annual Report, Part IV, page 234; 1898, Nineteenth Annual Report, Part IV, page 233. Two measurements were made in 1899 at the Macon and Birmingham bridge, near Woodbury, Georgia, 5 miles below the old Molena station. The gage heights are assumed, based on permanent bench marks. First measurement, January 29, gage height, 0.80 foot; discharge, 590 second-feet. Second measurement, August 29, gage height, 0.57 foot; discharge, 461 second-feet.

The United States Weather Bureau has a gage rod at Reynolds, 80 miles above Albany. It was erected in 1893 by the United States Engineer Corps. The rod is attached to the middle pier of the railroad bridge, 3 miles east of the town. The drainage area above Reynolds is reported to be 2,000 square miles.

A second station has been maintained at Albany, Georgia, by the United States Weather Bureau. The drainage area at this point is, approximately, 5,000 square miles. Mr. J. B. Marbury, the local forecast official at Atlanta, Georgia, furnishes the following information:

The river gage is in two sections, the long section, from 10 to 36 feet, is nailed in two segments to the south face downstream side of the west pier, on the right or Albany side of the river; the short section is nailed to a cypress tree 120 feet down the river from the pier. The top of the pier foundation sill is 8.1 feet above low water. A second gage, reading from zero to 21 feet, is nailed to a cypress tree on the left bank of the river about 100 feet downstream from the point where the south side of Commerce street, if extended, would cross the river. The first bench mark is the top of the wide marble foundation stone of the African Methodist Episcopal Church, corner of Washington and State streets, Albany, Georgia. It is 49.5 feet above zero of gage. A second bench mark is the top of the sill of the old wharf at the foot of Broad street. It is 3 feet above low water. The observer is John E. Clark. No measurements of discharge were made in 1899 at this station.

Daily gage height, in feet, of Flint River at Albany, Georgia, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.70	8.30	14.30	8.30	5.40	2.40	0.50	4.30	2.50	0.40	0.60	4.10
2	6.50	8.70	14.30	7.80	4.80	2.40	.60	4.70	2.10	.10	.70	4.30
3	6.40	8.90	15.10	7.00	4.40	2.20	.40	4.90	2.00	.20	.70	4.50
4	6.40	9.20	15.90	6.70	4.20	2.00	.20	4.90	2.30	.20	.70	4.50
5	7.30	9.60	15.90	6.40	4.10	2.00	.10	4.10	2.20	.20	.70	4.50
6	9.20	10.80	14.30	6.90	4.00	2.00	.00	3.90	2.00	.30	.70	4.20
7	10.00	11.60	13.00	7.50	3.80	2.00	.20	3.50	2.00	.90	.60	3.90
8	10.00	12.30	12.10	8.00	3.30	1.90	.40	3.30	2.00	1.30	.60	3.80
9	9.50	13.80	11.80	7.40	3.00	1.70	.00	3.00	2.10	1.60	.60	3.70
10	11.60	14.60	11.50	7.80	2.80	1.30	—.10	2.60	2.10	1.90	.50	3.50
11	13.50	15.90	10.90	8.00	2.60	1.20	—.10	2.60	2.00	2.40	.50	3.30
12	16.70	17.30	9.40	7.40	2.40	1.20	—.20	2.30	2.10	2.40	.40	3.70
13	16.80	18.20	8.30	6.90	2.00	1.20	—.30	2.20	2.20	2.40	.20	3.90
14	17.00	19.90	8.00	6.50	1.80	1.20	—.40	1.80	2.20	2.70	.30	4.10
15	17.00	21.80	7.80	5.00	1.70	.90	—.30	1.50	2.30	2.80	.60	4.30
16	17.50	19.00	8.30	5.00	1.50	.70	—.40	1.20	2.40	2.80	.70	4.30
17	18.00	17.60	8.90	5.00	1.30	.50	—.50	1.00	2.50	2.90	.80	4.00
18	18.80	16.90	9.60	5.20	1.20	.50	—.60	1.00	2.20	3.00	.80	3.80
19	17.30	15.20	10.40	5.30	1.00	.40	—.60	1.00	2.30	3.00	.90	3.60
20	16.90	14.60	11.30	5.50	.90	.40	—.60	.80	1.80	2.90	.80	3.30
21	15.30	14.30	12.80	5.50	.90	.40	—.70	.70	1.60	3.20	.80	3.10
22	14.10	13.90	11.90	5.50	.90	.30	—.70	.70	1.50	3.40	.90	3.40
23	12.30	13.20	11.60	5.50	1.00	.30	—.70	.90	1.20	3.20	.90	3.50
24	11.00	13.00	11.50	5.90	2.30	.60	—.80	1.10	1.10	2.70	1.00	3.50
25	10.20	12.00	11.30	6.70	3.80	.80	—.80	1.60	1.20	2.70	1.20	3.70
26	9.40	11.30	10.60	6.90	4.30	.90	—.30	.50	1.30	2.50	1.50	3.90
27	8.70	10.20	10.00	7.00	5.40	.90	—.70	.30	1.80	1.70	1.60	4.00
28	8.20	12.30	9.40	6.30	4.30	.80	—.90	.30	1.90	1.30	1.70	4.20
29	7.90	-------	9.20	6.00	3.80	.80	1.80	.30	1.90	.90	2.20	2.50
30	7.90	-------	8.90	5.80	3.00	1.30	1.70	.20	1.90	.70	2.60	4.90
31	7.90	-------	9.10	-------	2.50	-------	5.00	.20	-------	.50	------	5.90

CHATTAHOOCHEE RIVER AT OAKDALE, GEORGIA.

This river rises in the northeastern part of Georgia and flows in a southwesterly direction to the boundary line between Georgia and Alabama, when it turns to the southward and forms the dividing line between these States to the southern border of Georgia, where it joins Flint River to form the Apalachicola. Its watershed above the mouth of Chestatee River is mountainous and over 80 per cent in oak forests; from thence to West Point, Georgia, it is narrow and hilly and about 50 per cent is under cultivation. From West Point to Columbus, Georgia, is through a rocky, mountainous, well-wooded country. Below Columbus, Georgia, the river is navigable, but the country is hilly, consisting of extensive high plains traversed by deep narrow valleys. The drainage area above Oakdale is entirely mapped on the following atlas sheets: Marietta, Walhalla, Dahlonega, Ellijay, Suwanee, Gainesville, and Atlanta. A large number of important water-power privileges occur on the tributaries and on the main river. The most important fall occurs near Columbus, where the river descends 120 feet in 4 miles. A fall of 362 feet from West Point to Columbus, a distance of 34 miles, occurs in a number of shoals, separated by stretches of comparatively quiet water. Elaborate surveys of shoals near Atlanta, Georgia—Vining Shoal, 32 feet, and Bull Sluice, 50 feet—have been made by companies with the object of development and electric transmission to Atlanta. Two gaging stations are maintained on the Chattahoochee River, one at Oakdale, about 8 miles

northwest of Atlanta, and the other at West Point, Georgia, where the Chattahoochee River reaches the Alabama State line. The station was established at Oakdale by Cyrus C. Babb on October 17, 1895. It is described in the Eighteenth Annual Report, Part IV, page 85. It was located at the Southern Railway bridge, 1 mile above the mouth of Proctor Creek.

On July 30, 1896, the location of the station was changed to Mason & Turners Ferry, 1 mile below Oakdale. The gage at this point, known as the "Oakdale lower gage," is nailed to a tree on the right bank, 100 feet below the ferry, and set 1 foot lower than the gage at the Southern Railway bridge. On June 1, 1899, the lower gage was discontinued and the upper gage resumed and adopted by the United States Weather Bureau, the United States Geological Survey still receiving the records and making current-meter discharge measurements at that point. The gage recently put in and now used is set on the same datum as the old wire gage of the United States Geological Survey, established at that point by Mr. Babb in 1895, and above referred to, but is a vertical, timber, rod, 3.25 inches by 6 inches by 28 feet, bolted with five iron bolts to the east side of the center pier of the Southern Railway bridge. It is well painted and is graduated into feet with brass figures and into tenths with copper nails from −1.5 feet to +26.5 feet, making its total length 28 feet. Its zero point is 753.5 feet above sea level. Bench mark No. 1 is a railroad spike in corner of pier, right bank, 12.39 feet above datum of gage. Bench mark No. 2 is top of downstream iron girder under cross-ties, 23 feet from west end of bridge, and is 54.75 feet above gage datum. The flow is obstructed by rafts, which have to be cleared from the channel occasionally. The channel is straight and the current swift. The banks are subject to overflow. The bed of the stream is constant and the results obtained fairly good. All discharge measurements made in 1899 are referred to the upper gage at the railroad bridge. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 85; 1897, Nineteenth Annual Report, Part IV, page 236; 1898, Twentieth Annual Report, Part IV, page 182. The following measurements were made during 1899 by B. M. Hall and assistants:

Measurements of Chattahoochee River at Oakdale, Georgia.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.	*Feet.*	*Sec.-feet.*	1899.	*Feet.*	*Sec.-feet.*
March 11	4.35	4,397	September 9	1.32	1,452
May 1	3.80	3,452	October 6	.67	1,150
May 26	2.36	2,678	October 17	.54	1,083
June 14	3.92	4,788	November 18	.42	988

A number of miscellaneous discharge measurements were made on tributaries of Chattahoochee River by B. M. Hall and his assist-

ants during 1899. They are as follows, arranged in geographic order from the headstream down: Three measurements of Soquee River were made at Porter Mills, near Clarksville, Georgia. The first, on May 29, showed a discharge of 342 second-feet; the second, on June 7, gave a discharge of 239 second-feet; the third, on June 10, gave a discharge of 231 second-feet. The measurement of Hazel Creek, below the ford between Demorest and Porter Mills, on June 10, showed a discharge of 63 second-feet. Two measurements were made on Chattahoochee River at Shallow Ford bridge, near Gainesville, Georgia, 5 miles above the mouth of Chestatee River. The first, on June 22, at a gage height of 1.30 feet, showed a discharge of 933 second-feet; the second, on October 10, at a gage height of 0.95 foot, showed a discharge of 613 second-feet. Chestatee River at Newbridge post-office, Georgia, was discharging 354 second-feet on July 19. Chattahoochee River at Barkers Ferry, near Buford, Georgia, was carrying 782 second-feet on November 17. Sweetwater Creek enters the Chattahoochee 10 miles below Oakdale, Georgia. Three measurements of its discharge were made at the Strickland bridge near Austell. The first measurement, on April 19, gage height, 3.20, showed a discharge of 402 second-feet; the second, on June 24, gage height, 1.1 feet, gave a discharge of 242 second-feet. The third measurement, on October 24, gave a discharge of 108 second-feet. The three following measurements were made of Chattahoochee River, between Oakdale and West Point: October 3, at Moodys bridge, on the Owensbyville wagon road, at a gage height of 0.0 feet, the discharge was 1,165 second-feet; on October 4 the river at Franklin, Georgia, about 40 miles above West Point, at a gage height of —0.70 foot, showed a discharge of 1,164 second-feet; on November 4 this river at McGees bridge, about 20 miles above West Point, Georgia, at a gage height of 0.40 foot, was carrying 1,670 second-feet.

Yellow Jacket Creek, at its mouth just above McGees bridge, was discharging 77 second-feet on November 4.

Daily gage height, in feet, of Chattahoochee River at Oakdale, Georgia, for 1899.

LOWER GAGE AT MASON & TURNER'S FERRY. (a)

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1	4.25	5.10	9.80	13.00	4.70	17	4.75	7.25	24.25	5.25	3.60
2	4.75	4.50	6.85	7.75	4.45	18	4.50	6.10	11.00	4.95	3.50
3	3.60	5.80	6.17	6.50	4.40	19	4.10	5.60	10.50	5.00	3.55
4	3.40	4.90	5.90	7.75	4.35	20	3.90	4.90	15.00	4.95	3.50
5	3.10	6.50	8.10	6.50	4.50	21	3.75	5.25	8.75	4.85	3.45
6	3.75	10.00	8.50	5.90	5.10	22	3.60	5.20	7.25	4.65	5.50
7	6.75	16.00	6.40	6.50	4.60	23	3.90	5.00	9.50	4.75	3.60
8	6.10	21.50	5.90	7.75	4.35	24	4.25	4.90	9.00	4.95	3.50
9	5.25	13.40	5.50	7.50	4.25	25	4.10	4.60	6.50	7.25	3.35
10	4.70	9.50	5.25	7.10	4.10	26	4.25	10.23	7.10	8.00	3.25
11	6.30	6.40	5.10	6.80	4.00	27	3.70	22.13	6.20	6.25	3.15
12	4.75	5.50	5.00	5.75	3.95	28	3.45	18.88	6.10	5.25	3.10
13	4.25	4.90	4.95	5.25	3.90	29	3.25	.....	7.90	5.00	3.20
14	4.50	4.10	6.25	5.20	3.85	30	3.50	.....	6.45	4.80	6.10
15	5.50	4.60	10.00	5.10	3.80	31	4.65	.....	12.30	.....	3.40
16	4.90	5.60	21.50	5.00	3.70						

a Discontinued May 31.

UPPER GAGE AT SOUTHERN RAILWAY BRIDGE.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1..	2.45	1.50	1.70	4.60	0.40	0.60	1.30	17...	2.05	0.80	0.60	0.50	0.50	0.60	1.60
2..	2.40	1.40	1.40	2.70	.10	.50	1.80	18...	2.05	1.00	.60	.30	.60	.50	1.30
3..	2.30	1.35	1.20	2.10	.10	.50	1.50	19...	2.00	1.30	.50	.40	.60	.50	1.10
4..	2.10	1.25	1.10	1.90	.10	.50	1.40	20...	1.90	1.00	.40	.40	.80	.40	1.20
5..	2.05	1.20	1.10	1.60	.40	.50	1.10	21...	1.75	1.35	.40	.40	.90	.40	1.10
6..	2.00	1.40	1.00	1.00	.60	.40	.90	22...	1.70	3.80	.40	.40	.70	.90	1.10
7..	2.00	1.40	.90	.90	1.60	.40	.80	23...	1.55	2.30	.30	.30	.60	2.00	3.40
8..	2.05	1.40	.80	.80	1.50	.40	.80	24...	1.55	1.90	.20	.30	.50	2.40	5.50
9..	2.05	1.40	.70	.70	2.00	.40	.80	25...	1.80	.80	.10	.30	.50	1.70	4 60
10..	2.10	1.30	.60	.70	1.20	.40	.80	26...	2.05	2.10	.20	.30	.40	3.00	3.40
11..	2.15	1.30	.60	3.00	.90	.40	.70	27...	2.20	2.10	5.20	.20	.50	2.80	2.40
12..	2.75	1.10	.50	1.10	.70	.70	2.20	28...	2.00	5.90	3.40	.20	.50	2.70	2.00
13..	4.80	1.10	.50	.90	.70	.50	6.40	29...	1.80	3.40	1.40	.20	.90	2.10	2.10
14..	4.00	.90	.50	.80	.70	.50	3.10	30...	1.60	3.30	3.20	.20	.70	1.80	1.80
15..	2.90	.80	.50	.70	.60	.50	2.40	31...	.....	3.20	2.80	.....	.60	.....	1.70
16..	2.25	.80	.60	.60	.50	.60	1.80								

CHATTAHOOCHEE RIVER AT WEST POINT, GEORGIA.

This station was established July 30, 1896, by Max Hall, and is at the highway bridge in West Point, Georgia, about 1,200 feet above the railroad passenger station. A wire gage is suspended from the bridge and referred to four bench marks. First bench mark, downstream end, top of first iron-floor beam from the west bank pier of highway bridge, elevation 24.01 feet above datum; second bench mark, downstream end, top of second iron-floor beam from west bank pier of the highway bridge, elevation 24.19 feet above datum; third bench mark, top of second stone pier, Atlanta and West Point Railroad bridge, 1,000 feet upstream, elevation 24.65 feet; fourth bench mark, notch in large oak tree, east bank of river, 100 feet above wagon bridge, elevation 19.26 feet. The length of the wire gage is 33.46 feet. The gage was last verified March 14, 1899. The channel is straight and without obstructions, except from the piers of the bridge. The flow is sluggish in low stages of water. The banks overflow at high water, but all ordinary stages of water pass through the main channel. The bed of the stream is fairly constant. The observer is C. P. Jennings, a clerk in the Atlanta and West Point freight depot. He is paid by the United States Weather Bureau. The results of measurements at West Point may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 92; 1897, Nineteenth Annual Report, Part IV, page 239; 1898, Twentieth Annual Report, Part IV, page 183. The following measurements were made by B. M. Hall and his assistants during 1899:

March 14, gage height, 5.30 feet; discharge, 8,726 second-feet.
April 24, gage height, 4.72 feet; discharge, 7,144 second-feet.
May 13, gage height, 3.80 feet; discharge, 4,828 second-feet.
June 26, gage height, 3.06 feet; discharge, 3,234 second-feet.
September 12, gage height, 3.10 feet; discharge, 3,689 second-feet.
October 18, gage height, 2.07 feet; discharge, 2,088 second-feet.
December 16, gage height, 3.49 feet; discharge, 4,111 second-feet.

Daily gage height, in feet, of Chattahoochee River at West Point, Georgia, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.30	4.50	14.50	10.00	4.30	3.60	3.00	2.50	2.40	1.10	2.10	4.40
2	4.35	4.65	12.70	7.70	4.20	3.30	2.80	2.30	2.00	1.30	2.10	4.30
3	4.20	10.20	6.50	7.00	4.10	3.20	2.70	2.80	2.90	1.30	1.90	3.40
4	4.10	8.30	5.80	7.15	3.90	3.10	2.50	2.80	2.40	1.10	1.90	3.40
5	4.00	7.20	6.40	6.70	3.80	3.00	2.40	2.70	2.10	1.40	1.90	3.40
6	4.00	5.80	7.00	6.40	3.75	3.00	2.40	2.80	3.00	1.50	1.90	3.20
7	5.50	9.10	6.10	6.90	3.75	2.90	2.40	2.80	2.90	1.80	1.90	3.10
8	5.75	13.30	5.60	7.30	3.70	2.80	2.80	2.70	2.00	2.40	1.90	3.10
9	5.50	13.00	5.20	6.80	3.80	2.80	2.90	2.40	1.90	2.70	1.90	2.90
10	5.60	9.05	5.00	6.30	4.00	3.00	3.00	2.30	2.90	2.60	1.90	2.60
11	7.00	6.30	4.90	6.00	3.80	3.10	3.20	2.10	2.50	2.30	1.90	2.40
12	8.80	5.90	4.85	5.40	3.70	3.20	2.50	2.20	2.10	2.30	1.90	3.50
13	5.90	5.20	4.90	5.15	3.65	3.80	2.30	2.30	2.40	2.10	1.90	4.00
14	5.40	4.75	5.00	5.10	3.65	4.00	2.30	2.40	2.60	1.90	1.90	4.60
15	6.00	5.00	5.10	5.05	3.65	4.10	2.30	2.00	2.80	2.40	2.10	4.10
16	5.20	5.20	10.50	5.00	3.60	3.60	2.10	2.50	2.40	2.50	2.20	3.60
17	5.00	5.10	12.30	4.95	3.60	3.10	2.30	3.00	1.60	2.30	2.20	3.10
18	4.90	4.60	13.50	4.90	3.50	3.00	2.30	3.20	1.60	2.30	2.10	3.00
19	4.75	4.30	12.10	4.80	3.20	2.90	2.50	2.90	1.60	2.60	2.10	2.80
20	4.50	4.00	10.75	4.60	3.10	2.80	2.70	2.40	1.50	2.90	2.10	2.80
21	4.20	3.75	8.20	4.45	3.10	2.80	3.00	2.60	1.70	3.30	2.10	2.80
22	4.10	3.60	7.50	4.60	3.05	2.60	3.60	2.90	1.90	2.40	1.90	2.80
23	4.05	3.60	6.90	4.65	3.05	2.50	4.20	3.00	2.30	2.40	2.00	3.20
24	3.90	3.50	7.20	4.70	4.80	2.70	4.70	3.20	1.10	2.30	2.20	6.00
25	3.60	3.50	7.00	4.80	4.10	2.90	3.60	3.50	1.20	2.50	3.00	5.70
26	3.60	3.50	6.50	5.60	3.80	3.40	3.00	2.00	1.20	2.10	3.10	5.60
27	3.50	10.70	6.20	6.05	3.10	3.50	3.20	2.50	1.20	2.00	3.40	4.10
28	3.65	15.20	6.15	5.10	3.40	3.20	5.90	3.10	1.30	2.10	3.20	3.60
29	3.75	-------	6.80	5.00	3.30	3.00	3.30	3.60	1.80	2.10	3.50	3.40
30	4.00	-------	6.30	4.70	3.25	3.20	2.90	2.90	1.90	2.20	4.20	3.30
31	4.75	-------	7.15	------	4.00	-------	2.70	2.10	-------	2.10	-------	3.20

A station has been maintained by the United States Weather Bureau at Eufaula, Alabama, 80 miles below West Point. The rod is attached to the west side of brick pier of wagon bridge. The top of brick foundation of pier on west bank is 48.5 feet above gage datum. The drainage area above this point is reported to be 6,900 square miles.

ETOWAH RIVER AT CANTON, GEORGIA.

The headwaters of this stream adjoin those of Chattahoochee River on the east, and the headwater tributaries of Coosawattee River on the west. Its drainage area is on the southern slope of the Blue Ridge Mountains, and it flows westerly into the Gulf drainage. A number of fine water powers occur throughout its length, the one at Cartersville, where it crosses the western fall line, being especially noted. This river joins the Oostanaula at Rome, Georgia, to form Coosa River. Its drainage basin is mapped on the following atlas sheets: Ellijay, Cartersville, and Suwanee. The gaging station was established by the United States Weather Bureau March 12, 1892. It is located at the iron highway bridge over the Etowah River, about 1,000 feet north of and upstream from the Atlanta, Knoxville and Northern Railway station, Canton, Georgia, and about one-half a mile above the mouth of Canton Creek. The bench mark is the top of one of the four pieces of track iron which forms a cap on the left pier, upstream side, and on which the bridge rests, and is at an elevation of 23.30 feet above datum. Up to about 14 feet the river is con-

fined between its banks, but above this stage the river begins to overflow the bottom lands. The reports of discharge measurements are found as follows: 1896, Eighteenth Annual Report, Part IV, page 95; 1897, Nineteenth Annual Report, Part IV, page 242; 1898, Twentieth Annual Report, Part IV, page 189. The following measurements were made by B. M. Hall and his assistants in 1899:

April 27, gage height, 1.92 feet; discharge, 2,087 second-feet.
June 23, gage height, 0.25 foot; discharge, 770 second-feet.
September 27, gage height, —0.19 foot; discharge, 406 second-feet.
November 10, gage height, —0.10 foot; discharge, 420 second-feet.

Long Swamp Creek enters Etowah River 13 miles above Canton, Georgia. On April 21 it was measured at Revis Bridge, near Ballground, Georgia, and showed a discharge of 188 second-feet. Fourmile Creek, a tributary of Long Swamp Creek, was measured April 21 near Ballground, Georgia, and showed a discharge of 20 second-feet. Sharp Mountain Creek enters the Etowah 8½ miles above Canton. On November 10 a measurement of this stream, made by B. M. Hall near Ballground, Georgia, showed a discharge of 34 second-feet.

Daily gage height, in feet, of Etowah River at Canton, Georgia, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.80	1.60	3.00	2.40	1.60	1.00	1.40	1.40	0.80	—0.40	—0.10	0.10
2	1.80	1.60	2.80	2.20	1.50	1.40	1.40	1.40	.60	— .40	— .10	.40
3	1.80	1.80	2.80	2.00	1.40	1.40	1.40	1.80	.60	— .50	— .10	.40
4	1.80	2.80	2.60	3.80	1.40	4.40	1.20	1.60	.60	— .50	— .10	.40
5	1.80	3.00	2.40	3.00	1.40	3.00	1.20	1.60	.60	— .50	— .10	.20
6	1.80	6.20	2.00	2.80	1.40	1.00	1.00	1.40	.60	.00	— .10	.20
7	1.60	8.00	1.80	2.80	1.40	1.00	1.40	1.20	.50	.20	— .10	.20
8	1.40	4.00	1.80	4.00	1.40	1.00	1.60	1.60	.50	.20	— .10	.20
9	1.40	3.20	1.60	3.00	1.60	1.00	4.00	1.80	.40	.20	— .10	.20
10	1.40	3.00	1.50	2.80	1.60	1.00	2.00	1.60	.40	.10	— .10	.20
11	1.40	2.00	1.50	2.00	1.40	1.40	1.80	1.60	.40	.10	— .10	.30
12	1.80	(a)	1.40	1.80	1.40	1.60	1.60	1.60	.40	.10	— .10	2.80
13	1.80	(a)	1.40	1.80	1.40	1.60	1.40	1.40	.40	.00	— .10	.80
14	2.80	(a)	3.60	1.80	1.80	1.40	1.40	1.20	.40	.00	— .10	.30
15	2.60	3.00	7.00	1.80	1.80	1.40	1.80	1.20	.40	.00	.00	.20
16	2.40	2.00	18.20	1.60	1.80	1.40	1.90	1.00	.40	.00	.00	.20
17	2.30	2.00	18.00	1.60	1.60	1.40	1.80	1.00	.30	.00	.10	.20
18	2.30	2.00	4.00	1.60	1.60	1.40	1.80	.80	.30	.00	.00	.10
19	2.20	2.00	4.00	1.40	1.60	1.40	1.80	.80	.30	.00	.00	.10
20	2.20	1.80	3.00	1.40	1.40	1.30	1.60	1.40	.20	— .10	.00	.10
21	2.00	1.80	2.00	1.40	1.40	1.30	1.60	1.40	.10	— .10	.00	.10
22	1.80	1.80	2.00	1.40	1.40	1.30	1.60	1.20	.00	— .10	.00	.10
23	1.80	1.80	2.00	1.40	1.40	1.20	1.60	1.00	.00	— .10	.90	.80
24	2.00	1.60	1.80	1.80	1.40	1.20	1.40	1.00	.00	— .10	.70	3.00
25	2.80	1.40	1.80	4.80	1.40	1.20	1.20	.80	— .10	— .10	.70	3.00
26	2.00	1.80	2.80	3.00	1.20	1.00	1.20	.80	— .10	— .10	1.10	2.00
27	1.80	10.00	2.00	2.80	1.20	1.00	1.20	1.40	— .10	.00	.70	2.30
28	1.80	5.00	1.80	2.00	1.20	1.00	1.20	1.20	— .20	.00	.50	1.80
29	1.80	-------	2.80	1.80	1.20	1.00	1.20	1.00	— .30	— .10	.10	.60
30	10.00	-------	2.00	1.70	1.20	1.00	1.10	1.00	— .30	— .10	.10	.60
31	5.00	-------	2.60	-------	1.00	-------	1.00	.80	-------	— .10	-------	.60

a Gage covered with ice.

COOSAWATTEE RIVER AT CARTERS, GEORGIA.

This river is formed by the junction of Ellijay and Cartecay rivers at Ellijay, Georgia, and flows in a southwesterly direction, joining the Conasauga to form the Oostanaula. Its drainage area is for the

most part mountainous and covered with forest growth. The station was established August 15, 1896, at the iron highway bridge at Carters, Murray County, Georgia, about 20 miles northeast of Calhoun, the most convenient railroad station. It is described in the Eighteenth Annual Report, Part IV, page 96. Carters is the head of navigation, small boats running to Rome, Georgia, and the Coosa River below. It is at the foot of the great shoals made by this stream in cutting through the Cohutta Mountains, the last of which is Carters Shoals, a short distance above the bridge, with a fall of 50 feet. The drainage area above this point is 532 square miles, of which 150 square miles is on the Talking Rock Creek, which enters the river one-half mile above. The basin is mapped on Dalton, Ellijay, Cartersville, and Suwanee atlas sheets. The length of the wire gage is 37.24 feet. The top of the cylindrical iron pier at the right-bank downstream corner of bridge is 30.35 feet above gage datum. The gage was last verified in August, 1898. The current is swift, but is broken by a gravel bar above the section. The bed is gravelly and not apt to change. The banks are high, but occasionally overflow in high water. The observer, H. S. Weems, merchant at Carters, Georgia, gives his services to the Survey without compensation. Records of measurement may be found as follows: 1896 and 1897, Nineteenth Annual Report, Part IV, page 244; 1898, Twentieth Annual Report, Part IV, page 191. The following measurements were made by O. P. Hall and Max Hall in 1899:

January 28, gage height, 2.14 feet; discharge, 868 second-feet.
March 14, gage height, 8.95 feet; discharge, 5,240 second-feet.
March 14, gage height, 7.70 feet; discharge, 4,682 second-feet.
May 26, gage height, 2.35 feet; discharge, 906 second-feet.
June 22, gage height, 1.75 feet; discharge, 653 second-feet.
October 19, gage height, 1.10 feet; discharge, 377 second-feet.

A number of measurements of the tributaries of Coosawattee River have been made during the past season. Ellijay River, at the wagon bridge near Ellijay, Georgia, was measured on October 13, and showed a discharge of 80 second-feet. Talking Rock Creek, which enters Coosawattee River just above Carters Station, was measured twice during the year, the first time on May 26, when the discharge was 144 second-feet, and the second time on June 22, when the discharge was 114 second-feet. April 22 Scared Corn Creek, a tributary of Talking Rock Creek, was discharging 32 second-feet. Sallacoa Creek, which enters Coosawattee River from the south 1 mile above Fields Mill Ferry, was measured on May 20, when the discharge was found to be 103 second-feet. Coosawattee River itself at Fields Mill Ferry, 5½ miles above its junction with the Conasauga, was measured October 14, showing a discharge of 388 second-feet.

Daily gage height, in feet, of Coosawattee River at Carters, Georgia, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.80	2.50	5.00	5.10	3.40	2.00	1.40	1.90	1.00	0.75	0.95	0.95
2	1.90	3.06	4.50	5.00	3.30	1.95	1.50	1.80	1.05	.75	.90	1.30
3	1.90	3.50	3.50	5.20	3.20	1.95	1.40	1.80	1.00	.70	.90	1.20
4	2.00	15.80	3.50	6.00	3.00	1.90	1.40	1.70	1.00	.65	.90	1.20
5	2.05	14.00	6.10	5.80	2.90	2.00	1.45	1.60	.95	.65	.85	1.10
6	2.10	13.20	4.80	5.50	2.90	2.00	1.40	1.50	1.00	.70	.85	1.00
7	2.00	12.50	4.50	5.50	2.80	1.90	1.30	1.45	.95	.70	.80	1.10
8	3.00	8.00	4.00	4.80	2.70	1.90	1.30	1.50	.90	1.50	.80	1.00
9	2.00	6.00	3.20	4.00	2.65	1.85	1.60	1.50	.90	1.20	.90	.90
10	2.00	6.00	3.00	3.70	2.60	1.85	1.50	1.40	.90	1.00	.80	.90
11	2.10	5.00	3.50	3.60	2.50	1.90	1.50	1.40	.95	.90	.80	1.10
12	2.00	4.00	3.50	3.50	2.50	3.20	1.40	1.30	.90	.90	.90	7.40
13	1.90	4.00	4.00	3.40	2.60	3.00	1.40	1.30	.90	.95	.90	5.00
14	1.90	4.50	4.50	3.00	2.60	2.50	1.40	1.60	.90	.90	1.00	3.00
15	2.00	4.50	19.00	3.00	2.50	2.30	1.35	1.50	.85	.90	.90	2.00
16	2.20	4.00	12.00	3.10	2.50	2.20	1.30	1.40	.85	.90	.90	1.50
17	2.80	5.00	10.00	4.00	2.40	2.10	1.70	1.20	.85	.90	1.00	1.30
18	2.60	4.70	9.00	4.00	2.30	2.00	1.50	1.20	.80	.85	1.05	1.10
19	2.40	3.60	7.50	3.75	2.30	1.90	1.60	1.15	.85	.85	1.00	1.10
20	2.30	3.50	6.00	3.50	2.20	1.90	1.80	1.15	.85	.90	1.10	1.20
21	2.10	4.00	5.00	3.40	2.20	1.80	2.20	1.10	.80	.90	1.10	1.20
22	2.10	3.50	8.00	3.50	2.30	1.70	3.00	1.10	.80	.90	1.00	1.40
23	2.00	3.40	7.00	3.50	2.20	1.70	2.50	1.10	.85	.85	.90	1.50
24	2.00	3.50	6.50	4.00	2.15	1.70	2.00	1.05	.85	.85	1.00	3.00
25	2.50	4.00	5.00	6.00	2.15	1.60	2.00	1.05	.80	.80	1.00	2.00
26	2.30	5.00	5.00	5.00	2.10	1.60	3.20	1.10	80	.80	1.20	1.50
27	2.10	15.00	5.20	4.00	2.10	1.50	3.00	1.10	.80	.75	1.10	1.30
28	2.10	7.00	4.80	4.00	2.05	1.50	3.00	1.05	.80	.80	1.05	1.20
29	2.10	-------	4.50	3.70	2.05	1.40	2.20	1.15	.75	1.00	1.00	1.20
30	2.20	-------	4.60	3.60	2.00	1.45	1.90	1.20	.80	1.00	1.00	1.10
31	2.40	-------	4.40	-------	2.00	-------	2.00	1.10	-------	.90	-------	1.10

OOSTANAULA RIVER AT RESACA, GEORGIA.

This river is formed about 3 miles above Resaca by the junction of Coosawattee and Conasauga rivers, the former having a drainage area of 875 and the latter 648 square miles, while there are 4 square miles between the junction and Resaca. This gives a total drainage area of 1,527 square miles, mapped on atlas sheets Cleveland, Ellijay, Dalton, Cartersville, and Suwanee. The station is at the iron railroad bridge of the Western and Atlantic Railroad, in the town of Resaca, Georgia, 1,000 feet from the depot. On July 27, 1896, a discharge measurement was made by Max Hall, and a station established using the Weather Bureau gage. On August 19 a wire gage was established and referred to the same datum. The initial point is the right bank end iron of bridge, downstream side. The length of the wire gage is 43.40 feet. The first bench mark is on the top of capstone of center pier, at an elevation of 36.12 feet; the second is the top of crosstie near center, at an elevation of 40.12 feet. The channel is straight and the current fairly swift. The bed is soft and liable to change; the banks somewhat subject to overflow. The observer is S. M. Barnett, railroad agent at station, who is also the observer for the Weather Bureau. Records of measurement may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 98; 1897, Nineteenth Annual Report, Part IV, page 245; 1898, Twen-

tieth Annual Report, Part IV, page 190. The following measurements were made by Olin P. Hall and Max Hall during 1899:

April 26, gage height, 8.05 feet; discharge, 5,146 second-feet.
May 20, gage height, 4.15 feet; discharge, 1,671 second-feet.
June 9, gage height, 3.10 feet; discharge, 1,171 second-feet.
June 21, gage height, 3.05 feet; discharge, 1,087 second-feet.
October 14, gage height, 1.75 feet; discharge, 644 second-feet.

Three measurements of the discharge of Conasauga River at Fites Ferry, 3½ miles above its mouth, were made during the season. The first, on June 9, gave a discharge of 224 second-feet; second, on June 21, gave a discharge of 258 second-feet, and the third, on October 14, gave a discharge of 122 second-feet.

Daily gage height, in feet, of Oostanaula River at Resaca, Georgia, for 1899 (a).

Day.	Jan.	Feb.	Mar.	Apr.	Nov.	Dec.	Day.	Jan.	Feb.	Mar.	Apr.	Nov.	Dec.
1	5.10	11.00	16.20	13.40	1.80	2.30	17	6.10	12.10	28.60	6.20	2.00	3.30
2	5.00	8.80	9.60	10.30	1.70	2.50	18	6.25	11.40	27.30	6.00	1.80	2.80
3	4.50	7.95	8.00	8.40	1.70	2.60	19	5.65	10.20	26.60	6.10	1.80	2.70
4	4.20	16.00	7.40	8.10	1.70	2.30	20	5.10	9.55	26.20	6.00	1.80	3.50
5	4.10	19.90	9.30	10.20	1.70	2.20	21	4.85	8.10	27.30	5.80	1.70	4.40
6	4.50	21.90	10.40	9.00	1.70	2.10	22	4.70	8.20	25.20	5.60	1.70	3.60
7	7.50	25.50	9.40	8.90	1.60	2.00	23	4.50	8.65	21.10	5.40	2.30	3.30
8	9.35	26.50	7.50	14.30	1.60	2.00	24	4.55	7.70	17.00	6.40	2.80	8.10
9	8.80	25.50	6.80	13.90	1.60	1.90	25	5.50	6.90	11.00	8.60	2.30	8.10
10	6.20	22.20	6.60	12.70	1.60	2.00	26	5.30	6.40	9.00	8.70	2.70	6.00
11	5.85	15.80	6.40	8.90	1.60	2.10	27	4.80	17.50	8.60	7.00	3.80	4.30
12	6.00	8.20	6.10	7.80	1.70	5.10	28	4.55	20.20	7.90	6.30	3.40	3.80
13	5.80	7.00	6.00	7.40	1.70	8.00	29	4.40	.....	11.65	5.80	2.80	3.70
14	5.30	6.35	8.00	7.00	1.70	6.40	30	4.20	.....	11.40	5.50	2.50	3.50
15	5.50	6.70	16.00	6.80	1.60	4.00	31	6.10	.....	11.40	.....	.....	3.00
16	5.15	6.70	22.00	6.50	1.90	3.60							

a No records from May 1 to October 31.

MEASUREMENTS OF LARGE SPRINGS IN NORTHWEST GEORGIA.

In the basin of Sallacoa Creek, a tributary of Coosawattee River, and in the adjoining basin of Oothkalooga Creek, are a number of large springs which were measured by Olin P. Hall in 1899. On May 30 Dooley Spring, 3 miles south of Fairmount, Georgia, gave a discharge of 0.92 second-foot; Doves Mill Spring, near Cash, Georgia, 16.2 second-feet; Bakers Mill Spring, 5 miles south of Fairmount, Georgia, 3.9 second-feet. June 24 a number of springs in the basin of Sallacoa Creek showed discharges as follows: Colima Spring, near Colima, Georgia, 0.28 second-foot; Arnold Spring, 1 mile south of Colima, 0.38 second-foot; J. R. Byrd's spring, 2½ miles northwest of Fairmount, Georgia, 0.47 second-foot; R. W. Lander's spring, 3 miles east of Pinelog, Georgia, 4.27 second-feet; J. A. Johnson's spring, 2½ miles east of Pinelog, Georgia, 0.48 second-foot; Oakhill Church Spring, 2½ miles east of Pinelog, Georgia, 1.85 second-feet.

The five following springs occur in the basin of Oothkalooga Creek, which enters Oostanaula River 1 mile below Calhoun. On June 26 their discharge was measured and found to be as follows: Hayse

Spring, at Folsom, Georgia, 0.35 second-foot; Cedar Spring, at Mostetters Mill, 1¼ miles west of Folsom, 4.45 second-feet; Trimble Spring, 2 miles north of Adairsville, Georgia, 2.35 second-feet; Gardners Spring, 5 miles north of Adairsville, 0.41 second-foot; Blackwood Spring, 5 miles southeast of Calhoun, Georgia, 1.00 second-foot.

COOSA RIVER AT ROME, GEORGIA.

Coosa River is formed by the junction of Etowah and Oostanaula rivers at Rome, Georgia. The drainage area is 3,720 square miles. Both of the tributary rivers rise in the northern part of Georgia and flow for the most part through a hilly, broken country, well wooded, about one-fourth of the land being under cultivation. The Coosa River flows in a southwesterly direction into Alabama and joins the Tallapoosa 6 miles above Montgomery, Alabama, to form Alabama River. Measurements of flow are made at Rome and at Riverside, 120 miles farther downstream, and will be made in 1900 at Montgomery and Selma. The measurements at Rome are made on the Oostanaula and Etowah just above their junction. Etowah River is measured at Second avenue bridge and the Oostanaula at Fifth avenue bridge in Rome, and the results added to give the flow of Coosa River. The gage height is taken from the United States Weather Bureau gage at Fifth avenue bridge, on the Oostanaula. There is practically no fall on Oostanaula River from Fifth avenue bridge to the junction, hence the gage is used as Coosa River gage and gives the fluctuations of Coosa River. This gage is a 4 by 6 inch timber, graduated to feet and tenths and fastened to the downstream left-hand corner of the first pier from the left bank. The zero of gage is 575.79 feet above sea level. The United States Weather Bureau has maintained the station here for many years. It is now maintained only as a half-year station, from November 1 to April 30, inclusive, but W. M. Towers, the river observer, kindly reads the gage and furnishes the Survey with monthly reports of the daily gage heights for the entire year without charge. Mr. Towers has kept the records for many years and has predicted floods with great precision. The channel of the Etowah is straight, current swift and unobstructed, but the Oostanaula is rather sluggish and somewhat obstructed by piers. The banks are high, but liable to overflow in times of high water. Records of measurements may be found as follows: 1897, Nineteenth Annual Report, Part IV, page 198; 1898, Twentieth Annual Report, Part IV, page 184. The following measurements have been made by Max Hall and others during 1899:

January 25, gage height, 3.80 feet; discharge, 6,540 second-feet.
January 25, gage height, 3.60 feet; discharge, 5,932 second-feet.
May 19, gage height, 2.75 feet; discharge, 4,394 second-feet.
June 16, gage height, 2.40 feet; discharge, 3,352 second-feet.
August 4, gage height, 1.45 feet; discharge, 2,835 second-feet.
October 13, gage height, 0.60 foot; discharge, 1,769 second-feet.

Daily gage height, in feet, of Coosa River at Rome, Georgia, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.00	6.90	19.70	13.20	4.00	3.00	1.70	2.20	3.40	0.40	0.7	1.1
2	3.40	7.80	15.00	10.60	3.70	2.60	1.50	1.90	2.00	.30	.6	1.1
3	3.00	6.00	8.60	7.90	3.70	2.60	1.00	1.70	1.60	.30	.5	1.5
4	2.70	9.20	6.60	7.20	3.50	2.00	.90	1.50	1.40	.30	.5	1.3
5	2.60	15.30	7.80	9.50	3.50	2.00	2.00	1.40	1.30	.30	.4	1.1
6	2.60	18.20	9.00	8.20	3.50	2.00	1.90	1.50	1.30	.50	.4	1.0
7	3.60	27.80	8.00	8.20	3.70	2.00	1.90	1.60	1.20	.70	.3	.9
8	5.90	24.00	6.80	15.00	3.70	1.90	3.00	1.50	1.00	.70	.3	.8
9	5.90	22.40	5.70	13.40	3.60	1.80	2.10	1.80	1.00	.80	.3	.8
10	4.90	21.00	5.40	11.20	3.50	1.80	1.90	1.60	1.00	.60	.3	.8
11	4.00	19.00	5.20	9.50	3.30	1.80	2.50	1.40	2.90	1.00	.3	.8
12	4.50	16.50	4.90	7.00	3.10	2.20	2.80	1.40	2.30	.90	.3	2.8
13	4.00	7.00	4.50	6.40	3.10	3.80	2.00	1.20	1.50	.70	.3	6.1
14	3.80	5.00	6.00	5.90	3.00	4.00	1.60	1.10	1.00	.70	.4	5.0
15	3.60	5.00	16.60	5.60	3.00	3.50	1.30	1.30	.90	.60	.4	3.2
16	3.60	5.50	27.70	5.40	2.90	2.50	1.80	1.90	.80	.60	.5	2.0
17	4.00	8.90	29.20	5.20	2.80	2.10	5.20	1.60	.60	.60	.9	1.8
18	4.20	9.50	25.80	4.80	2.80	2.00	4.20	1.40	.60	.60	.7	1.7
19	4.00	8.50	24.90	4.70	2.80	2.00	4.80	1.10	.60	.60	.5	1.3
20	3.70	7.70	26.20	4.60	2.80	2.00	8.80	.90	.70	.60	.5	1.6
21	3.30	6.80	24.60	4.30	2.60	1.80	12.80	.90	.70	.70	.5	2.0
22	3.20	6.90	23.00	4.10	2.60	2.20	7.90	.80	.60	.70	.4	2.0
23	3.10	7.30	22.60	4.00	2.40	1.70	4.80	.80	.60	.60	1.0	1.8
24	3.50	6.60	21.90	5.40	2.60	1.70	3.90	.70	.50	.50	2.1	7.2
25	3.80	5.80	18.00	7.40	2.50	1.70	2.60	.70	.50	.40	1.5	7.5
26	3.80	5.50	10.50	9.10	2.40	1.70	2.60	.70	.50	.40	2.5	5.0
27	3.30	19.10	7.70	6.70	2.20	2.10	3.80	2.50	.50	.40	3.0	3.5
28	3.00	23.40	6.80	5.50	2.20	1.90	3.00	2.50	.60	.40	2.2	3.0
29	3.00	.....	8.80	4.80	2.00	1.90	2.40	2.50	.50	.40	1.9	3.0
30	2.90	.....	9.30	4.20	2.00	1.80	1.40	2.00	.40	.50	1.4	3.4
31	4.40	.....	10.20	.....	3.30	.....	1.20	2.50	.....	.80	.....	2.0

COOSA RIVER AT RIVERSIDE, ALABAMA.

This station, described in the Eighteenth Annual Report, Part IV, page 99, was established September 25, 1896, at the bridge of the Southern Railway across Coosa River near Riverside, Alabama. The drainage area is 6,850 square miles. It is mapped on the Springville, Anniston, Gadsden, Fort Payne, Rome, Tallapoosa, Marietta, Cartersville, Suwanee, Ellijay, Dalton, Cleveland, Ringgold, and Stevenson atlas sheets. The town of Riverside is on the west bank of the river, and the railroad station is 1,000 feet west of the bridge at which the measurements are made. The length of the gage wire is 38.35 feet. The first bench mark is the top capstone on the large circular center pier of turn-span, the elevation of which is 26.80 feet above gage datum; second bench mark is base of rail near same pier, and is 32.80 feet above gage datum. The channel is straight, current swift, but somewhat obstructed by a ledge of rock under water about 300 feet above the station. The observer is J. W. Foster, Riverside, Alabama. The records of measurement may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 101; 1897, Nineteenth Annual Report, Part IV, page 248; 1898, Twentieth Annual Report, Part IV, page 187. The following measurements were made by Max Hall and others during 1899:

April 26, gage height, 9.00 feet; discharge, 29,069 second-feet.
May 3, gage height, 4.05 feet; discharge, 10,592 second-feet.
May 20, gage height, 2.70 feet; discharge, 6,276 second-feet.
June 14, gage height, 2.20 feet; discharge, 5,010 second-feet.

August 26, gage height, 1.42 feet; discharge, 3,791 second-feet.
September 23, gage height, 1.00 foot; discharge, 2,457 second-feet.
November 7, gage height, 0.85 foot; discharge, 2,271 second-feet.
December 9, gage height, 1.20 feet; discharge, 2,727 second-feet.

Daily gage height, in feet, of Coosa River at Riverside, Alabama, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.80	5.90	12.10	10.30	5.00	2.70	1.70	3.95	2.30	0.90	0.95	2.60
2	2.75	6.30	12.20	10.20	4.50	2.80	1.70	3.00	2.40	.90	.95	2.00
3	2.75	7.50	12.30	10.00	4.20	2.80	1.65	2.30	2.80	.90	.95	1.60
4	2.80	7.40	12.10	9.80	3.95	2.60	1.60	2.00	2.40	.90	.95	1.50
5	2.80	9.10	10.10	8.90	3.80	2.30	1.50	1.90	2.10	.90	.95	1.45
6	3.00	12.10	9.00	8.75	3.75	2.10	1.50	1.75	2.00	.90	.95	1.40
7	3.50	14.10	8.00	9.00	3.60	2.00	1.45	1.65	1.85	.90	.95	1.35
8	4.30	14.30	7.50	10.00	4.00	2.00	1.40	1.50	1.40	.90	.95	1.30
9	4.20	14.30	7.25	12.30	3.85	1.95	1.70	1.50	1.30	.95	.95	1.30
10	4.40	14.10	7.00	12.00	3.60	1.95	1.60	1.55	1.25	1.20	.95	1.35
11	5.20	13.80	6.15	11.70	3.45	1.95	1.50	1.55	1.25	1.30	.95	1.40
12	5.90	13.00	5.20	10.00	3.30	1.95	1.50	1.60	2.20	1.40	.95	5.80
13	5.60	12.00	5.50	8.90	3.20	2.00	1.40	1.50	2.50	1.30	.95	8.25
14	5.00	10.90	7.50	7.90	3.00	2.15	1.40	1.45	2.65	1.20	1.00	8.00
15	4.70	8.70	8.30	6.30	3.00	2.80	1.30	1.50	2.00	1.20	1.00	6.00
16	4.90	7.90	16.00	5.55	2.95	3.20	1.30	1.50	1.40	1.20	1.00	4.50
17	5.00	7.60	17.40	5.25	2.95	2.95	1.30	1.50	1.25	1.10	1.00	3.75
18	4.90	7.80	17.00	5.10	2.80	2.50	1.20	1.55	1.20	1.00	1.00	3.60
19	4.70	8.10	16.50	5.00	2.80	2.25	1.30	1.50	1.20	.95	1.00	3.40
20	4.60	8.20	16.30	4.80	2.75	2.00	1.50	1.45	1.10	.95	1.00	3.00
21	4.20	8.00	16.35	4.60	2.75	1.80	1.50	1.45	1.00	.90	.95	2.85
22	4.00	7.65	16.20	4.30	2.70	1.70	1.90	1.35	.95	.90	.95	2.75
23	3.90	8.00	15.90	4.75	2.70	1.70	3.20	1.30	1.00	.95	.95	3.00
24	3.90	8.10	15.70	5.65	2.65	1.60	4.70	1.30	1.00	1.20	.95	5.40
25	4.00	7.30	15.50	8.90	2.60	1.75	3.60	1.30	1.00	1.15	1.00	6.40
26	4.25	7.00	14.90	9.00	2.50	1.60	3.20	1.60	1.00	1.00	2.15	7.10
27	4.15	8.30	13.25	8.90	2.45	1.60	3.00	1.20	.95	1.00	2.90	7.00
28	4.00	11.00	11.00	8.30	2.35	1.65	3.60	1.10	.95	.95	3.00	6.60
29	3.90	.....	8.00	6.90	2.30	1.70	4.20	1.50	.90	.95	3.00	6.00
30	3.75	.....	7.90	5.45	2.20	1.65	5.20	2.10	.90	.90	2.75	4.85
31	3.70	.....	8.50	.....	2.70	.....	4.75	2.10	.....	.95	.....	4.00

COOSA RIVER AT LOCKS NOS. 4 AND 5, ALABAMA.

The station at Lock No. 4 is located 3 miles above Riverside, Alabama. Measurements here give the discharge past Riverside except the small quantity, about 1 cubic foot per second, flowing into the Coosa from Blue Spring Branch. The measurements are made from the bridge of the Southern Railway at Riverside. A record has been kept at Lock No. 4 by the United States Engineer Corps. The first section of the vertical gage rod is fastened to the lower end of the cofferdam, 500 feet below the dam on the river. The second section is fastened to a sycamore tree, 150 feet below rod. The zero of rod is 477.30 feet above the Mobile datum. The bench mark is a brass point in a stone post 1,000 feet up the river from lower gage, and is 510.55 feet above Mobile datum.

The station at Lock No. 5 is described in the Eighteenth Annual Report, Part IV, page 101, and is located one-half mile above the Birmingham and Atlantic Railroad crossing and about 20 miles below gaging station at Riverside, Alabama. The gage is vertical in two sections, fastened to the trees immediately above the landing of Collins Ferry. The zero of the gage is 460.37 feet above Mobile datum. Bench mark No. 1, which is on the tree to which one section of the rod is fastened, is 471.80 feet above Mobile datum. Bench mark No. 2 is

center of iron plate at top of cylindrical pier, at right bank upstream side of the railroad bridge, and is at an elevation of 493.91 feet Mobile datum. Records of river height are kept by the United States Engineer Corps, and are kindly furnished to the Survey. Measurements of discharge are not made at either of these stations.

Daily gage height, in feet, of Coosa River, at Lock No. 4, Alabama, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.0	7.6	14.0	11.6	5.5	2.8	1.9	4.5	2.2	0.4	0.5	2.2
2	3.0	7.7	14.2	11.7	5.2	2.9	1.8	3.3	2.3	.4	.5	1.9
3	3.3	8.8	14.2	11.1	4.8	2.9	1.6	2.5	3.2	.5	.6	1.4
4	3.5	8.6	13.5	10.6	4.6	2.6	1.5	2.0	2.5	.5	.6	1.4
5	3.3	10.7	11.4	9.8	4.3	2.2	1.4	1.8	1.8	.5	.6	1.4
6	3.3	14.2	9.5	8.6	4.2	2.2	1.3	1.7	1.4	.5	.6	1.4
7	3.9	15.9	9.2	9.8	4.1	2.7	1.3	1.7	1.3	.5	.6	1.3
8	5.0	16.4	8.9	12.8	4.6	2.7	1.3	1.5	1.3	.5	.5	1.1
9	5.4	16.4	8.3	14.0	4.4	2.0	1.6	1.4	1.2	.8	.5	1.0
10	6 0	16.1	7.3	13.9	4.3	1.9	1.8	1.5	1.0	1.1	.5	1.0
11	6.4	15.8	6.5	13.2	4.0	1.9	1.7	1.5	.9	1.0	.5	1.0
12	6.6	15.5	6.1	11.6	4.0	1.9	1.5	1.6	1.0	1.0	.5	6.7
13	6.0	14.9	5.8	10.0	3.8	2.0	1.5	1.5	2.5	1.3	.5	9.4
14	5.8	13.9	8.5	8.1	3.8	2.0	1.4	1.4	2.8	.8	.5	9.8
15	5.5	10.6	9.4	7.1	3.3	2.7	1.3	1.3	1.8	.9	.5	7.4
16	5.1	7.5	19.7	6.6	3.3	3.7	1.3	1.4	1.3	.2	.6	5.8
17	5.4	7,8	20.2	6.2	3.3	2.7	1.1	1.2	1.0	.3	.6	4.3
18	5.8	8.6	19.1	5.9	3.0	2.2	1.1	1.5	.9	.3	.5	3.4
19	5.7	9.6	18.5	5.7	3.0	1.9	1.1	1.9	.8	.4	.4	2.8
20	5.4	9.6	18.8	5.4	3.0	2.0	1.1	1.7	.7	.4	.4	2.4
21	5.0	9.1	18.8	5.2	3.0	2.0	1.5	1.4	.7	.4	.8	2.6
22	4.6	8.8	18.7	5.1	2.8	1.8	1.6	1.2	.6	.4	.6	3.0
23	4.3	9.7	18.4	5.5	2.8	1.7	2.2	1.0	.4	.4	.7	3.0
24	4.3	9.3	18.0	6.8	2.7	1.7	5.6	.9	.3	.4	.8	5.9
25	4.8	8.6	17.5	10.6	2.9	1.7	5.5	1.0	.3	.2	.8	7.6
26	4.9	7.7	17.0	10.5	3.0	1.6	3.8	1.4	.4	.6	2.2	8.3
27	4.9	11.2	16.7	10.5	2.7	1.6	3.4	1.0	.4	.6	3.1	7.8
28	4.6	12.9	15.2	9.8	2.7	1.5	3.4	1.0	.4	.5	3.4	6.3
29	4.3	.....	12.7	8.0	2.7	1.8	4.1	1.5	.5	.6	3.1	5.4
30	4.0	.....	9.5	6.0	2.4	1.8	6.3	2.1	.4	.5	2.8	4.4
31	.....	.....	9.5	.....	3.0	.....	5.3	2.3	.....	.5	.....	3.8

Daily gage height, in feet, of Coosa River at Lock No. 5, Alabama, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	3.9	10.5	8.6	3.3	1.3	0.8	2.5	1.0	0.1	0.1	1.0
2	1.7	4.7	10.4	8.8	2.9	1.4	.7	1.7	1.1	.1	.1	.8
3	1.7	5.7	10.4	8.1	2.7	1.5	.6	1.2	1.1	.1	.1	.6
4	1.7	5.6	10.0	7.6	2.5	1.4	.6	.9	1.0	.1	.1	.5
5	1.7	7.1	8.9	7.4	2.3	1.2	.6	.7	.8	.1	.1	.5
6	1.6	10.1	6.7	6.7	2.2	1.0	.5	.7	.6	.1	.1	.5
7	1.9	12.1	6.4	7.6	2.1	.9	.4	.7	.5	.1	.1	.4
8	2.8	12.5	6.0	10.0	2.0	.9	.5	.6	.5	.1	.1	.4
9	3.0	12.4	5.4	11.0	2.3	.9	.5	.6	.4	.1	.1	.4
10	3.3	12.0	4.7	10.5	2.2	.8	.7	.6	.4	.2	.1	.4
11	4.1	11.6	4.0	9.7	2.0	.8	.7	.5	.3	.3	.1	.4
12	4.1	11.4	3.7	8.5	2.0	.9	.6	.5	.3	.3	.1	4.0
13	3.7	10.9	4.3	7.0	1.8	.9	.6	.5	.3	.4	.1	5.6
14	3.4	10.0	6.0	5.4	1.8	1.0	.5	.5	1.3	.4	.1	6.2
15	3.2	7.8	6.7	4.6	1.7	1.3	.5	.5	.8	.3	.1	5.4
16	3.0	4.8	14.8	4.0	1.7	1.8	.4	.8	.5	.2	.1	4.6
17	3.0	5.0	15.4	3.9	1.6	1.6	.4	.5	.3	.2	.1	2.4
18	3.3	5.6	14.5	3.6	1.5	1.3	.4	.5	.3	.1	.1	1.6
19	3.2	6.2	14.0	3.4	1.5	1.0	.4	.8	.2	.1	.1	1.3
20	3.0	6.4	14.1	3.2	1.5	.9	.3	.6	.2	.1	.1	1.2
21	2.8	6.0	14.0	3.1	1.5	.8	.5	.6	.1	.1	.1	1.2
22	2.5	5.8	14.0	3.0	1.4	.8	.8	.4	.1	.1	.1	1.3
23	2.3	6.4	14.0	3.0	1.3	.7	1.4	.4	.1	.1	.1	1.4
24	2.3	6.1	13.5	4.0	1.3	.7	2.9	.4	.1	.1	.1	2.4
25	2.6	5.6	13.0	7.1	1.3	.7	3.0	.4	.1	.1	.1	4.6
26	2.7	5.0	12.7	7.2	1.3	.6	2.1	.4	.1	.1	.8	5.3
27	2.7	9.5	12.4	7.2	1.3	.6	1.7	.4	.1	.1	1.5	4.9
28	2.5	9.6	11.0	6.6	1.1	.6	1.9	.3	.1	.1	1.7	3.8
29	2.3	.....	9.5	5.3	1.1	.7	2.6	.5	.1	.1	1.4	2.8
30	2.1	.....	7.1	4.0	1.0	.9	3.8	1.0	.1	.1	1.3	2.3
31	2.2	.....	6.9	.....	1.3	.....	3.1	1.0	.....	.1	.....	1.9

COOSA RIVER AT WETUMPKA, ALABAMA.

This station is located at gage No. 1, 3 miles above Wetumpka, Alabama, and was established November 5, 1889, by the United States Engineer Corps, who have maintained daily gage readings since that date until December 31, 1898, when the station was abandoned. The gage heights here are affected by backwater from Tallapoosa River at high stages of the latter stream, so that the record does not show the true flow of Coosa River. Discharge measurements can not be made at the Wetumpka bridge, as it is located directly over a shoal. Discharge measurements will be made next year at Montgomery, 10 miles below Wetumpka, but below the mouth of Tallapoosa River, and at Selma, 45 miles below Montgomery, at both of which points Weather Bureau stations are maintained.

TALLAPOOSA RIVER AT MILSTEAD, ALABAMA.

Tallapoosa River rises in the west-central part of Georgia and flows in a southwesterly direction into Alabama, where it joins the Coosa, to form Alabama River, 6 miles above Montgomery, Alabama. Its upper tributaries drain an area between the Chattahoochee and Coosa basins. At Tallassee, Alabama, it crosses the southern fall line. The shoals at this place have a fall of 60 feet, forming an obstruction to navigation. The drainage area is largely wooded, with cultivated fields at short intervals. A gaging station was established at Milstead on August 7, 1897, at the bridge of the Tallassee and Montgomery Railway, about one-fourth of a mile from Milstead, Alabama. The bridge is of iron, two spans of about 155 feet each, with short wooden trestles at each end. The initial point of measurement is the end of iron bridge, left bank, downstream side. The rod of wire gage is fastened to outside of guard rail on downstream side of bridge. The gage was last verified April 18, 1899. The bench mark is top of second cross beam from left-bank pier, downstream end, and is 60.00 feet above datum. The channel is straight at the bridge, and bends above and below. The current is sluggish at low water and obstructed by center pier of bridge. The banks are high, but overflow at extreme high water for several hundred feet on each side. The bed is fairly constant, and all water is confined to the main channel by railroad embankments. The observer is Seth Johnson, a farmer and fruit grower, Milstead, Alabama. Records of discharge measurements may be found as follows: 1897, Nineteenth Annual Report, Part IV, page 250; 1898, Twentieth Annual Report, Part IV, page 193.

The following measurements were made by Max Hall during 1899:

April 17, gage height, 6.34 feet; discharge, 7,444 second-feet.
April 18, gage height, 5.63 feet; discharge, 6,853 second-feet.
May 17, gage height, 2.80 feet; discharge, 3,000 second-feet.
June 26, gage height, 2.05 feet; discharge, 1,847 second-feet.
September 9, gage height, 1.36 feet; discharge, 1,016 second-feet.
November 8, gage height, 1.25 feet; discharge, 972 second-feet.
December 18, gage height, 2.66 feet; discharge, 2,844 second-feet.

Two measurements of Big Sandy Creek, a tributary of Tallapoosa River, were made September 11. The first, near the bridge 4 miles from Dadeville, Alabama, showed a discharge of 79 second-feet and the second, at a point a short distance above the bridge, showed a discharge of 74 second-feet.

Daily gage height, in feet, of Tallapoosa River at Milstead, Alabama, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5 00	17 00	27 00	18.00	4.30	2.40	2.80	3.00	2.40	0.70	1.50	2.40
2	4.60	11.60	19.00	12.20	4.00	2.90	2.30	2.70	2.30	.70	1.40	2.50
3	3.90	24.50	13.50	6.50	3.90	2.40	1.90	3.10	2.10	.80	1.40	2.60
4	3.90	20.00	9.60	6.40	3.80	2.40	1.80	3.10	2.00	.90	1.30	2.60
5	3.90	12.90	14.20	8.50	3.70	2.30	1.60	2.50	1.80	1.00	1.30	2.90
6	3.80	11.90	13.20	9.70	3.60	2.20	1.50	2.30	1.60	1.40	1.20	2.20
7	7.40	17.50	10.10	10.30	3.50	2.10	1.50	2.20	1.60	1.40	1.20	2.00
8	8.00	27.00	8.60	13.00	3.60	2.00	2.00	2.00	1.40	1.30	1.20	1.90
9	7.10	19.00	7.70	13.00	3.50	1.90	2.20	1.80	1.40	1.30	1.20	1.80
10	6.40	13.80	7.20	11.20	3.40	1.70	2.00	1.60	1.30	1.30	1.20	1.90
11	18.50	10.00	6.80	8.40	3.30	1.90	1.80	1.50	1.20	1.40	1.30	2.00
12	16.80	8.30	6.60	7.00	3.20	2.00	1.70	1.70	1.20	1.40	1.30	15.20
13	13.00	7.40	6.50	6.50	3.10	2.00	1.50	1.60	1.20	1.30	1.30	13.20
14	11.60	7.00	6.40	6.20	3.10	2.70	1.40	1.60	1.10	1.30	1.30	8.20
15	9.40	6.10	7.20	6.00	3.00	2.70	1.30	1.50	1.00	1.20	1.30	5.00
16	7.80	10.40	12.20	7.10	2.90	2.60	1.30	4.00	1.00	1.10	1.30	3.70
17	12.70	11.50	11.00	6.60	2.80	2.10	1.20	3.90	1.00	1.20	1.60	3.00
18	10.00	10.60	10.20	5.60	2.70	1.90	1.10	2.20	1.00	1.10	1.50	2.60
19	8.00	9.30	14.80	5.50	2.60	1.80	1.60	1.90	1.10	1.20	1.50	2.50
20	6.50	8.30	13.90	5.40	2.50	1.80	1.40	1.70	1.00	1.30	1.50	2.70
21	5.70	8.30	10.40	5.20	2.60	1.70	8.40	1.50	.90	1.40	1.40	2.70
22	5.30	8.40	8.30	5.00	2.70	1.50	16.75	1.60	1.00	1.50	1.40	2.70
23	5.10	7.60	8.10	4.90	2.60	1.50	14.00	2.00	1.00	1.60	1.60	2.60
24	5.20	6.90	12.70	6.00	3.30	1.50	16.95	2.60	.90	1.80	1.80	9.30
25	5.20	6.40	8.70	10.00	4.60	1.50	7.90	1.90	.90	1.50	2.20	9.40
26	5.10	6.30	7.30	7.50	3.30	2.00	6.70	1.80	.90	1.40	4.60	7.20
27	4.80	25.00	6.90	6.60	2.80	2.50	6.80	3.70	.90	1.30	6.20	5.00
28	4.70	37.00	6.80	5.80	2.60	2.50	8.40	2.80	.80	1.20	4.80	4.00
29	5.10	.....	9.00	4.90	2.50	2.20	10.10	2.10	.80	1.50	3.60	3.50
30	5.20	.....	8 90	4.60	2.60	2.70	5.40	1.90	.80	1.50	2.80	3.10
31	6.50	.....	13.85	.....	2.50	.....	4.40	2.30	.....	1.60	.....	2.90

ALABAMA RIVER AT MONTGOMERY, ALABAMA.

This river is formed by the junction of Coosa and Tallapoosa rivers 6 miles above Montgomery. The basin is described at length under the descriptions of its two tributaries. A gage rod was established by the United States Engineer Corps a number of years ago at the Montgomery wharf, near the Union Passenger Station, at foot of Commerce street. The readings are now taken by the Weather Bureau and are furnished to our Survey. The gage rod is in six sections, as follows: Section 1, from 2 to 10 feet on fender pile at face of

wharf, 108 feet from lower end; section 2, from 10 to 15 feet at upper end of pile protection to Louisville and Nashville Railroad bank in corner pile, and the 15-foot mark is 1.1 feet above the top of pile; section 3, 15 to 27 feet on bent in center of drain, on the lower side of Commerce-street sewer; section 4, 27 to 36 feet, on upper side of sewer, third bent; section 5, 36 to 46 feet, same side of sewer, sixth bent; section 6, 46 to 50 feet, same side of sewer, seventh bent. The rods are of pine timber, painted and graduated to feet and tenths. There are also two new sections, 15 to 25 feet and 25 to 37 feet, on trees about 50 yards south of the old gage. The bench mark is northeast corner of stone doorsill, north door of Windsor Hotel, on Commerce street, and is 57.68 feet above zero of gage. This latter datum is 103.7 feet above sea level. The high-water mark for Montgomery is 59.7 feet, and was reached in April, 1886. The danger line is placed at 35 feet. The width of the river at low water is 690 feet. No discharge measurements at this station were made during 1899, but will probably be made in the coming year, and in that case the measurements will be made at the iron bridge of the Louisville and Nashville Railroad, about 3 miles above Montgomery. This bridge is 60.6 feet above low water, with three spans over the river, the center one being a draw or turn span.

Daily gage height, in feet, of Alabama River at Montgomery, Alabama, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.0	13.0	35.1	20.3	9.8	3.2	2.3	9.4	3.1	−0.3	0.4	3.3
2	5.2	14.9	35.2	21.5	8.4	3.5	2.5	7.2	2.6	— .4	.2	2.8
3	5.1	19.0	33.5	21.4	7.3	3.7	2.3	6.8	2.2	— .4	.1	2.5
4	5.0	23.0	30.3	19.0	6.7	3.8	2.0	5.6	2.1	— .3	.0	2.3
5	4.8	23.5	27.0	17.2	6.3	3.6	1.7	4.8	2.5	.2	.0	2.0
6	4.8	22.1	25.6	16.8	6.0	3.2	1.5	3.8	1.9	.1	.0	1.7
7	5.3	24.8	18.7	16.4	5.8	3.0	1.2	3.4	1.7	.2	— .1	1.5
8	7.4	28.9	16.1	20.3	5.6	2.8	1.2	3.2	1.3	.3	— .1	1.4
9	8.5	31.6	14.3	22.3	5.8	2.6	1.3	2.9	.5	.3	— .1	1.3
10	8.9	32.0	13.2	24.2	6.3	2.5	1.5	2.5	.9	.2	— .1	1.0
11	11.0	31.6	12.1	24.0	6.3	2.4	1.7	2.2	.9	.2	— .1	7.5
12	17.5	29.7	10.9	22.1	5.7	2.3	1.7	2.0	.8	.4	— .1	14.6
13	18.0	26.8	9.8	19.4	5.1	2.4	1.5	1.7	.6	.6	— .1	15.6
14	16.3	24.7	13.2	17.1	5.1	2.6	1.3	1.5	.5	.4	— .1	15.5
15	13.9	20.6	16.0	14.1	5.0	2.8	1.1	1.4	1.3	.5	— .1	14.6
16	12.7	19.2	18.3	12.0	4.8	3.3	1.0	1.3	1.8	.4	— .1	11.4
17	12.4	17.6	24.9	10.4	4.4	3.4	.9	2.3	1.0	.2	.0	7.5
18	13.0	16.5	29.0	9.8	4.3	3.5	.9	3.5	.8	.1	.1	5.9
19	13.1	15.9	30.8	9.3	4.0	3.1	.9	2.8	.5	.1	.1	4.6
20	10.0	15.9	31.7	9.0	3.9	2.2	1.4	1.8	.4	.2	.1	4.0
21	8.4	16.0	32.0	8.5	3.8	1.7	1.8	1.8	.0	.4	.1	3.7
22	7.8	15.4	32.0	8.1	3.8	1.5	4.8	1.5	.0	.5	.0	3.6
23	7.8	14.7	31.4	8.2	3.8	1.2	9.0	1.5	— .1	.8	.4	3.5
24	8.9	13.5	30.0	9.4	4.9	1.2	13.7	1.8	— .1	.4	.5	9.6
25	8.9	13.5	30.0	11.0	5.2	1.2	16.0	2.0	— .1	.4	.6	10.5
26	9.0	13.5	28.3	14.8	5.2	1.6	11.7	1.5	— .1	.3	1.0	11.2
27	9.1	24.0	27.4	16.7	4.3	1.8	8.3	1.7	— .2	.2	3.0	12.0
28	9.0	33.0	26.1	16.7	3.8	2.1	9.5	2.7	— .2	.1	4.0	10.6
29	8.7	.....	24.9	15.8	3.5	2.3	10.4	2.8	— .3	.1	3.8	8.6
30	8.7	.....	23.9	12.2	3.1	2.1	10.4	1.9	— .3	.4	3.3	6.9
31	9.0	.....	19.3	.....	3.0	.....	9.2	1.9	.....	.4	.....	5.5
Mean.	9.5	21.2	24.2	15.6	5.2	2.5	4.3	2.9	0.9	0.2	0.6	6.7

ALABAMA RIVER AT SELMA, ALABAMA.

This station is located 45 miles by railroad below Montgomery, and was originally established by the United States Engineer Corps. Readings are now taken by the Weather Bureau. The gage rod is a pine plank painted white with black marks, and is in two sections. Section 1, 3 feet to 23 feet, is fastened to the pile on the lower side of the cofferdam on the draw pier. Section 2, 23 feet to 48 feet, is spiked to the bridge. The bench mark is an iron bolt driven in the face of a rock bluff, 182.3 feet from center of north face of pier and above the bridge, and is 26.05 feet above zero of the gage. The high-water mark is 57 feet, and was reached April 8, 1886. The danger line is placed at 35 feet. The rod is attached to the iron highway bridge, the floor of which is about 60 feet above low water. There is a turn-span at one end. The section is good for measurements, with a width of about 300 feet at low water. No measurements of discharge were made here during 1899.

Daily gage height, in feet, of Alabama River at Selma, Alabama, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.2	10.8	35.8	23.8	13.9	4.5	2.5	11.1	3.7	—1.2	—0.2	4.8
2	6.2	17.0	36.8	24.3	11.5	4.0	2.5	9.9	4.3	—1.3	— .3	3.7
3	6.5	20.2	38.8	24.9	9.9	4.0	2.6	9.0	4.6	—1.3	— .5	3.0
4	6.2	24.0	37.7	24.1	9.8	4.0	2.6	6.7	4.8	—1.3	— .6	3.0
5	6.2	26.8	35.3	22.3	8.5	3.8	2.1	6.5	4.4	—1.1	— .7	2.8
6	5.8	27.2	32.6	20.9	8.1	3.9	1.6	5.8	4.4	—1.0	— .7	2.8
7	6.6	27.2	30.5	20.0	7.5	3.8	1.6	5.3	4.1	—1.6	— .8	1.7
8	8.3	29.8	27.5	19.8	7.4	3.7	1.5	4.7	3.9	— .5	— .8	1.7
9	9.7	32.2	23.4	23.3	7.3	3.3	1.4	4.5	3.6	— .4	— .8	1.3
10	11.6	33.9	19.7	25.6	7.3	3.1	1.3	3.7	.6	— .4	— .9	1.3
11	13.9	34.4	16.9	26.9	7.5	2.8	1.3	3.5	.4	— .5	— .9	1.4
12	14.8	33.9	15.0	26.6	7.2	2.3	1.2	3.0	.3	— .6	—1.0	4.0
13	21.2	32.0	13.9	25.1	6.8	2.6	1.5	2.9	.3	— .6	—1.1	10.4
14	21.9	30.0	16.2	22.6	6.5	2.4	1.2	2.7	.2	— .2	—1.2	16.6
15	19.8	28.0	16.8	19.5	6.3	2.4	1.1	2.6	.2	— .2	—1.2	17.8
16	18.0	26.5	19.4	16.3	6.2	2.3	1.0	2.6	.1	— .2	—1.3	16.3
17	17.5	26.8	21.4	14.0	6.1	2.8	1.0	2.6	.6	— .3	—1.3	13.4
18	17.2	24.0	27.7	13.0	5.6	3.4	.7	3 6	1.3	— .5	—1.3	9.9
19	17.0	22.3	31.6	12.0	5.4	3.9	.6	4.1	1.0	— .7	—1.2	8.4
20	15.8	19.9	33.5	11.2	5.0	3.9	.6	4.3	.9	— .6	—1.0	3.8
21	14.2	19.9	34.7	10.5	4.8	3.1	1.0	3.6	.6	— 7	—1.0	3.8
22	12.6	19.5	34.8	10.4	4.5	2.8	1.6	3.5	— .6	— .8	— .6	3.4
23	10.2	18.8	34.2	10.2	4.4	1.6	5.5	3.4	— .7	— .2	— .6	3.4
24	10.3	17.8	33.4	10.1	4.8	1.4	10.7	3.1	— .8	.0	— .3	3.8
25	9.4	17.3	31.1	12.4	5.0	1.4	14.8	3.6	—1.0	.0	.1	7.6
26	9.0	16.4	32.6	13.5	6.0	1.6	17.0	4.2	—1.0	— .5	.2	12.2
27	8.9	20.3	31.8	16.3	6.1	1.7	17.0	3.9	—1.0	— .5	.9	13.5
28	8.6	31.2	30.5	17.9	5.2	2.0	14.9	3.6	—1.0	— .6	3.2	13.7
29	8.6	.....	29.3	17.7	4.5	2.2	13.1	4.3	—1.1	— .6	4.6	12.3
30	9.0	.....	27.8	16.1	4.3	2.4	12.8	4.6	—1.1	— .6	4.8	11.4
31	9.6	.....	26.3	.....	4.2	.....	11.9	3.8	.....	— .4	.....	8.3
Mean.	11.6	24.6	28.3	18.4	6.7	2.9	4.8	4.5	1.2	— .6	— .2	7.1

CATAWBA RIVER NEAR BIRMINGHAM, ALABAMA.

A measurement of this river, a tributary of Alabama River, was made by Mr. S. Hill Lea, civil engineer, in June, 1897, at a point 7 miles northeast of Birmingham, Alabama. The stage of the river was considered to be that of average low water. The mean velocity of the current was found to be 2.56 feet per second, and the discharge 817 second-feet.

BLACK WARRIOR RIVER AT TUSCALOOSA, ALABAMA.

The Black Warrior River rises in the south-central part of Alabama and flows in a southwesterly direction into the Tombigbee, on the southern boundary of Greene County. Tombigbee River flows southward from the junction until it reaches Alabama River, with which it unites to form Mobile River. The drainage area is for the most part flat, open country, much of it being under cultivation. Above Tuscaloosa it is largely in a Carboniferous formation, containing pervious strata, porous shales, and limestone caves, through which considerable water is probably lost. A continuous record of gage height at Tuscaloosa since 1889 has been kept by the United States Engineer Corps. During 1895 and 1896 a number of discharge measurements were also made, from which a rating table was obtained, and since that time measurements of flow have been made regularly by the United State Geological Survey, and computations made of the discharge. This station is described in the Eighteenth Annual Report, Part IV, page 103, and is located about three-fourths of a mile from the business center of Tuscaloosa, Alabama. It is reached by passing down Bridge street to the river, thence down the east bank 1,800 feet to the gage, which consists of an inclined timber 2 by 6 inches, supported on posts and graduated by means of notches placed 1 foot apart vertically. There are two bench marks, one on a willow tree, 10 feet west of gage, and 97.84 feet above Mobile datum; the other on a small hackberry, 30 feet south of the upper end of the gage, and 139.36 feet above Mobile datum. The zero of gage is 87.30 feet above same datum. The discharge measurements are made from the highway bridge above the gage. The channel is straight and unobstructed. The current is sluggish at time of low water; the banks high and rocky and not subject to overflow. The observer is R. C. McCalla, jr., United States assistant engineer. Records of measurement may be found as follows: From 1889 to 1896, Eighteenth Annual Report, Part IV, page 108; 1897, Nineteenth Annual Report, Part IV, page 251; 1898, Twentieth Annual Report, Part IV, page 194. The following measurements were made by B. M. Hall and Prof. George S. Wilkins, of the University of Alabama, in 1899:

Measurements of Black Warrior River at Tuscaloosa, Alabama.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.	*Feet.*	*Sec. feet.*	1899.	*Feet.*	*Sec. feet.*
February 21	19.36	12,855	March 4	23.70	12,609
February 21	19.25	12,640	March 14	31.18	36,653
February 24	22.85	16,216	March 14	34.37	40,331
February 28	39.47	48,010	March 17	59.50	119,533
March 1	35.50	24,988	March 18	56.40	86,410
March 2	30.35	18,052	March 23	40.30	23,911

Daily gage height, in feet, of Black Warrior River at Tuscaloosa, Alabama, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.40	26.10	37.70	30.30	7.90	2.00	0.10	6.50	1.20	—1.50	—1.03	4.83
2	4.50	29.50	32.00	29.20	7.00	1.50	.80	4.90	.70	—1.61	—1.02	3.50
3	4.60	27.00	27.70	24.80	6.30	1.20	.30	3.40	.62	—1.80	—1.03	2.77
4	4.70	29.00	24.10	22.00	5.80	1.00	—.70	2.70	.23	—1.79	— .99	2.03
5	4.70	45.50	21.00	23.20	5.30	1.00	—.10	2.00	— .02	—1.51	—1.00	1.50
6	11.20	50.60	20.80	22.60	4.80	.90	—.30	1.90	— .17	—1.48	—1.02	1.22
7	42.50	51.40	19.50	23.30	4.40	1.00	—.20	1.80	— .38	—1.46	—1.03	.98
8	49.30	51.70	16.90	33.90	4.40	.80	—.30	1.30	— .40	—1.34	—1.03	.88
9	46.60	48.60	14.40	34.00	7.60	.40	—.40	1.20	— .46	—1.30	—1.03	.58
10	40.40	43.10	12.90	30.80	6.50	.40	—.40	1.10	— .68	— .96	—1.01	.60
11	35.70	37.80	11.90	27.00	5.10	.50	—.40	2.00	— .73	— .78	—1.01	2.20
12	31.90	32.80	11.30	23.60	4.30	.50	—.50	1.70	— .79	— .72	— .98	23.50
13	28.00	28.80	10.00	20.10	4.20	.50	—.60	1.30	— .71	— .70	— .96	39.53
14	25.00	25.70	28.80	17.20	4.30	.50	—.60	.90	— .73	— .88	— .98	35.71
15	22.20	22.90	44.50	14.90	4.70	.50	—.70	.60	— .78	— .94	— .99	26.50
16	20.00	21.60	59.30	13.00	4.30	.70	—.70	.40	— .83	—1.03	—1.00	20.63
17	19.60	19.90	60.30	11.60	3.70	.60	—.70	.30	— .86	—1.07	— .97	15.21
18	20.10	20.10	57.70	10.50	3.30	.40	—.70	.30	— .88	—1.12	— .97	10.83
19	18 60	20.80	52.40	9.80	2.80	.30	—.70	.60	— .90	—1.16	— .95	8.02
20	16.10	20.60	49.30	9.60	2.70	.20	—.70	.60	— .92	—1.12	— .95	8.09
21	14.00	19.60	46.80	9.50	3.70	.10	—.60	.70	— .94	—1.10	— .92	9.63
22	12.20	18.50	41.60	8.70	3.80	.40	—.50	1.50	— .99	— .84	— .89	10.80
23	11.00	22.70	36.80	8.60	3.30	—.10	—.20	2.60	—1.03	— .73	— .33	10.63
24	11.00	23.10	33.00	11.30	3.10	—.10	+.60	2.50	—1.05	— .71	+ .17	22.01
25	20.30	20.90	29.50	13.60	2.70	—.60	4.90	2.60	—1.04	— .88	.88	29.04
26	29.30	18.50	26.50	13.20	2.30	+.20	7.60	2.30	—1.05	— .94	2.60	25.91
27	26.20	23.50	24.20	12.60	2.00	.20	7.40	2.10	—1.04	—1.02	4.50	20.98
28	22 50	39.00	22.30	11.40	1.75	.20	7.90	1.90	—1.18	— .60	10.48	17.09
29	18.60	.....	21.10	10.00	1.50	.20	9.50	1.60	—1.28	— .73	9.49	15.80
30	15.70	.....	19.30	8.90	1.60	.10	9.30	1.50	—1.38	— .96	6.67	14.62
31	14.80	.....	18.10	.....	2.50	.....	8.50	1.10	.....	—1.03	.....	12.51

The United States Weather Bureau has maintained gage readings at Demopolis, Alabama, on Tombigbee River, at the mouth of the Black Warrior River. The distance to Mobile is 185 miles. The gage rod is on the steamboat landing, and is 225 feet in length. From the bottom of the rod to the top of the bluff the gage is constructed of 2 by 12 inch pine boards set edgewise in a trench cut in the bank and securely fastened, the upper edge faced with three-eighths by 2 inch iron graduated to feet and tenths. At the top of the bluff to a point 5 feet above highest water the gage is marked by rows of copper tacks on a 6 by 8 inch post set firmly in the ground. The bench mark is the top of water table on the north side of the city jail at the western end, and is 68.40 feet above zero of gage and 13.71 feet below top of track of Southern Railway at the freight depot. The highest water was 66 feet, on April 18, 1874; the lowest, 3.9 feet, on October 26 to 30, 1875. The danger line is at 35 feet.

ALLEGHENY RIVER.

Allegheny River, which with the Monongahela forms the Ohio at Pittsburg, rises in northern Pennsylvania, flows northerly into the State of New York, then again turning southerly flows through western Pennsylvania. The headwaters have an elevation of about 2,250 feet and adjoin those of Genesee River on the north and of the Susquehanna on the east. The total length from the source to the mouth at Pittsburg is about 300 miles, 47 miles of which are in New York State. The catchment basin on the upper waters attains the

height of from 2,600 to 2,800 feet above sea level. The principal facts concerning this river have been given in a report by Mr. George M. Lehman, assistant engineer, contained in House Document No. 72, Fifty-fifth Congress, third session. The total area of the watershed as measured from the map of the Pennsylvania geological survey, is 11,400 square miles. The principal tributaries making up this total with their area in square miles are as follows: Conewago Creek, including Chautauqua Lake watershed, 935; Tionesta Creek, 458; French Creek, 1,180; Clarion River, 1,175; Redbank Creek, 526; Mahoning Creek, 397; Kiskiminitas River, 1,846, and Allegheny River above mouth of French Creek, about 5,950. The average fall of the river below Oil City is 2.2 feet per mile, but there are several stretches where for several miles the fall reaches nearly 5 feet per mile. Between Oil City and Tarentum, a distance of 112.6 miles, there are 81 ripples, some of them at very low water having only 0.5 foot depth of water; the depths in quiet water are in many places from 10 to 20 feet. The distance between Oil City and Tarentum, the part of the river surveyed and reported upon in 1897 by the United States Engineer Corps, and where the river is quite winding, is 112.6 miles by river channel and 57 miles by air line. The distance by river channel from Pittsburg to Franklin is 126.4 miles and the railroad distance 124 miles. The following table, furnished by Mr. George M. Lehman, was made in connection with the survey of the river by the United States Engineer Corps in 1897. It shows the heights above low water of 1865 and 1898:

Height of Allegheny River above low water in 1865 and 1898.

Distance from Pittsburg.	Place.	Width between banks.	Flood—	
			1865.	1898.
Miles.		*Feet.*	*Feet.*	*Feet.*
134.0	Oil City	800	22.5	12.5
126.4	Franklin (French Creek)	1,050	23.2	12.0
110.0	Kennerdell	900	26.5	13.5
91.6	Emlenton	500	31.3	19.0
85.0	Parker (Clarion River)	1,000	26.0	16.2
80.5	Monterey	700	32.0	20.5
70.7	East Brady	700	33.0	23.5
65.0	Redbank Junction (Redbank Creek)	950	24.5	18.0
56.2	Mahoning (Mahoning Creek)	1,000	28.3	23.5
45.6	Kittanning	1,000	30.3	25.0
38.2	Logansport	750	28.0	28.0
28.7	Freeport (Kiskiminitas River)	850	32.0	28.5
21.6	Tarentum	1,500	28.5	24.0
0	Pittsburg	1,000	31.4	29.0

It is said that the highest flood occurred in 1832, when the water rose to a height of 36 feet at Pittsburg. The flood of 1865 is the highest known, at least for any great extent of river and for which it was possible to get fairly reliable information. The depths show that the rainfall was quite general over the watershed, particularly

above Oil City. There is a very gradual and slight increase toward Pittsburg. The flood of 1898 was high on the lower Allegheny; the records show heavy rainfall over the watersheds of tributaries south of Clarion River, and the depths indicate this. The width of river has strong influence in depths, as shown in list.

Other high floods than those mentioned above have occurred at Pittsburg, but they have not all come from Allegheny River. The flood of 1884 backed water for several miles up from the mouth of the Monongahela, the depth recorded being 34.5 feet above low water. The flood of 1889 rose to 31.3 feet, but at points above the vicinity of Pittsburg the heights ranged about halfway between those of the 1865 and 1898 floods. The high water of 1865 is locally known as the "oil flood," because of the fact that many hundred barrels of oil awaiting shipment by steamboat from the Oil City district were carried downstream.

Observations of the discharge of the Allegheny at Pittsburg at the time of the 1898 flood were made by Mr. George M. Lehman on the velocity of drift passing between the bridges. The current averaged 7.7 miles per hour, and the estimated discharge was 290,000 second-feet.

YOUGHIOGHENY RIVER AT FRIENDSVILLE, MARYLAND.

This river rises in Garrett County, Maryland, and flows in a northwesterly direction into Pennsylvania, where it empties into Monongahela River 15 miles above Pittsburg. Its source is on the western slope of the Alleghény Mountains, at an elevation of about 2,900 feet. The average fall of the stream for 19 miles above its mouth is about 2 feet per mile, but above this point it soon increases to an average fall of nearly 5 feet per mile. The bank height above low water ranges between 15 and 28 feet, and the average width between banks from the mouth to West Newton, Pennsylvania, is 546 feet. The following heights at various points in Pennsylvania of the high water of February, 1897, above low-water stage, was furnished by Mr. George M. Lehman: Whikett, 13 feet; Jacobs Creek, 10 feet; Smithton, 14 feet; Port Royal, 17 feet; Snyder, 16 feet; West Newton, 20 feet; Suterville, 22 feet; Buena Vista, 26.5 feet; Coulterville, 28.5 feet; Boston, 29 feet; McKeesport, 28.5 feet.

A measurement of Youghiogheny River was made October 13, 1892, with surface floats, at Ohio Pyle, Pennsylvania, by Mr. Kenneth Allen, in connection with an investigation of a water supply for the works of the H. C. Frick Coke Company. It was during a period of extreme drought, and the discharge was found to be 106 second-feet. The area of its watershed was approximately obtained from maps of uncertain accuracy, but was called 1,775 square miles.

The station at Friendsville, Maryland, was established by E. G. Paul August 17, 1898. Measurements are made from the iron high-

way bridge connecting the east and west portions of the village. The wire gage is 20 feet from zero to the end of the weight, and referred to a scale board 14 feet long, graduated to feet and tenths. The channel is straight for several hundred feet above and below the bridge. The bed is rocky and the banks high and not subject to overflow. The observer is J. H. Cuppet, a merchant residing within a short distance of the gage. The results of measurements for 1898 may be found in the Twentieth Annual Report, Part IV, page 199. The following measurements were made by E. G. Paul during 1899:

January 24, gage height, 5.40 feet; discharge, 959 second-feet.
January 25, gage height, 6.35 feet; discharge, 2,050 second-feet.
May 17, gage height, 5.97 feet; discharge, 1,697 second-feet.
June 30, gage height, 5.40 feet; discharge, 944 second-feet.

Daily gage height, in feet, of Youghiogheny River at Friendsville, Maryland, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.20	5.00	6.50	6.50	4.60	4.90	5.20	4.50	4.00	4.10	4.10	4.30
2	5.20	4.90	6.40	6.30	5.00	4.90	4.80	4.30	4.10	4.10	4.60	4.30
3	5.20	5.00	6.30	6.00	5.20	4.80	4.60	4.20	4.00	4.10	5.00	4.30
4	5.40	7.40	6.30	5.80	5.30	4.80	4.40	4.20	4.00	4.10	4.80	4.30
5	6.50	7.00	7.70	5.30	5.30	4.80	4.60	4.60	3.90	4.00	4.50	4.30
6	6.30	6.20	8.20	5.20	5.20	4.60	4.50	4.80	3.90	4.00	4.50	4.50
7	6.10	5.90	6.60	5.10	5.20	4.50	4.50	4.50	3.90	4.00	4.40	4.60
8	6.00	5.60	6.20	6.90	5.10	4.50	4.50	4.30	4.10	4.00	4.30	4.60
9	5.80	5.40	5.90	6.50	6.90	4.40	4.40	4.20	4.00	4.00	4.30	4.80
10	5.60	5.30	6.30	5.90	6.50	5.20	4.40	4.20	4.40	4.00	4.40	4.90
11	5.30	5.20	6.10	5.70	6.30	5.90	4.30	4.30	4.40	3.90	4.30	4.90
12	5.20	5.10	6.00	5.50	5.90	5.80	4.20	4.20	4.30	3.90	4.20	5.40
13	5.10	5.10	5.90	5.30	5.60	5.60	4.20	4.20	4.30	3.90	4.20	5.80
14	6.10	Frozen	5.70	5.20	5.60	5.60	4.30	4.20	4.20	3.90	4.20	5.50
15	8.00	...do..	5.60	5.10	5.50	5.70	4.40	4.10	4.10	3.90	4.20	5.30
16	7.10	...do..	5.60	5.10	5.60	6.50	4.60	4.10	4.10	3.90	4.10	5.10
17	6.80	...do..	5.70	5.00	5.70	6.20	4.60	4.10	4.00	3.90	4.10	5.10
18	6.50	...do.	5.70	5.00	8.00	5.40	4.90	4.00	4.00	3.90	4.10	5.20
19	6.20	5.10	5.70	5.00	9.50	5.00	4.70	4.00	4.10	3.90	4.30	5.40
20	5.80	5.20	5.70	4.90	7.20	4.80	4.50	4.00	4.10	3.90	4.40	5.40
21	5.50	5.40	6.00	4.90	6.90	4.80	4.40	4.00	4.30	3.90	4.60	5.30
22	5.40	6.80	6.00	4.80	6.50	4.70	4.30	4.00	4.20	3.90	4.70	5.30
23	5.30	7.20	6.30	4.70	6.10	4.60	4.20	4.00	4.20	3.90	4.60	5.30
24	5.30	6.40	6.30	4.70	5.60	4.50	4.20	4.00	4.10	3.90	4.60	5.20
25	6.40	5.90	6.00	4.70	5.30	5.30	4.40	4.00	4.00	3.90	4.60	5.20
26	6.00	6.20	5.80	4.60	5.10	5.10	4.20	4.00	4.00	3.90	4.40	5.20
27	5.70	7.90	5.60	4.60	4.90	5.20	4.20	4.00	4.10	3.90	4.40	5.10
28	5.50	7.20	6.60	4.70	4.90	5.20	4.20	4.00	4.10	4.00	4.40	5.10
29	5.30	.....	8.00	4.70	4.80	5.40	4.40	4.10	4.10	4.00	4.40	5.10
30	5.10	.....	7.30	4.60	4.90	5.60	4.30	4.10	4.10	4.00	4.30	5.10
31	5.10	.....	6.90	.....	4.90	.....	4.30	4.00	.....	.....	.....	5.10

CHEAT RIVER AT UNEVA, WEST VIRGINIA.

This river rises in the eastern part of West Virginia, and flows almost due north across the Pennsylvania boundary, entering Monongahela River 3 miles north of the State line. The drainage area is partly mapped on the St. George, Piedmont, Franklin, Beverly, Monterey, and Huntersville atlas sheets. As there is no bridge at a place convenient for making measurements, a cable of 600 feet span was stretched across the stream 6 miles northeast of Morgantown, at Uneva, West Virginia, and observations of heights begun on July 8,

1899. The gage is a post bolted to a rock and graduated to feet and tenths. The initial point of soundings is on the right bank. The channel above and below the station is straight. The current is sluggish. The right bank is low and subject to overflow, but the left bank is high and rocky. The bed of the stream is rocky and constant. The observer is A. F. Blosser, a blacksmith at Uneva, West Virginia. On July 8, 1899, a measurement at this station was made by E. G. Paul, at a gage height of 2.60 feet, and gave a discharge of 1,148 second-feet. A measurement was made of this river during a period of extreme drought at Morris crossroads, Pennsylvania, 1 mile below the West Virginia State line, on October 6, 1892, by Mr. Kenneth Allen, and the discharge found to be 249 second-feet.

Daily gage height, in feet, of Cheat River at Uneva, West Virginia, for 1899.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	------	3.00	2.20	2.00	3.70	2.90	17	3.50	2.40	2.70	1.80	2.40	3.40
2	------	2.80	2.00	2.00	4.00	2.80	18	3.40	2.30	2.30	1.80	2.40	3.20
3	------	2.70	2.30	1.90	3.80	2.70	19	3.00	2.20	2.20	1.70	2.50	3.00
4	------	2.50	2.20	1.90	3.50	2.70	20	2.80	2.10	2.00	1.70	3.40	4.80
5	------	3.40	2.20	1.90	3.30	2.60	21	2.40	2.00	1.90	1.60	3.40	4.40
6	------	3.30	2.20	1.90	3.10	2.60	22	2.40	2.00	1.90	1.60	3.20	4.10
7	------	3.00	2.10	1.80	2.10	2.50	23	2.40	1.90	2.30	1.60	3.00	3.90
8	2.60	2.80	2.00	1.80	2.10	2.50	24	2.30	1.90	2.20	1.60	3.00	5.20
9	3.00	2.70	2.00	1.80	2.80	2.50	25	2.50	1.80	2.20	1.60	3.90	4.40
10	2.80	2.60	2.20	1.70	2.70	2.50	26	2.70	1.80	2.10	1.70	3.70	3.60
11	2.70	2.50	4.10	1.70	2.60	2.70	27	2.80	1.80	2.30	1.70	3.50	3.20
12	2.50	2.40	3.80	1.70	2.90	5.50	28	2.60	2.50	2.40	1.70	3.30	2.90
13	2.40	2.30	3.50	1.70	2.70	6.40	29	2.50	2.40	2.30	1.70	3.10	2.70
14	2.50	2.20	3.20	1.70	2.60	4.80	30	3.50	2.30	2.20	1.70	3.10	2.60
15	2.80	2.20	3.00	1.70	2.60	4.20	31	3.60	2.30	------	1.70	------	--------
16	2.80	2.30	2.80	1.70	2.50	3.80							

The United States Weather Bureau have maintained gage readings on Cheat River at Rowelsburg, West Virginia, 36 miles above its junction with the Monongahela. The river at this point is 270 feet wide. The drainage area above the station is reported to be 890 square miles. The gage rod is on the second pier of the Baltimore and Ohio Railroad bridge. The bench mark of the United States Coast and Geodetic Survey, situated on the center pillar, west end of the bridge, is 26.66 feet above zero of the gage. The highest water was 22 feet, on July 10, 1880; lowest, 0.9 foot, on October 15, 1895. The danger line is at 14 feet.

NEW RIVER AT RADFORD, VIRGINIA.

This river rises in Watauga, Ashe, and Alleghany counties, North Carolina, and flows in a northwesterly direction into West Virginia, where it meets the Gauley, near Kanawha Falls, to form the Great Kanawha. The drainage area is mapped on the Kanawha Falls, Nicholas, Hinton, Beverly, Monterey, Huntersville, Lewisburg, Raleigh, Christiansburg, Dublin, Pocahontas, Abingdon, Wytheville, Hillsville, Yadkinville, Wilkesboro, and Cranberry topographic sheets. The upper tributaries have a general northeasterly and southwesterly direction, draining the narrow valleys of the greater Appalachian

Valley in Virginia. The basin of New River is for the most part mountainous and wooded, forming one of the most beautiful and picturesque sections in the eastern part of the United States. The river itself is rapid and a part of it almost impassable, even for canoes. Systematic measurements of flow of New River are made at Radford, Montgomery County, Virginia, and at Fayette, West Virginia. The station at Radford is located at the highway bridge close to the Norfolk and Western Railway station. It was established by D. C. Humphreys August 1, 1898. The gage used was erected by the United States Weather Bureau. It consists of a vertical board graduated to feet and tenths, and is attached to the iron framework connecting the pair of iron concrete cylinders which form the first pier from the right bank. The bench mark is the bottom of the lowest horizontal brace connecting the two cylinders, the elevation being 3.88 feet above the zero of the gage. The discharge measurements are made from the upstream side of the bridge. The initial point of soundings is on the right bank of the river 40 feet from the first pier. The bottom is of solid rock and gravel and is smooth and regular. On the left bank there is a steep, rocky bluff. The right bank is low and subject to overflow for about 100 yards, but all the water must pass under the bridge, which is about 85 feet above low water. The observer is A. J. Killinger, bridge tender at Radford, Virginia. The following measurements were made by D. C. Humphreys during 1899:

June 29, gage height, 1.12 feet; discharge, 4,980 second-feet.
August 11, gage height, 0.20 foot; discharge, 2,172 second-feet.

Daily gage height, in feet, of New River at Radford, Virginia, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.00	0.70	3.00	2.40	1.40	1.10	0.80	0.00	1.00	0.30	0.40	—0.30
2	1.10	.70	2.60	2.00	1.30	1.00	.40	.00	1.00	.20	1.00	— .30
3	1.00	1.70	2.00	1.90	1.30	.90	.40	.00	1.00	.00	.90	— .20
4	1.20	2.00	6.05	1.60	1.40	.80	.30	.00	1.10	.00	.60	— .30
5	1.50	3.90	10.50	2.00	1.30	.70	.30	.00	1.00	.00	.30	— .10
6	1.80	5.70	7.00	1.90	1.00	.60	.40	.00	.10	.00	.20	— .10
7	4.00	5.00	5.00	1.80	1.10	.40	.50	.00	.00	.00	.00	— .10
8	2.60	4.20	4.00	4.10	1.20	.40	.40	.00	.00	.20	.00	— .10
9	1.80	3.10	2.90	3.80	1.90	.30	.30	.00	.00	.10	.00	— .20
10	1.70	3.00	2.50	2.90	1.80	.30	.20	.00	.00	.00	.00	+ .10
11	1.60	2.40	2.20	2.90	2.00	.40	.30	.00	.00	.00	.00	.20
12	1.20	2.00	2.00	1.90	1.90	1.00	.30	.00	.00	.00	.00	1.75
13	1.50	1.90	1.90	1.80	2.00	3.90	.40	.00	.00	.00	.00	4.20
14	1.40	1.30	1.70	1.70	2.10	2.60	.20	1.00	.00	.00	.00	2.90
15	1.50	.90	3.00	1.80	1.80	2.00	.10	.50	.00	.00	.00	1.00
16	1.60	1.20	6.10	1.60	1.70	1.70	.00	.40	.00	.00	.00	.90
17	1.70	3.50	3.70	1.50	1.30	1.10	.00	.20	.00	.00	.20	.80
18	1.20	3.20	2.90	1.40	1.10	.90	.00	.20	.00	.00	.00	.80
19	1.10	3.60	7.75	1.60	1.00	.80	.00	.10	1.00	.00	.00	.70
20	1.10	2.80	7.90	1.50	1.00	.90	.00	.20	1.60	.00	.00	.90
21	.90	3.00	4.00	1.40	.90	.70	.10	.30	1.00	.00	.00	1.00
22	.80	3.00	3.80	1.30	.80	.60	.10	.30	.90	.00	.00	.90
23	1.00	2.90	3.00	1.30	1.10	.50	.10	.20	.80	.00	.00	.60
24	1.00	2.00	2.80	1.10	1.50	.50	.00	.00	.60	.00	.00	.60
25	.90	1.90	2.60	1.00	1.40	.60	.00	.00	.50	.00	.00	.50
26	1.00	2.00	2.50	2.00	1.10	.90	.00	.00	.50	.00	.00	.40
27	1.00	4.60	2.00	2.50	.80	1.20	1.00	.00	.40	.00	.00	.30
28	.90	4.00	3.10	2.00	.80	1.00	.90	1.00	.30	.00	.00	.30
29	1.00	-------	3.00	1.80	.70	1.00	.80	1.10	.40	.00	—.20	.20
30	.80	-------	3.20	1.60	.80	.90	.50	1.00	.30	.10	—.30	.20
31	.80	-------	2.90	-------	.90	-------	.40	1.00	-------	.00	-------	.20

GREENBRIER RIVER AT ALDERSON, WEST VIRGINIA.

This river rises on the western slope of the Allegheny Mountains, in Pocahontas County, West Virginia, and flows in a southwesterly direction, emptying into New River near Hinton, Summers County, West Virginia. The station was established by C. C. Babb and D. C. Humphreys, at Alderson, West Virginia, 21 miles above Hinton, August 1, 1895. The drainage area at this point is 1,344 square miles, and is mapped on Hinton, Beverly, Monterey, Huntersville, and Lewisburg atlas sheets. Greenbrier River receives many short tributaries from the Allegheny Range, and flows for the most part through a hilly, broken, and mountainous country well covered with forests. The station, described in the Eighteenth Annual Report, Part IV, page 111, is located one-half mile above the mouth of Muddy Creek, on the county bridge at Alderson. The wire gage, length 28.37 feet, is in the third panel of the second span, downstream side, and was last verified on August 12, 1899. This gage is referred to three bench marks: The first, on the upper end of the coping of the first pier from the left bank, 21.75 feet above zero of the gage; the second, on upper end of the bridge seat of the left bank abutment, 21.61 feet above the zero of the gage; the third, on stone foundation of water tank of the Chesapeake and Ohio Railway, 23.48 feet above the zero of the gage. A temporary bench mark has been established on lower end of third floor beam, in second span from left bank. Elevation 22.47 feet above the zero of the gage. The bridge consists of four spans 435 feet long. At ordinary stages the water flows in two channels, there being an island 600 feet long and 75 feet wide between them. The banks are high and not subject to overflow. The bed is of rock and gravel and fairly constant. The observer is W. J. Hancock, clerk in a hardware store, Alderson, West Virginia. Records of measurement can be found as follows: 1895–96, Eigtheenth Annual Report, Part IV, page 113; 1897, Nineteenth Annual Report, Part IV, page 254; 1898, Twentieth Annual Report, Part IV, page 204. The following measurements were made by D. C. Humphreys during 1899:

June 22, gage height, 1.94 feet; discharge, 456 second-feet.
August 12, gage height, 1.36 feet; discharge, 104 second-feet.

Daily gage height, in feet, of Greenbrier River at Alderson, West Virginia, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.80	2.63	5.75	4.13	2.42	2.75	1.78	1.48	1.30	1.48	1.37	1.52
2	2.75	2.90	4.95	3.68	2.40	3.15	1.75	1.43	1.40	1.42	1.48	1.50
3	3.08	2.38	6.10	3.35	2.77	3.20	1.73	1.43	1.38	1.42	1.58	1.45
4	2.75	2.27	12.98	3.13	2.60	2.90	1.72	1.33	1.35	1.42	1.58	1.45
5	3.52	4.58	15.38	2.90	2.55	2.65	1.67	1.48	1.45	1.40	1.60	1.45
6	5.35	6.21	10.95	2.83	2.52	2.47	1.61	1.35	1.42	1.40	1.68	1.45
7	8.60	5.80	6.45	2.75	2.66	2.34	1.58	1.22	1.37	1.40	1.62	1.45
8	6.00	4.50	4.90	3.00	5.38	2.25	1.61	1.35	1.47	1.40	1.58	1.42
9	4.60	3.68	4.15	4.75	7.30	2.47	1.63	1.35	1.55	1.33	1.53	1.40
10	3.90	3.10	3.90	4.10	6.30	2.27	1.62	1.34	1.47	1.38	1.48	1.40
11	3.50	2.70	3.75	3.58	4.60	2.25	1.64	1.34	1.50	1.35	1.48	1.40
12	3.20	2.65	3.75	3.42	4.30	2.68	1.60	1.36	1.50	1.34	1.48	1.48
15	3.03	2.75	3.60	3.23	4.58	3.30	1.58	1.38	1.47	1.34	1.45	2.20
14	2.98	2.75	3.43	3.15	4.80	2.90	1.60	1.32	1.42	1.37	1.43	2.40
15	3.90	2.80	3.60	3.05	4.35	2.83	1.58	2.30	1.38	1.36	1.43	2.45
16	3.28	2.70	4.05	2.95	3.83	2.75	1.56	2.00	1.40	1.35	1.43	2.20
17	3.95	2.60	4.10	2.85	3.45	2.52	1.52	1.72	1.38	1.35	1.40	2.00
18	3.70	2.68	3.75	2.80	3.15	2.37	1.52	1.60	1.32	1.26	1.40	1.75
19	3.48	2.80	5.05	2.75	3.05	2.23	1.55	1.38	1.40	1.26	1.38	1.73
20	3.23	3.10	6.35	2.70	2.92	2.20	1.58	1.40	1.47	1.30	1.38	1.76
21	3.00	4.40	4.95	2.60	2.88	2.15	1.55	1.35	1.48	1.30	1.42	1.85
22	2.92	6.75	4.20	2.50	2.68	2.03	1.63	1.42	1.42	1.27	1.38	1.75
23	2.90	6.60	3.85	2.45	2.58	1.89	1.60	1.36	1.65	1.22	1.38	1.73
24	2.80	5.25	3.70	2.40	2.52	2.10	1.54	1.37	1.70	1.32	1.38	1.78
25	2.85	4.28	3.50	2.37	2.42	1.95	1.55	1.30	1.60	1.28	1.40	1.73
26	3.30	3.80	3.35	2.60	2.33	1.92	1.50	1.30	1.58	1.25	1.40	2.13
27	3.15	8.63	3.22	2.88	2.27	1.87	1.54	1.28	1.55	1.25	1.36	2.02
28	3.05	7.60	3.17	2.72	2.20	1.90	1.50	1.25	1.53	1.25	1.40	1.80
29	2.97	.....	6.38	2.57	2.17	1.92	1.58	1.37	1.50	1.25	1.53	1.80
30	2.70	.....	5.95	2.50	2.15	1.85	1.52	1.32	1.50	1.22	1.56	1.80
31	2.75	.....	4.65	.....	2.30	.....	1.50	1.32	.....	1.32	.....	1.95

The United States Weather Bureau has maintained gage readings on New River at Hinton, West Virginia. The drainage area above the station is reported to be 6,020 square miles. The railroad track at the depot is 33.5 feet above zero of gage. The highest water was on September 13, 1878, when it reached 23 feet; lowest, 0.5 foot, date unknown. The danger line is at 14.5 feet.

NEW RIVER AT FAYETTE, WEST VIRGINIA.

This station, established by C. C. Babb and D. C. Humphreys July 29, 1895, is described in the Eighteenth Annual Report, Part IV, page 113, and is located just below the mouth of Wolf Creek, on the highway bridge of one span at Fayette, West Virginia. The drainage area is mapped on the Kanawha Falls, Nicholas, Hinton, Beverly, Monterey, Huntersville, Lewisburg, Raleigh, Christiansburg, Dublin, Pocahontas, Abingdon, Wytheville, Hillsville, Yadkinville, Wilkesboro, and Cranberry atlas sheets. The wire gage is on the guard rail on the upper side of the bridge, about the middle of the span, the scale being graduated to feet and tenths. The gage is referred to four bench marks: First, the top of the bottom plate of the lower plate girder at the end of the first panel from the left bank, downstream side, 55.13 feet above the zero of the gage; second, top of lower end of coping on the main pier, right bank, downstream side, 52.13 feet above the zero of the gage; third, bridge seat on the right bank, downstream side, 54.58 feet above the zero of the gage; fourth, west

corner of abutment stone by Chesapeake and Ohio Railway station, 58.62 feet above the zero of the gage. The gage was last verified August 14, 1899. The channel is straight above and below the station, the current is swift and without obstructions, except for immense bowlders in the bottom. The banks are high, rocky, and not subject to overflow. The bed is constant in section. The observer is M. W. Brellahan, agent Chesapeake and Ohio Railway, Fayette, West Virginia. Records of measurement may be found as follows: 1895–96, Eighteenth Annual Report, Part IV, page 115; 1897, Nineteenth Annual Report, Part IV, page 156; 1898, Twentieth Annual Report, Part IV, page 203. The following measurements were made by D. C. Humphreys during 1899: June 22, gage height, 3.65 feet; discharge, 5,097 second-feet; August 14, gage height, 1.80 feet; discharge, 2,985 second-feet.

Daily gage height, in feet, of New River at Fayette, West Virginia, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.45	4.45	9.00	8.40	6.80	6.30	3.80	2.40	2.70	0.95	1.80	0.80
2	4.30	5.00	11.51	8.35	6.25	6.35	3.00	2.30	1.55	.80	2.00	.85
3	4.10	6.40	19.35	6.50	6.00	6.00	3.20	2.20	1.50	.80	1.95	.80
4	4.10	7.25	35.08	6.10	5.85	5.50	3.05	2.40	1.90	.70	1.85	.70
5	4.00	14.20	29.78	5.50	5.70	4.95	2.40	2.25	2.20	.60	1.80	.55
6	5.90	20.60	24.43	5.85	5.75	4.60	2.45	2.15	2.10	.65	1.75	.50
7	13.00	22.80	18.78	7.50	5.65	3.15	2.25	2.00	2.00	.50	1.75	.50
8	10.10	17.10	14.00	8.10	7.55	3.25	2.20	1.85	1.40	.50	2.40	.45
9	6.50	14.35	13.30	7.10	12.40	3.20	2.10	1.40	1.30	2.05	1.65	.35
10	5.20	10.05	10.10	7.05	12.10	3.05	2.05	1.45	1.35	2.40	1.40	.80
11	8.10	8.30	9.50	7.15	8.10	3.05	1.95	1.35	1.45	2.35	1.20	1.00
12	7.50	6.50	9.00	9.80	9.95	3.00	1.90	1.30	1.40	2.65	1.20	1.00
13	7.40	6.10	8.20	8.00	8.25	6.85	2.05	1.35	1.30	2.60	1.15	1.70
14	6.45	5.30	8.00	7.55	8.90	11.60	1.85	1.40	1.30	2.60	1.10	9.50
15	6.15	4.50	8.40	7.00	10.70	11.75	1.45	1.50	1.25	2.45	1.10	8.30
16	5.80	4.30	8.25	6.75	9.50	10.30	1.35	2.10	1.20	2.40	1.05	4.60
17	5.50	4.45	10.50	6.65	8.00	7.05	1.30	2.70	1.15	2.30	1.05	3.25
18	5.05	6.50	10.10	6.00	6.60	6.00	1.40	2.15	1.20	2.15	1.00	2.95
19	4.75	6.85	15.00	5.55	5.95	5.30	1.35	1.45	1.20	2.10	1.00	2.80
20	4.35	6.20	20.00	5.55	5.65	5.05	1.40	1.40	1.15	2.10	1.00	2.85
21	4.10	9.40	17.60	5.50	5.20	4.35	1.80	1.30	1.10	2.05	.90	3.05
22	4.20	11.25	11.40	5.40	5.05	4.10	1.90	1.25	1.15	2.05	.90	3.10
23	5.55	10.10	8.30	5.40	5.00	3.50	1.75	1.25	1.10	2.00	.90	3.15
24	5.40	9.50	8.00	5.30	4.85	3.20	1.50	1.10	1.05	1.85	.95	3.00
25	4.90	8.60	7.55	5.25	4.60	3.20	1.45	1.05	1.15	1.80	1.00	3.40
26	4.85	8.95	6.40	5.40	4.50	3.10	1.45	.95	1.30	1.70	1.10	3.80
27	4.85	20.05	11.10	8.50	4.10	3.05	1.40	.90	1.20	1.70	1.10	4.10
28	4.60	14.65	15.00	8.70	3.90	3.30	1.30	.90	1.20	1.60	1.05	4.40
29	4.50	.....	18.70	7.75	3.85	4.15	3.80	.85	1.20	1.65	1.00	3.05
30	4.60	.....	14.10	7.10	3.80	4.05	3.00	.80	1.20	1.70	.85	2.90
31	4.50	.....	9.05	.....	4.30	.....	2.25	2.60	.....	1.60	.....	2.85

FRENCH BROAD RIVER AT ASHEVILLE, NORTH CAROLINA.

French Broad River rises in the western part of North Carolina, and flows in a general northwesterly direction into Tennessee. It joins Holston River just above Knoxville to form the Tennessee. The watershed is for the most part mountainous and covered with a heavy growth of timber. There are water powers capable of development at a number of places on the French Broad. The drainage area is mapped on the Asheville, Mount Mitchell, Pisgah, and Saluda atlas sheets. Measurements of flow have been made at Asheville, North Carolina. This station, described in the Eighteenth Annual

Report, Part IV, page 116, was established by Cyrus C. Babb in September, 1895, and is located at the Bingham School iron highway bridge, 3 miles west of Asheville, North Carolina, and is reached by an electric car line from Asheville. The Swannanoa River joins the French Broad 3 miles above the station. The zero of the rod of the wire gage is opposite the east edge of the fifth upright, first span from east, upper side. When the gage height is 3.22 feet, water surface is 17.18 feet below top of the lower end of the second floor beam, first span from the east. The gage was last verified on October 27, 1899. The initial point for soundings is on the right bank at the end of the first span of the bridge. Both banks may overflow in very high water. The current is swift, the channel straight, rocky, and reasonably permanent. The observer is J. M. Taylor, a carpenter at Asheville, North Carolina. Records of measurements may be found as follows: 1895–97, Nineteenth Annual Report, Part IV, page 257; 1898, Twentieth Annual Report, Part IV, page 205.

The following measurements were made by E. W. Myers and R. E. Shuford during 1899:

February 25, gage height, 4.30 feet; discharge, 2,810 second-feet.
June 16, gage height, 3.03 feet; discharge, 2,359 second-feet.
September 30, gage height, 1.94 feet; discharge, 714 second-feet.
October 27, gage height, 1.95 feet; discharge, 815 second-feet.
November 30, gage height, 2.12 feet; discharge, 1,043 second-feet.

Daily gage height, in feet, of French Broad River at Asheville, North Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.60	3.60	6.80	5.25	4.20	2.90	2.40	2.45	3.10	1.80	2.30	2.23
2	4.20	3.55	6.40	5.20	4.15	2.80	2.43	2.30	3.05	1.83	2.30	2.15
3	3.90	4.65	5.60	5.80	4.17	2.73	2.50	2.23	3.00	1.85	2.20	2.15
4	3.80	8.20	4.40	5.50	4.15	2.70	2.45	2.20	2.80	1.90	2.15	2.20
5	3.90	8.00	4.20	5.10	4.20	2.73	2.45	2.10	2.60	1.90	2.13	2.17
6	3.95	7.03	4.30	5.40	4.30	2.65	2.47	2.00	2.30	2.00	2.10	2.15
7	4.20	7.00	4.35	5.85	4.40	2.53	2.45	2.03	2.10	2.05	2.07	2.13
8	4.70	6.50	4.35	5.80	4.30	2.50	2.40	2.50	3.50	2.65	2.05	2.11
9	4.65	5.50	4.30	5.70	4.30	2.57	2.40	2.70	2.60	2.40	2.03	2.05
10	4.50	5.00	4.25	5.80	4.20	2.63	2.37	3.00	2.50	2.30	2.00	2.15
11	4.40	4.80	4.30	5.90	4.35	2.70	2.35	3.50	2.35	2.25	2.00	3.40
12	4.20	4.70	4.30	6.45	4.60	2.73	2.35	2.45	2.20	2.20	2.20	6.35
13	4.10	4.50	5.00	6.45	4.55	2.65	2.30	2.20	2.15	2.13	1.97	6.13
14	4.03	4.40	8.50	5.60	4.40	2.53	2.23	2.25	2.10	2.05	1.95	5.20
15	4.40	4.30	11.50	4.50	4.30	2.50	2.20	2.27	2.10	2.65	1.93	3.70
16	4.40	5.60	9.00	4.80	4.20	2.57	2.15	2.23	2.10	2.40	1.95	2.77
17	4.35	5.40	7.60	4.60	4.00	2.63	2.40	2.10	2.10	2.30	2.00	2.85
18	4.30	5.25	5.50	4.50	3.80	2.83	2.45	2.05	2.15	2.25	2.00	2.75
19	4.25	5.20	11.25	4.45	3.70	2.80	2.37	2.03	2.23	2.20	2.13	2.70
20	4.10	5.00	10.00	4.35	3.60	2.80	2.27	2.03	2.20	2.10	2.10	2.67
21	3.70	4.15	7.50	4.30	4.40	2.70	2.23	2.00	2.10	2.05	2.07	2.60
22	3.65	4.30	6.70	4.20	4.30	2.65	2.15	2.00	1.90	2.07	2.05	2.55
23	3.60	4.50	6.05	4.40	4.20	2.60	2.20	1.97	1.85	2.10	2.03	3.40
24	3.70	4.40	5.70	4.50	4.00	2.55	2.20	1.95	1.83	2.10	2.00	3.93
25	4.05	4.30	5.40	4.60	3.80	2.47	2.15	1.93	1.90	2.07	2.00	3.80
26	4.03	4.40	5.25	4.70	3.70	2.65	3.00	2.00	2.15	2.05	2.15	3.53
27	4.00	8.80	5.60	4.50	3.60	2.85	3.15	2.10	2.10	2.03	2.30	2.10
28	3.80	7.75	5.25	4.40	2.85	2.95	3.00	2.50	2.15	2.00	2.40	2.70
29	3.75	-------	5.33	4.30	2.80	2.80	2.80	2.60	1.85	2.05	2.37	2.65
30	3.70	-------	5.40	4.25	2.75	2.50	2.50	2.80	1.80	2.13	2.35	2.60
31	3.65	-------	5.35	-------	3.00	-------	2.43	3.85	-------	2.25	-------	2.57

TUCKASEGEE RIVER AT BRYSON, NORTH CAROLINA.

This river rises in the southwestern part of North Carolina, at the base of Tennessee Ridge, which separates Jackson and Transylvania counties. It flows in a northwesterly direction, emptying into the Little Tennessee River at Bushnell, North Carolina. Measurements of discharge are made at Bryson, 2 miles below the mouth of Newton Mill Creek. The drainage area is 609 square miles, largely of a rough and mountainous nature, covered with forest growth, and is mapped on the Cowee, Pisgah, and Mount Guyot atlas sheets. The old station, described in the Eighteenth Annual Report, Part IV, page 116, was located on the Southern Railway bridge about 3 miles above Bryson, North Carolina, and just below Governor Island post-office, and was abandoned March 25, 1897, because the section was poor. A new station was established by A. P. Davis November 7, 1897, at the highway bridge in the town of Bryson, North Carolina. The gage is bolted to the north pier, lower side, and can be read from the bridge. The initial point of sounding is at the south end of upstream hand rail. The channel is straight, but obstructed by the remnants of two old piers. The current is sluggish, the river bed muddy and fairly constant. The observer is H. H. Welch, a carpenter at Bryson, North Carolina. Results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 117; 1897, Nineteenth Annual Report, Part IV, page 257; 1898, Twentieth Annual Report, Part IV, page 206. The following measurements were made by E. W. Myers and R. E. Shuford in 1899:

Measurements of Tuckasegee River at Bryson, North Carolina.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.	*Feet.*	*Sec.-feet.*	1899.	*Feet.*	*Sec.-feet.*
Feb. 26	7.00	19,160	Oct. 28	1.10	404
June 17	2.00	1,216	Do	1.10	460
June 19	1.80	712	Dec. 5	1.20	479
Sept. 20	1.25	376	Dec. 28	1.70	1,010
Do	1.25	369			

Daily gage height, in feet, of Tuckasegee River at Bryson, North Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.50	2.05	3.20	3.40	2.30	1.80	1.50	1.40	1.40	1.00	1.00	1.50
2	2.20	1.85	3.00	3.05	2.30	1.80	1.50	1.40	1.40	1.00	1.00	1.40
3	2.05	3.00	2.25	3.50	2.50	2.00	1.50	1.40	1.35	1.00	1.80	1.40
4	2.20	9.00	3.30	3.20	2.60	1.70	1.50	1.40	1.30	1.00	1.70	1.20
5	2.60	.....	3.50	3.10	2.60	1.70	1.50	1.40	1.30	1.00	1.20	1.20
6	3.00	7.50	3.40	3.10	3.00	1.70	1.80	1.30	1.30	1.00	1.15	1.20
7	2.60	7.00	3.25	3.10	3.00	1.70	1.80	1.30	1.20	1.00	1.05	1.20
8	2.55	5.30	3.00	3.00	2.90	1.70	1.70	1.30	1.20	2.00	1.05	1.20
9	2.50	3.50	2.95	3.60	2.85	1.70	1.60	1.30	1.20	1.50	1.00	1.50
10	2.80	3.00	2.80	3.20	2.60	1.80	1.60	1.40	1.20	1.40	1.00	1.30
11	2.30	3.20	2.80	3.00	2.60	1.80	1.50	1.40	1.20	1.40	1.00	1.50
12	(a)	3.00	2.65	3.00	2.35	3.50	1.40	1.40	1.20	1.30	1.00	6.50
13	(a)	2.80	2.60	2.90	2.30	2.80	1.30	1.40	1.20	1.25	1.00	2.90
14	2.60	2.80	3.40	2.90	2.20	2.20	1.30	1.40	1.20	1.10	1.00	2.00
15	2.30	2.70	9.60	2.85	2.20	2.10	1.30	1.30	1.20	1.00	1.00	1.65
16	2.20	2.70	6.50	2.80	2.25	2.00	1.30	1.30	1.20	1.00	1.00	1.50
17	2.20	2.70	4.80	2.60	2.20	2.00	1.50	1.30	1.15	1.00	1.00	1.30
18	2.20	2.60	4.90	2.60	2.25	2.00	1.30	1.30	1.15	1.00	1.00	1.30
19	2.10	2.50	11.00	2.55	2.25	1.80	1.30	1.30	1.10	1.00	1.00	1.90
20	2.10	2.50	5.80	2.50	2.20	1.70	1.30	1.20	1.25	2.00	1.05	1.50
21	2.05	2.50	4.60	2.50	2.10	1.70	1.40	1.20	1.05	1.15	1.50	1.50
22	2.00	2.45	4.80	2.45	2.00	1.60	1.40	1.20	1.00	1.10	1.50	1.50
23	2.00	2.40	4.30	2.40	2.00	1.60	1.50	1.20	1.00	1.10	1.30	1.50
24	2.20	2.35	3.70	3.00	2.00	1.60	1.50	1.20	1.00	1.10	1.20	1.90
25	2.05	2.30	3.60	2.90	2.00	1.50	1.50	1.20	1.00	1.10	1.20	1.90
26	2.00	3.40	3.60	2.80	1.90	1.80	1.50	1.20	1.00	1.10	1.20	1.90
27	2.00	7.00	4.00	2.80	1.90	1.70	1.50	1.20	1.00	1.05	1.20	1.80
28	1.95	3.50	3.60	2.60	1.90	1.60	2.00	1.30	1.00	1.05	1.50	1.70
29	1.90	.....	3.50	2.50	1.80	1.60	2.00	1.35	1.00	1.05	1.45	1.70
30	1.80	.....	3.40	2.40	1.80	1.60	1.60	1.50	1.00	1.00	1.30	1.50
31	2.00	.....	4.00	.....	1.80	.....	1.50	1.50	.....	1.00	.....	1.50

a River frozen.

LITTLE TENNESSEE RIVER AT JUDSON, NORTH CAROLINA.

This river rises in the mountains between North Carolina and Georgia, and flows in a northwesterly direction, emptying into Tennessee River at Lenoir, Tennessee. Measurements of flow are made at Judson, North Carolina, below the mouth of Sawyer Branch. The area drained is 682 square miles, which is largely mountainous and covered with a forest growth. It is mapped on the Nantahala, Cowee, and Walhalla atlas sheets. The station, as described in the Eighteenth Annual Report, Part IV, page 117, was established by E. W. Myers in June, 1896. It is located on the Southern Railway bridge about one-fourth of a mile from Judson, North Carolina. The river is straight for several hundred yards above and below the station; the bottom rocky and very rough on the west side and sandy on the east side. The current is swift and considerably obstructed by two old piers. The section is constant, but not a good one for measurements. The observer is R. C. Sawyer, a farmer at Judson, North Carolina. Records of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 117; 1897, Nineteenth Annual Report, Part IV, page 256; 1898, Twentieth Annual Report, Part IV, page 207. The following measurements were made by E. W. Myers and R. E. Shuford during 1899:

February 27, gage height, 10.25 feet; discharge, 21,880 second-feet.
June 20, gage height, 3.30 feet; discharge, 1,491 second-feet.
September 21, gage height, 2.23 feet; discharge, 339 second-feet.
September 27, gage height, 2.65 feet; discharge, 721 second-feet.
October 29, gage height, 2.84 feet; discharge, 896 second-feet.
December 6, gage height, 2.75 feet; discharge, 758 second-feet.

Daily gage height, in feet, of Little Tennessee River at Judson, North Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.52	3.56	4.82	4.78	3.78	2.38	3.14	3.70	4.32	2.48	2.48	2.72
2	3.59	3.59	4.39	4.50	3.76	2.47	3.40	3.68	4.21	2.46	2.49	2.72
3	3.59	4.98	3.98	3.99	3.80	2.40	3.33	3.68	3.17	2.46	2.40	2.70
4	3.57	11.38	3.74	3.82	3.92	2.37	3.30	3.64	3.80	2.45	2.41	2.70
5	3.58	10.58	3.72	3.81	5.68	2.38	3.27	3.62	3.81	2.42	2.72	2.70
6	3.52	9.72	3.64	3.80	4.93	2.34	3.28	3.58	3.70	2.39	2.74	2.58
7	4.23	11.40	3.64	3.78	4.80	2.31	4.42	3.47	2.91	2.39	2.69	2.59
8	4.23	9.58	3.68	3.72	3.91	2.30	3.90	3.28	2.46	3.71	2.68	2.52
9	3.98	8.56	3.67	3.72	3.90	2.29	3.18	2.71	2.33	5.58	2.64	2.50
10	3.92	7.51	3.61	3.70	3.82	2.29	3.10	2.70	2.32	4.31	2.64	2.62
11	3.84	5.32	3.61	3.68	3.71	2.27	2.90	4.98	2.32	3.72	2.63	2.62
12	3.84	5.32	3.62	3.69	3.70	2.91	2.71	4.57	2.28	3.20	2.62	2.60
13	3.80	4.58	3.64	3.49	3.68	6.71	2.71	3.38	2.27	2.58	2.62	2.70
14	3.71	3.72	9.55	3.48	3.60	6.70	2.70	2.92	2.25	2.51	2.62	8.40
15	3.70	3.71	7.42	3.46	3.62	5.82	2.68	2.88	2.25	2.50	2.64	6.50
16	3.69	3.70	8.93	3.48	3.80	5.40	2.69	2.88	2.24	2.50	2.63	4.51
17	3.68	3.68	6.81	3.52	3.82	3.58	3.48	2.64	2.22	2.48	2.58	3.92
18	3.69	3.68	4.58	3.52	3.71	3.41	3.30	2.63	2.25	2.49	2.59	2.94
19	3.69	3.72	13.00	3.51	3.74	3.40	3.10	2.60	2.28	2.52	2.57	2.94
20	3.69	3.74	12.00	3.48	3.78	2.56	2.93	2.60	2.28	2.52	2.57	2.90
21	3.66	3.74	8.55	3.49	3.52	2.58	2.84	2.48	2.23	2.57	2.49	2.53
22	3.68	3.70	6.54	3.61	2.90	2.47	3.91	2.42	2.20	2.60	2.54	2.52
23	3.67	3.69	4.88	3.60	2.80	2.75	4.28	2.41	2.21	2.60	2.70	2.41
24	3.67	3.68	4.32	3.72	2.50	2.70	4.20	2.41	2.21	2.50	2.71	2.40
25	3.69	3.60	4.28	3.72	2.47	3.15	3.90	2.40	2.26	2.50	2.77	2.42
26	3.58	3.65	3.92	3.70	2.46	3.10	3.90	2.39	2.65	2.50	2.89	2.42
27	3.52	10.25	4.78	3.78	2.30	3.00	3.91	2.38	2.50	2.50	3.42	2.43
28	3.59	6.72	4.74	3.74	2.31	3.31	3.88	2.37	2.41	2.60	3.50	2.41
29	3.58	.....	5.70	3.79	2.36	3.30	3.86	2.37	2.41	2.58	2.93	2.42
30	3.59	.....	5.90	3.76	3.36	3.00	3.86	2.24	2.40	2.57	2.90	2.42
31	3.57	.....	5.60	.....	2.84	.....	3.71	2.26	.....	2.57	.....	2.39

HIWASSEE RIVER AT MURPHY, NORTH CAROLINA.

Hiwassee River rises in the northern part of Georgia and flows through the southwestern corner of North Carolina into Tennessee, where it empties into Tennessee River. The watershed is broken and mountainous for the most part and well covered with forest. The area drained is 410 square miles, and is mapped on the Murphy, Nantahala, and Dahlonega atlas sheets. The river is measured at two places, Murphy, North Carolina, and Charleston, Tennessee, 17 miles above its mouth. The station at Murphy, described in the Eighteenth Annual Report, Part IV, page 117, is located on the highway bridge crossing the river at Murphy, North Carolina, one-half mile above Valley River, and was established by E. W. Myers July 26, 1896. The wire gage was last verified on December 29, 1899. The length of the gage is 29.10 feet. The section here is a fairly good one, though somewhat obstructed by the remains of two old piers directly under the present bridge. The course of the stream is straight for several hundred yards above and below the bridge, and the current fairly rapid. The bottom is hard and rocky and not subject to any decided change by high water. The observer is M. L. Brittain, Murphy, North Carolina. The results of measurements may be found as follows: 1896–97, Nineteenth Annual Report, Part IV, page 269; 1898, Twen-

tieth Annual Report, Part IV, page 209. The following measurements were made by E. W. Myers and R. E. Shuford in 1899:

February 28, gage height, 7.50 feet; discharge, 2,150 second-feet.
June 23, gage height, 5.17 feet; discharge, 400 second-feet.
June 23, gage height, 5.30 feet; discharge, 436 second-feet.
September 28, gage height, 4.93 feet; discharge, 304 second-feet.
September 28, gage height, 5.00 feet; discharge, 345 second-feet.
December 7, gage height, 5.10 feet; discharge, 317 second-feet.
December 29, gage height, 5.50 feet; discharge, 613 second-feet.

Daily gage height, in feet, of Hiwassee River at Murphy, North Carolina, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.80	5.60	6.90	6.80	5.85	5.30	-------	5.30	5.40	4.90	4.85	5.10
2	5.70	5.70	6.60	6.60	5.82	5.30	-------	5.20	5.25	4.80	4.90	5.35
3	5.70	5.70	6.70	6.50	5.80	5.30	-------	5.20	5.50	4.85	4.90	5.10
4	5.65	14.00	6.32	7.20	5.80	5.25	-------	5.15	5.30	4.75	4.90	5.10
5	5.60	9.60	7.40	6.55	6.10	5.25	-------	5.12	5.20	4.80	4.90	5.10
6	5.70	9.45	6.75	6.50	5.80	5.25	-------	5.20	5.10	4.90	4.90	5.02
7	6.30	9.90	6.50	6.55	5.85	5.10	-------	5.20	5.10	4.90	4.90	5.00
8	6.00	7.85	6.40	6.70	5.70	5.10	-------	5.20	5.15	5.70	4.90	5.10
9	5.90	7.20	6.40	6.60	5.70	5.20	5.20	5.12	5.05	5.15	4.90	5.05
10	5.80	6.75	6.30	6.50	5.70	5.15	5.10	5.15	5.00	5.00	4.90	5.10
11	5.80	6.60	6.20	6.40	5.62	5.10	5.10	5.15	5.20	5.02	4.90	5.10
12	5.80	6.55	6.10	6.30	5.62	5.82	5.05	5.10	5.10	5.00	4.85	9.10
13	5.70	6.30	6.10	6.20	5.60	5.80	5.00	5.10	5.00	4.90	4.85	6.30
14	5.70	6.40	6.75	6.20	5.55	5.50	5.00	5.05	5.00	4.80	4.90	5.82
15	5.75	6.40	10.80	6.10	5.60	5.35	5.00	5.20	5.00	5.00	4.90	5.70
16	5.75	6.30	8.75	6.10	5.50	5.25	5.00	5.32	4.90	5.00	4.90	5.50
17	5.75	6.25	7.50	6.05	5.50	5.30	5.10	5.20	5.00	5.00	4.90	5.40
18	5.70	6.25	7.10	6.00	5.50	5.20	5.30	5.10	5.00	4.95	4.90	5.40
19	5.70	6.00	18.40	6.00	5.60	5.20	5.20	5.00	5.00	5.10	4.85	5.30
20	5.70	6.10	8.70	6.00	5.50	5.15	5.10	5.00	5.10	5.00	4.85	5.50
21	5.70	6.10	7.60	6.00	5.45	5.10	5.30	5.00	5.00	5.00	4.90	5.40
22	5.60	6.10	7.20	5.90	5.40	5.10	5.30	5.00	5.00	4.90	4.90	5.35
23	5.60	6.00	8.15	5.90	5 40	5.10	5.30	5.00	5.00	4.90	5.40	5.30
24	5.52	5.92	7.00	5.90	5.42	4.85	5.20	5.00	5.00	4.90	5.12	6.30
25	5.65	6.10	6.80	6.70	5.40	4.95	5.20	5.10	5.00	4.90	5.10	5.70
26	5.60	6.00	6.60	6.10	5.40	5.05	6.80	5.05	5.00	4.90	5.75	5.60
27	5.60	9.10	6.52	6.00	5.35	5.00	5.75	5.25	5.02	4.90	5.40	5.50
28	5.60	7.30	6.50	6.00	5.35	5.00	5.90	5.45	5.00	5.00	5.30	5.55
29	5.50	-------	6.90	5.90	5.32	5.00	-------	5.10	5.00	5.10	5.20	5.50
30	5.50	-------	6.70	5.90	5.32	5.00	-------	5.10	4.88	4.90	5.10	5.35
31	5.90	-------	7.80	-------	5.30	-------	-------	5.70	-------	5.00	-------	5.40

No readings July 1 to 9; gage broken.

HIWASSEE RIVER AT CHARLESTON, TENNESSEE.

The gaging station on this river is located at the bridge of the Southern Railway 600 feet from the depot in the town of Charleston, Tennessee. It is 17 miles above the mouth of the river and 53 miles above Chattanooga, Tennessee. The drainage area is mapped on the Cleveland, Murphy, Ellijay, Nantahala, Dahlonega, Dalton, Loudon, and Kingston atlas sheets. This station was originally established by the United States Engineer Corps, but is now maintained as a half-year station by the United States Weather Bureau, gage heights being kept from November 1 to April 31, inclusive. The gage rod is fastened to the downstream end of the south pier of the bridge, 125 feet from the shore. It is painted white and marked in feet and tenths. The bench mark is a cross cut in the top surface of the upper corner stone of the

pier, and is 35.00 feet above the zero of the gage. The greatest height recorded at this point was on March 31, 1886, when the gage read 32.2 feet. The danger line is placed at 22 feet. The railroad bridge is an iron 3-span bridge, with a total length of 390 feet. There are embankments at each end which confine the water, even at the highest stages, within the banks. The observer is J. M. Bates, Charleston, Tennessee. The following measurements were made by Max Hall in 1899:

May 6, gage height, 3.65 feet; discharge, 6,684 second-feet.
May 25, gage height, 2.05 feet; discharge, 3,730 second-feet.
September 16, gage height, 0.35 foot; discharge, 1,366 second-feet.
October 27, gage height, 0.20 foot; discharge, 1,194 second-feet.

Daily gage height, in feet, of Hiwassee River at Charleston, Tennessee, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	Nov.	Dec.
1	2.60	4.30	7.20	9.40	0.50	1.00
2	2.80	3.40	5.90	7.20	.40	.80
3	2.40	3.10	5.30	6.10	.40	1.20
4	2.30	16.00	5.30	6.40	.40	1.00
5	2.30	21.60	7.30	7.90	.40	.80
6	4.00	18.60	8.90	6.50	.30	.70
7	8.30	22.40	8.10	6.30	.30	.70
8	6.70	20.90	7.50	11.00	.30	.60
9	4.90	16.50	5.60	7.80	.30	.60
10	3.90	13.50	4.50	7.10	.30	.60
11	3.40	8.90	4.30	6.00	.30	.60
12	3.50	5.90	4.00	5.60	.30	3.00
13	3.10	5.00	3.90	5.30	.30	7.00
14	2.90	3.70	5.70	5.00	.30	2.90
15	3.00	4.30	24.20	4.80	.30	2.10
16	2.90	4.80	27.30	4.60	.50	1.80
17	3.20	6.90	20.00	4.40	.50	1.40
18	3.30	5.60	14.40	4.10	.40	1.30
19	3.00	5.90	24.00	4.00	.40	1.30
20	2.80	5.30	27.60	4.00	.30	1.80
21	2.60	4.70	19.90	3.90	.30	2.00
22	2.50	4.60	16.60	3.70	.30	1.50
23	2.40	4.60	16.00	3.50	.70	1.40
24	2.40	4.20	13.00	4.50	1.70	3.20
25	2.70	3.90	8.70	4.60	1.00	3.70
26	2.70	3.70	7.60	6.00	.90	2.50
27	2.40	7.50	7.00	4.50	1.70	2.00
28	2.30	11.50	7.50	4.00	1.50	1.90
29	2.20	------	10.60	3.70	1.20	2.00
30	2.20	------	8.60	3.60	1.00	1.70
31	2.40	------	8.00	------	------	1.10

No readings May 1 to October 31.

A measurement of Hiwassee River at Reliance, Tennessee, was made by Max Hall, October 25, 1899: Gage height, 2.60 feet; discharge, 607 second-feet.

TOCCOA RIVER AT BLUERIDGE, GEORGIA.

This stream has its source on the northern slopes of the Blue Ridge Mountains, in Georgia, and flows northwesterly into Hiwassee River. The area is covered with a fine growth of oak, hickory, and other hard woods, and is mapped on the Ellijay and Dahlonega atlas sheets. The station, established by B. M. Hall on November 25, 1898, is located at the Morganton bridge, about 4 miles east of the town of Blueridge, Georgia. The gage is a 14-foot rod, in two 7-foot sections, nailed to a

tree on the right bank just below the bridge. It is graduated to feet and tenths, and is set to conform to bench marks which were established October 15, 1896, and October 26, 1898. The measurements during 1896 were made at the railroad bridge about 3 miles below, but are referred to the present gage by comparison of the bench marks at the two bridges. The bench mark at Morganton bridge is on the top of the bridge floor, on the downstream side, 50 feet from the initial point, and is 18.00 feet above zero of gage. This bridge is a wooden, queen-post, open bridge, in three spans, with a total length between abutments of 153 feet. The width of the river, including the two piers, at ordinary stages is 143 feet between banks, the three channels being 50, 38, and 33 feet. The observer is M. V. Pressley, a mail carrier who crosses the bridge twice daily, except on Sundays; no readings are had on this day, but figures have been interpolated. The following measurements were made by B. M. Hall and Max Hall during 1899:

April 28, gage height, 3.50 feet; discharge, 1,141 second-feet.
June 16, gage height, 2.70 feet; discharge, 522 second-feet.
September 18, gage height, 1.93 feet; discharge, 242 second-feet.
October 24, gage height, 1.90 feet; discharge, 222 second-feet.

Daily gage height, in feet, of Toccoa River at Blueridge, Georgia, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.10	3.20	4.30	4.20	3.70	3.00	2.50	2.60	2.80	2.00	2.10	2.40
2	3.00	3.20	4.00	3.60	3.50	2.10	2.45	2.60	2.40	2.00	2.00	2.20
3	2.90	3.30	4.10	3.11	3.50	2.10	2.40	2.50	2.40	1.90	2.00	2.10
4	2.90	5.90	4.10	4.60	3.40	2.20	2.40	2.50	2.50	1.90	2.00	2.10
5	2.10	6.70	4.00	4.40	3.10	3.00	2.50	2.50	2.40	1.90	2.00	2.10
6	3.02	8.90	4.00	3.90	3.60	2.90	2.80	2.50	2.40	2.00	2.00	2.00
7	3.04	6.10	3.80	4.50	3.40	2.90	2.70	2.50	2.30	3.00	2.00	2.00
8	3.08	5.50	3.70	4.80	3.20	2.90	2.80	2.40	2.30	2.80	2.10	2.00
9	3.10	5.00	3.60	4.00	3.20	2.70	2.75	2.30	2.30	2.60	2.10	2.00
10	3.10	4.00	3.10	4.00	3.10	2.70	2.75	2.30	2.50	2.30	2.10	2.50
11	3.20	3.70	3.00	3.10	3.00	2.70	2.70	2.30	2.60	2.10	2.10	3.60
12	3.00	3.80	3.50	3.90	3.00	3.40	2.70	2.60	2.50	2.00	2.10	3.50
13	3.00	3.90	4.00	3.80	3.00	3.20	2.80	3.40	2.30	2.00	2.00	3.30
14	3.10	4.00	4.00	3.70	3.00	3.00	2.70	3.40	2.30	2.00	2.00	2.90
15	3.10	4.00	4.90	3.70	3.00	2.10	2.60	3.40	2.20	2.00	2.10	2.80
16	3.10	4.10	6.00	3.60	3.00	2.70	2.40	3.20	2.20	2.00	2.10	2.50
17	3.20	3.10	4.40	3.60	3.00	2.60	2.40	2.40	2.10	2.00	2.00	2.40
18	3.10	3.30	4.00	3.60	3.00	2.60	2.80	2.40	2.30	2.00	2.00	2.30
19	3.00	3.40	4.50	3.60	3.30	2.60	2.70	2.40	2.30	2.00	2.00	2.60
20	3.00	3.60	5.00	3.60	3.00	2.60	2.70	2.20	2.00	2.00	2.00	2.60
21	2.10	3.50	4.80	3.60	3.20	2.50	2.80	2.20	2.00	2.00	2.00	2.50
22	3.00	3.60	4.60	3.60	3.20	2.45	2.80	2.20	2.00	2.00	2.00	2.40
23	3.80	3.50	5.60	3.80	3.10	2.60	2.60	2.30	2.00	2.00	2.00	2.50
24	3.10	3.40	5.00	4.00	3.10	2.10	2.50	2.20	2.00	2.00	2.00	.....
25	3.20	3.40	4.50	5.30	3.10	2.40	2.80	2.30	2.00	2.00	2.00	.....
26	3.10	4.00	4.20	4.10	3.10	2.70	2.80	2.20	2.00	2.00	2.30	.....
27	2.10	5.80	4.00	4.60	3.10	2.90	3.90	2.40	2.00	2.00	2.60	.....
28	2.10	4.90	4.00	3.10	3.00	2.85	3.60	2.60	2.00	2.00	2.30	.....
29	2.09	.....	4.00	3.00	3.00	2.70	2.80	2.50	2.00	2.20	3.20	.....
30	2.80	.....	4.00	3.30	3.10	2.60	2.80	2.60	2.00	2.40	3.10	.....
31	4.00	.....	4.80	.....	3.11	.....	2.80	2.70	.....	2.20	.....	.....

TENNESSEE RIVER AT KNOXVILLE, TENNESSEE.

This river is formed by the junction of French Broad and Holston rivers 4 miles above Knoxville. The drainage basin is mapped on Knoxville, Maynardsville, Morristown, Jonesville, Estillville, Bristol,

Abingdon, Tazewell, Pocahontas, Greenville, Asheville, Roan Mountain, Cranberry, Mount Guyot, Mount Mitchell, Morganton, Saluda, Pisgah, Cowee, and Wytheville atlas sheets. The station was originally established by the United States Weather Bureau, and was located at the old county highway bridge at Knoxville, which has lately been torn down. The new gage is situated at the Augusta and Knoxville Railroad bridge. The datum of the new gage is 0.6 of a foot higher than that of the old one, so that this amount has to be added to the new readings to make them conform to the old standard. This correction has been applied to the published heights of the Weather Bureau and of this Survey, both in the table of gage heights and in the list of discharge measurements. Measurements of discharge are made at the Cherokee highway bridge 2¼ miles below the gage, as there is at that point a better section for meter measurements. This bridge is a three-span iron bridge, and the width of water surface at low stages under it is 550 feet. The bridge is about 80 feet above low water. The following measurements were made by Max Hall during 1899:

May 4, gage height, 1.90 feet; discharge, 12,810 second-feet.
May 25, gage height, 1.70 feet; discharge, 10,134 second-feet.
September 16, gage height, 0.10 foot; discharge, 3,912 second-feet.
October 26, gage height,—0.60 foot; discharge, 2,728 second-feet.

Daily gage height, in feet, of Tennessee River at Knoxville, Tennessee, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	(a)	1.20	9.20	8.00	2.30	1.50	1.20	1.00	0.80	—0.10	—0.20	0.30
2	(a)	1.20	6.80	6.60	2.20	1.10	.90	.80	1.60	— .20	+ .40	.30
3	(a)	1.40	6.40	5.60	2.00	1.70	.60	.70	1.40	— .30	.50	.30
4	(a)	8.60	14.00	5.80	2.00	1.60	.40	.60	.80	— .30	.50	.40
5	(a)	16.70	14.40	8.20	2.40	1.40	.20	.40	.60	— .40	.50	.30
6	(a)	18.70	19.20	7.60	2.60	1.20	.40	.30	.40	— .40	.40	.30
7	(a)	22.50	16.40	6.00	3.80	1.10	.30	.20	.30	— .50	.30	.10
8	(a)	22.20	9.00	5.90	4.40	.90	.30	.20	.30	— .30	.10	.10
9	(a)	16.00	6.70	6.50	5.40	.90	.40	.20	.30	— .20	.00	.00
10	(a)	9.40	6.10	7.30	5.20	1.10	.40	.30	.30	— .60	— .10	— .10
11	(a)	6.00	5.10	6.20	4.40	1.20	.40	.30	.40	+ .80	— .20	— .20
12	(a)	5.00	4.60	5.20	4.00	1.40	.50	.70	.70	.70	— .20	.00
13	(a)	4.20	4.20	4.80	4.30	1.70	.30	.80	.60	.40	— .30	4.60
14	(a)	3.60	3.90	4.50	4.40	3.00	.20	.80	.40	.30	— .30	5.30
15	(a)	2.00	11.50	4.00	4.80	3.10	.10	.60	.30	.20	— .40	4.90
16	(a)	2.40	20.40	3.80	4.80	3.70	.00	.60	.20	.10	— .50	3.30
17	2.40	3.40	17.40	3.50	3.00	2.40	.00	.50	.10	.00	— .50	2.60
18	2.50	7.00	11.00	3.20	2.40	2.00	.10	.30	.00	— .10	— .60	1.90
19	2.40	6.60	18.00	2.90	2.20	1.60	.20	.20	— .10	— .10	— .60	1.80
20	2.20	5.70	28.00	2.80	2.10	1.40	.40	.10	.00	— .20	— .60	1.80
21	2.10	4.80	25.40	2.60	1.90	1.20	.40	.00	.20	— .20	— .70	1.60
22	1.80	4.30	13.60	2.50	1.80	1.00	.40	.10	.50	— .30	— .70	1.90
23	1.60	4.40	10.10	2.30	1.80	.90	.30	.20	.40	— .30	— .70	1.80
24	1.50	4.40	7.80	2.20	1.70	.70	.20	.30	.20	— .40	— .60	2.10
25	1.50	3.90	7.00	2.40	1.70	.80	.30	.40	.00	— .50	— .50	3.40
26	1.60	3.50	6.50	2.60	1.60	1.20	.30	.40	.00	— .50	— .50	3.70
27	1.60	5.20	7.60	3.00	1.40	1.00	1.40	.50	.20	— .60	— .40	3.20
28	1.50	9.40	9.20	2.70	1.30	1.10	1.30	.60	.20	— .60	— .20	2.50
29	1.30	.....	12.20	2.60	1.20	1.60	2.10	.60	.10	— .60	+ .20	2.20
30	1.20	.....	12.10	2.50	1.20	1.40	2.60	.00	.00	— .40	.30	1.70
31	1.20	.....	10.40	.....	1.30	.....	1.40	.00	.....	— .40	.....	1.70

a January 1 to 16, no readings; gage obstructed by false work of new bridge.

Clinch River, a tributary of Tennessee River, was measured at Clinton, Tennessee, on May 5, at a gage height of 7.55 feet, and showed a discharge of 5,220 second-feet.

TENNESSEE RIVER AT CHATTANOOGA, TENNESSEE.

This river, after passing Chattanooga, enters Alabama. It then makes a bend to the west and later to the north, returning to Tennessee. Flowing through this State and Kentucky, it empties into the Ohio 50 miles above Cairo. In 1879 a gage was established at Chattanooga, Tennessee, at the foot of Lookout street, just below Chattanooga Island, by the Signal Corps of the United States Army, which has been in charge of the Weather Bureau since July 1, 1891. The drainage area above this station is 21,382 square miles, and is mapped on Morristown, Greenville, Roan Mountain, London, Knoxville, Mount Guyot, Asheville, Murphy, Briceville, Standingstone, Wartburg, Pikeville, Maynardville, Cumberland Gap, Jonesville, Estillville, Bristol, Whitesburg, Grundy, Abingdon, Tazewell, Pocahontas, Wytheville, Cranberry, Morganton, Mount Mitchell, Saluda, Pisgah, Como, Nantahala, Walhalla, Dahlonega, Ellijay, Dalton, Cleveland, Ringgold, Kingston, and Chattanooga atlas sheets. The gage is on an inclined railroad iron for about 20 feet of its lower portion. Above this it is a vertical rod bolted to the rock bluff forming the river bank. The zero of the gage is 630.64 feet above sea level. Measurements are made from the Hamilton County steel highway bridge at the foot of Walnut street, a short distance below the gage. Gage heights are obtained from L. M. Prindell, United States Weather Bureau observer. Records of measurement may be found as follows: 1890 to 1895, Eighteenth Annual Report, Part IV, page 120; 1896–97, Nineteenth Annual Report, Part IV, page 261; 1898, Twentieth Annual Report, Part IV, page 210. The following measurements were made by Max Hall and others during 1899:

May 3, gage height, 6.71 feet; discharge, 37,770 second-feet.
May 26, gage height, 4.76 feet; discharge, 25,526 second-feet.
June 21, gage height, 4.15 feet; discharge, 21,391 second-feet.
September 15, gage height, 1.90 feet; discharge, 10,819 second-feet.
October 27, gage height, 0.80 foot; discharge, 6,566 second-feet.

East Chickamauga Creek, a tributary of the Tennessee, was measured at Anderson upper ford, 3 miles from Ringgold, Georgia, October 26, and gave a discharge of 35 second-feet.

Daily gage height, in feet, of Tennessee River at Chattanooga, Tennessee, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.75	5.70	19.25	22.80	7.60	4.15	3.45	4.20	2.20	1.20	1.10	1.70
2	4.95	5.65	17.60	19.50	7.10	4.25	3.30	3.55	2.35	1.10	1.10	1.70
3	5.30	5.60	15.15	14.90	6.70	4.40	3.05	3.05	2.80	1.05	1.05	1.70
4	5.80	10.70	14.15	12.95	6.30	4.85	2.80	2.75	3.05	.95	1.10	1.70
5	5.95	23.10	17.95	13.25	6.15	4.65	2.60	2.45	2.65	.90	1.50	1.80
6	7.25	30.45	24.50	14.70	7.10	4.25	2.60	2.45	2.25	.80	1.50	1.70
7	18.80	34.30	26.55	15.70	8.50	4.05	2.65	2.40	1.95	.85	1.50	1.60
8	18.40	36.95	27.60	18.05	9.35	3.75	3.05	2.40	1.80	1.00	1.45	1.50
9	17.35	38.25	27.70	17.75	10.00	3.55	2.90	2.25	1.60	1.15	1.35	1.40
10	17.15	36.75	16.15	15.70	10.70	3.40	2.60	2.10	1.80	1.60	1.20	1.40
11	13.85	30.30	11.85	14.20	11.15	3.90	2.55	2.10	1.70	1.80	1.15	1.60
12	10.50	19.35	10.60	12.90	10.40	4.30	2.45	2.00	2.00	1.85	1.10	5.20
13	9.15	12.15	9.55	11.65	9.60	5.25	2.30	2.00	1.80	1.70	1.00	6.45
14	8.10	9.50	11.20	10.70	9.30	5.80	2.20	2.25	2.00	1.65	1.00	7.40
15	7.55	8.50	24.55	10.00	9.55	6.45	2.15	2.65	1.85	1.40	1.00	7.15
16	7.30	7.55	34.25	9.40	9.20	6.10	1.95	2.65	1.65	1.25	1.00	6.20
17	7.40	7.95	36.90	8.75	8.70	6.40	1.90	2.40	1.45	1.15	1.00	5.20
18	7.45	9.55	36.15	8.40	7.75	6.20	1.80	2.30	1.35	1.15	1.00	4.25
19	7.25	11.30	35.85	8.00	6.90	5.25	1.90	2.15	1.20	1.10	1.00	3.85
20	7.00	12.65	37.05	7.55	6.40	4.70	2.05	1.90	1.05	1.10	.95	4.25
21	6.80	11.50	39.20	7.35	5.90	4.20	2.05	1.70	1.00	1.10	.85	4.40
22	6.45	10.65	40.00	7.05	5.60	3.75	2.40	1.60	1.05	1.10	.85	4.40
23	5.90	10.10	38.70	7.85	5.35	3.50	2.70	1.45	1.30	1.05	1.00	4.15
24	5.65	9.75	32.70	9.65	5.30	3.25	3.50	1.30	1.50	1.00	1.15	5.65
25	6.05	9.50	23.15	9.35	5.05	3.15	3.40	1.20	1.50	.95	1.30	6.15
26	6.35	9.20	16.30	10.75	4.80	3.00	3.00	1.20	1.45	.85	1.70	6.30
27	5.85	13.20	13.65	10.30	4.65	3.25	3.05	1.20	1.30	.80	1.80	5.85
28	5.75	18.45	13.95	9.20	4.40	3.65	3.65	1.25	1.20	.80	1.85	5.55
29	5.55	-------	17.30	8.35	4.30	3.50	4.25	1.50	1.25	.90	1.80	5.10
30	5.30	-------	21.20	7.75	4.20	3.30	4.25	1.85	1.30	1.00	1.75	4.65
31	5.30	-------	22.80	-------	4.25	-------	5.15	1.75	-------	1.05	-------	3.85

OLENTANGY RIVER AT COLUMBUS, OHIO.

This river rises in the north-central part of Ohio and flows in a southerly direction into the Scioto at Columbus. Its watershed is in general flat and for the most part cultivated. Systematic measurements were begun in Columbus on November 22, 1898, when the station at the Fifth avenue bridge was established by H. A. Pressey, Prof. C. N. Brown, and B. H. Flynn. The gagings are made on the upstream side of the bridge, the initial point being on the left bank. A wooden post, graduated to feet and tenths, was driven in the bed of the stream near the bridge as a gage, and referred to a scale cut in the face of the left abutment, from which high-water readings can be taken directly. The observations of river heights are made under the direction of Prof. C. N. Brown, of the Ohio State University. The students in civil engineering have for the last two years studied the rainfall and run-off of the basin of the Olentangy and Scioto rivers. A description of the watershed and the results of observations may be found in the Twentieth Annual Report, Part IV, page 215. The following measurements were made during 1899:

Measurements of Olentangy River at Columbus, Ohio.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.	*Feet.*	*Sec.-feet.*	1899.	*Feet.*	*Sec.-feet.*
Jan. 5	5.71	5,335	Mar. 25	3.25	1,717
Jan. 15	7.90	9,236	Mar. 27	3.15	1,546
Mar. 15	1.87	387	Mar. 31	3.67	2,221
Mar. 16	1.97	477	Apr. 6	1.70	326
Mar. 20	3.58	2,356	Apr. 17	1.45	180
Mar. 22	2.95	1,430	Apr. 22	1.33	126
Mar. 24	4.54	3,174	Sept. 16	0.90	5
Do	4.21	2,910			

Daily gage height, in feet, of Olentangy River at Columbus, Ohio, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.95	1.55	2.65	3.76	1.24	2.20	1.15	1.20	1.10	1.00	1.10	1.10
2	1.70	1.55	2.65	2.80	1.28	2.50	1.10	1.20	1.10	1.00	1.10	1.10
3	2.10	1.55	2.57	2.24	1.19	3.00	1.10	1.20	1.10	1.00	1.15	1.20
4	1.94	1.55	2.90	1.98	1.27	2.55	1.10	1.40	1.10	1.00	1.20	1.20
5	5.53	1.55	4.37	1.82	1.27	2.00	1.10	1.50	1.10	1.00	1.20	1.20
6	5.17	1.55	4.25	1.73	1.17	1.75	1.10	3.10	1.10	1.00	1.20	1.20
7	3.80	1.55	3.00	1.70	1.60	1.85	1.10	2.45	1.10	1.00	1.20	1.20
8	2.57	1.55	2.14	2.00	1.56	1.55	1.10	2.10	1.10	1.00	1.20	1.20
9	2.18	1.55	2.07	2.45	1.38	1.45	1.10	1.75	1.10	1.00	1.20	1.20
10	2.06	1.55	2.07	2.45	1.28	1.50	1.10	1.45	1 00	1.00	1.20	1.20
11	1.87	1.55	2.32	2.05	1.34	1.40	1.10	1.40	1.00	1.00	1.10	1.20
12	1.77	1.55	2.80	1.83	1.18	1.40	1.10	1.35	1.00	1.00	1.10	1.55
13	1.90	1.55	2.57	1.72	1.27	1.30	1.10	1.30	1.00	1.00	1.10	1.90
14	8.45	1.55	2.20	1.75	1.20	1.30	1.15	1.25	1.00	1.00	1.20	1.90
15	8.20	1.55	1.90	1.66	1.20	1.30	1.10	1.20	1.00	1.00	1.20	1.50
16	5.90	1.55	1.88	1.55	1.20	1.20	1.30	1.20	1.00	1.00	1.20	1.45
17	4.07	1.55	1.98	1.48	1.14	1.20	1.35	1.20	1.00	1.00	1.20	1.50
18	2.98	1.55	1.87	1.42	1.17	1.30	1.30	1.20	1.00	1.00	1.20	1.50
19	2.53	2.22	3.42	1.40	1.27	1.25	1.40	1.20	1.00	1.00	1.20	1.90
20	2.10	2.17	3.65	1.36	1.20	1.25	1.55	1.10	1.00	1.00	1.20	3.30
21	1.98	1.87	3.04	1.35	1.25	1.30	1.45	1.10	1.00	1.00	1.20	2.75
22	1.88	2.38	2.80	1.33	1.30	1.45	1.30	1.10	1.00	1.00	1.20	2.20
23	1.80	3.92	5.19	1.29	1.40	2.35	1.30	1.10	1.00	1.00	1.20	1.85
24	1.80	2.87	4.43	1.30	1.25	1.90	1.25	1.10	1.00	1.00	1.20	1.80
25	1.87	1.88	3.38	1.31	1.20	1.65	1.40	1.10	1.00	1.00	1.20	1.80
26	1.80	1.87	3.67	1.27	1.20	1.45	1.50	1.10	1.00	1.00	1.20	1.80
27	1.78	3.97	3.48	1.31	1.25	1.25	1.30	1.10	1.00	1.00	1.20	1.80
28	1.55	3.52	3.64	1.45	1.25	1.20	1.30	1.10	1.00	1.05	1.20	1.80
29	1.55	-------	3.73	1.35	1.35	1.20	1.20	1.10	1.00	1.10	1.15	1.80
30	1.55	-------	3.12	1.30	1.60	1.20	1.20	1.10	1.00	1.10	1.10	1.80
31	1.87	-------	3.64	-------	1.95	-------	1.20	1.10	-------	1.10	-------	1.80

SCIOTO RIVER AT COLUMBUS, OHIO.

This river drains the central portion of the State of Ohio, and flows in a general southerly direction into Ohio River near the city of Portsmouth. Its watershed is flat and highly cultivated above Columbus, while in the southern part it is hilly, with comparatively little cultivation. A description of the watershed and results of measurements may be found in the Twentieth Annual Report, Part IV, page 212. Systematic measurements were begun at Columbus November 22, 1898, when a station was established by H. A. Pressey, Prof. C. N. Brown, and B. H. Flynn. It is located at the Grandview avenue bridge in Columbus. The wire gage is located on the upstream side of the bridge, and is referred to a scale cut in the face of the left abutment, from which high-water readings can be taken directly. The river bed at the station is rocky. The banks are naturally low, but levees have been built on each side in order to prevent overflow; high water seldom reaches the top of the levees, but occasionally they are overflowed. The following measurements were made under the direction of Prof. C. N. Brown during 1899:

Measurements of Scioto River at Columbus, Ohio.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.	*Feet.*	*Sec.-feet.*	1899.	*Feet.*	*Sec.-feet.*
Jan. 15	19.50	13,895	Mar. 27	14.05	3,379
Jan. 20	13.00	2,291	Mar. 29	14.56	3,894
Mar. 6	15.50	5,367	Apr. 5	11.76	982
Mar. 8	13.35	2,457	Apr. 8	11.94	1,116
Mar. 9	12.89	1,995	Apr. 14	11.30	668
Mar. 17	11.61	942	Apr. 16	11.02	531
Mar. 20	14.05	3,271	Apr. 18	10.72	341
Mar. 22	14.30	3,905	Apr. 22	9.90	236
Mar. 24	15.00	4,526	Apr. 26	9.80	203
Do	14.57	4,050	Sept. 16	9.10	23
Mar. 25	14.58	3,919			

Daily gage height, in feet, of Scioto River at Columbus, Ohio, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	11.25	10.65	13.80	14.15	9.60	10.35	9.10	9.50	9.10	9.05	9.45	9.45
2	11.30	10.80	13.60	13.30	9.75	10.35	9.00	9.40	9.10	9.20	9.35	9.40
3	10.95	10.50	13.15	12.70	9.85	10.70	9.10	9.40	9.00	9.25	9.30	9.40
4	11.50	10.45	13.65	12.10	9.80	10.90	9.10	9.30	9.00	9.20	9.35	9.35
5	16.00	10.35	15.85	11.75	9.70	10.40	9.10	9.35	9.00	9.20	9.40	9.30
6	15.75	10.40	15.65	11.50	9.65	10.20	9.10	12.70	9.00	9.10	9.35	9.30
7	14.25	10.40	14.55	11.40	9.60	10.00	9.50	11.95	9.00	9.00	9.40	9.40
8	13.50	10.35	13.60	11.95	9 85	9.70	9.30	11.10	9.00	9.00	9.30	9.30
9	13.25	10.30	13.00	12.25	9.75	9.70	9.05	10.65	9.00	9.00	9.25	9.30
10	12.25	10.30	12.55	12.15	9.70	9.65	8.90	10.20	9.00	9.05	9.25	9.30
11	11.45	10.40	12.80	11.85	9.70	9.55	8.90	9.95	9.00	9.10	9.35	9.35
12	11.20	10.40	13.05	11.55	9.75	9.45	9.00	9.75	9.00	9.10	9.25	9.50
13	11.70	10.30	12.90	11.35	9.80	9.40	9.00	9.55	9.00	9.10	9.15	9.65
14	20.30	10.30	12.45	11.30	9.70	9.40	9.30	9.45	8.95	9.10	9.30	10.10
15	19.65	10.30	11.95	11.15	9.60	9.50	9.35	9.35	8.95	9.10	9.25	10.00
16	17.85	10.25	11.85	10.95	9.60	9.40	9.50	9.30	9.00	9.10	9.20	9.90
17	16.80	10.20	11.65	10.85	9.60	9.30	9.75	9.30	9.05	9.10	9.30	9.80
18	15.40	10.80	12.25	10.70	9.55	9.25	9.95	9.20	9.10	9.15	9.30	9.80
19	14.05	11.10	14.30	10.70	9.60	9.20	9.85	9.20	9.00	9.15	9.30	9.95
20	13.10	11.25	14.10	10.50	9.60	9.25	9.90	9.20	8.90	9.15	9.30	11.55
21	12.55	11.40	13.95	10.15	9.60	9.20	9.90	9.20	8.95	9.10	9.35	11.30
22	11.95	12.60	14.20	9.75	9.70	9.20	9.65	9.10	9.05	9.10	9.45	11.20
23	11.65	13.45	16.40	9.85	9.55	9.20	9.60	9.10	9.05	9.10	9.30	10.85
24	11.50	12.60	14.95	9.80	9.55	9.20	9.50	9.00	9.05	9.10	9.25	10.55
25	11.55	12.25	14.60	9.80	9.50	9.15	10.35	9.10	9.00	9.10	9.25	10.30
26	11.40	12.85	15.45	9.85	9.40	9.10	9.75	9.10	9.00	9.10	9.35	10.25
27	11.10	15.15	14.25	9.80	9.40	9.15	10.20	9.10	9.00	9 10	9.30	10.15
28	10.65	14.25	15.05	9.75	9.40	9.10	10.05	9.10	9.05	9.25	9.30	10.10
29	10.80	-------	14.85	9.70	9.50	9.10	9.75	9.10	9.00	9.40	9.35	10.10
30	11.00	-------	14.00	9.70	9.50	9.10	9.70	9.10	9.00	9.40	9.30	9.95
31	11.05	-------	14.90	-------	9.75	-------	9.65	9.10	-------	9.40	-------	9.90

LAKE SUPERIOR OUTFLOW.

In December, 1895, and January, 1896, the United States engineers measured the outflow of Lake Superior under each of the spans of the international bridge.[1] From these and other measurements made at Spry's dock, about a mile below the rapids, the discharge at various stages of the river was computed as shown in the following table:

Discharge of St. Marys River at various stages.

Stage of river.	Discharge.
Feet.	*Second-feet.*
600.6	57,440
601.2	67,310
602.0	81,210
603.0	99,770

[1] From report by Alfred Noble, civil engineer, May 25, 1897, in Report on Compensating Works, Michigan Lake Superior Power Company, Sault Ste. Marie, Michigan, September, 1899.

It is proposed to withdraw from St. Marys River about 30,000 second-feet by a canal traversing the city of Sault Ste. Marie, Michigan, pass it through turbines installed below the Government pier and return it to the river. The turbine shafts are to be coupled directly to electric generators which are to develop 40,000 effective horsepower. The section of this canal in rock will be about 200 feet wide and carry 22 feet of flowing water. The available head has been assumed to be 19 feet, and from this a little less than 3 feet is deducted for losses by friction and other causes, leaving an effective head of a trifle over 16 feet, as given by the report of Mr. H. von Schon.

The above-described measurements were made by Mr. E. E. Haskell, assistant engineer, and briefly noted in the annual report of the Chief of Engineers, United States Army, 1896, page 4027. In the next annual report, that for 1897, on pages 4092 to 4104, are details of measurements made by Mr. E. E. Haskell during February and March, 1896. The discharge section was in the reach of river extending from the foot of St. Marys Rapids to the head of Little Rapids. It began at the foot of Spry's dock on the American side of the river and ended at Plummer's dock on the Canadian side. The total water width at this point is 2,483 feet. The river was frozen at the time of making observations, and the section was sounded and current observations made through the ice. At this time the attempt was made to measure low velocities by means of a hydrometric pendulum, but the results obtained with this instrument were not satisfactory. It was found that the friction caused by the ice was practically 31 per cent of that caused by the bottom. The discharges as measured varied from 60,470 to 77,290 second-feet.

In addition to the measurements of the outflow of Lake Superior similar work has been done on the St. Clair and Niagara rivers, results of which are to appear in the annual report of the Chief of Engineers for the year ending June 30, 1900. Investigations of Detroit and St. Lawrence rivers and additional details concerning St. Marys River are being obtained for publication a year later.

MAUMEE RIVER AT WATERVILLE, OHIO.

Maumee River is formed by the junction of St. Joseph and St. Marys rivers near Fort Wayne, Indiana, and flows in a northeasterly direction through Ohio, emptying into Lake Erie at Toledo. The southern part of the watershed is flat, the northern part being gently rolling and hilly in places. Formerly the hilly section was covered with timber, all of the best of which has been cut, leaving a section of scrub timber, with occasional farms cleared and cultivated. At the station the bed of the stream is rocky and the current sluggish, the fall being only 1.1 feet per mile on an average. Two dams have been built on the Maumee—one at Defiance, to supply water for the Ohio State

canals, and one at Grand Rapids for furnishing water power. A station was established on this river by H. A. Pressey and B. H. Flynn November 19, 1898. It is located at the highway bridge near Waterville, the gagings being made on the downstream side of the bridge. Zero of gage is on the left bank, marked by a nail in the guard rail. The wire gage is referred to a bench mark cut in the upstream side of the abutment on the left bank of the river. The elevation is 25.2 feet above gage datum. This is the lowest place on the river at which gagings can be made without being affected by backwater from the lake. The observer is J. E. Harper, station agent at Waterville, Ohio. Two measurements of discharge were made by B. H. Flynn and H. A. Pressey during 1899, as follows: The first, on March 3, at a gage height of 6.18 feet, gave a discharge of 15,490 second-feet; the second, on September 25, at a gage height of 2.15 feet, gave a discharge of 125 second-feet.

Daily gage height, in feet, of Maumee River at Waterville, Ohio, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.35	3.00	7.60	5.70	3.00	3.05	2.10	2.25	2.40	2.00	2.35	2.30
2	4.35	3.15	7.70	5.25	2.95	3.00	2.10	2.35	2.45	2.00	2.45	2.20
3	4.05	3.35	6.10	5.50	3.00	3.00	2.05	2.35	2.45	2.00	2.50	2.20
4	4.30	3.35	6.85	5.20	2.85	3.15	2.05	2.35	2.40	2.00	2.40	2.15
5	5.15	3.45	6.75	5.25	2.80	3.25	1.95	2.25	2.55	2.00	2.40	2.10
6	5.70	2.75	6.85	5.10	2.80	3.10	2.05	3.55	2.70	2.00	2.35	2.10
7	5.50	3.20	6.55	4.90	2.80	3.20	2.05	4.05	2.65	2.00	2.45	2.05
8	5.15	3.80	5.60	4.90	2.95	3.10	2.10	3.75	2.55	2.00	2.60	2.00
9	4.40	3.80	5.10	4.80	3.15	3.00	2.05	3.70	2.50	2.10	2.90	2.00
10	4.45	3.80	4.80	4.70	3.25	2.95	2.10	3.60	2.40	2.10	2.90	2.00
11	4.45	3.80	5.35	4.55	3.05	2.95	1.90	3.60	2.35	2.00	2.85	2.10
12	4.10	3.80	7.00	4.30	2.95	2.95	2.00	3.60	2.30	2.00	2.90	2.20
13	3.80	3.80	8.70	4.20	2.75	2.85	2.05	3.50	2.25	2.00	2.75	2.25
14	5.00	3.80	7.75	4.20	3.05	2.80	1.90	3.40	2.20	2.00	2.75	2.30
15	8.50	3.80	6.95	4.10	3.35	2.55	1.85	3.40	2.15	1.90	2.60	2.40
16	9.50	3.80	6.30	3.20	3.30	2.50	1.80	3.05	2.10	1.90	2.50	2.45
17	9.65	3.80	6.90	3.75	3.30	2.40	1.85	2.80	2.10	1.95	2.35	2.60
18	8.80	3.80	5.95	3.65	3.15	2.35	2.05	2.55	2.00	2.10	2.25	2.75
19	7.85	3.50	7.35	3.45	3.25	2.40	2.40	2.30	2.00	2.15	2.20	3.05
20	6.55	2.95	9.25	3.50	3.35	2.30	2.80	2.20	2.00	2.20	2.20	3.90
21	5.65	3.00	9.50	3.15	3.15	2.15	2.75	2.20	2.00	2.20	2.15	4.50
22	4.90	4.05	8.90	3.00	3.15	2.10	2.65	2.15	2.00	2.10	2.20	5.25
23	4.50	4.50	8.35	3.05	3.35	2.20	2.60	2.10	2.00	2.10	2.35	5.05
24	4.20	5.20	8.10	3.20	3.15	2.30	2.40	2.10	2.00	2.10	2.40	4.50
25	3.95	5.50	7.30	3.35	3.00	2.20	2.40	2.05	2.05	2.10	2.50	4.10
26	4.00	6.10	7.15	3.65	2.75	2.25	2.30	2.15	2.10	2.05	2.50	4.10
27	2.50	8.35	7.00	3.70	2.85	2.20	2.35	2.20	2.00	2.00	2.40	4.00
28	3.70	8.40	6.65	3.35	3.30	2.25	2.50	2.25	2.00	2.05	2.40	4.00
29	2.90	-------	6.10	3.10	3.30	2.20	2.45	2.30	2.10	2.00	2.40	4.00
30	3.00	-------	5.75	3.10	3.05	2.15	2.40	2.25	2.10	2.10	2.30	4.00
31	2.70	-------	5.65	-------	3.00	-------	2.35	2.35	-------	2.20	-------	4.00

SANDUSKY RIVER AT MEXICO, OHIO.

This river rises in the north-central part of Ohio and flows in a westerly and northerly direction into Sandusky Bay, an arm of Lake Erie. Its watershed is largely used for farming and pasturage, having only an occasional patch of forest. Sixteen dams have been built along its course in order to utilize the water power. Only five of these are now in use, but the flow is more or less obstructed by them all.

Measurements of flow were begun in November, 1898, in connection with the work of the State board of health in their study of the pollution of the Ohio streams and also to obtain information in regard to water power. Two stations have been established on the Sandusky, one at Mexico, 6 miles above Tiffin, and the other at Fremont, about 15 miles from the mouth of the river. The Mexico station was established by H. A. Pressey and B. H. Flynn on November 17, 1898, and is located at the highway bridge near Mexico, about 40 miles above Fremont, Ohio. The wire gage is on the upstream side of the bridge, and is referred to a bench mark cut in the top side of the upstream wing of the right abutment of the bridge. The elevation of the bench mark is 30.00 feet above gage datum. Gagings are made from the downstream side of the bridge, the initial point being on the left bank, marked by a nail in the guard rail. The stream flows through a long stretch of clay banks, with little sand and gravel, and is unobstructed near the point of measurement. At extreme high water the banks are overflowed, and at very low water the measurements are somewhat uncertain, owing to the sluggishness of the stream. The observer is M. L. Estep, of Mexico, Ohio. One measurement of discharge was made by B. H. Flynn in March, 1899, at a gage height of 5.40 feet, which gave a discharge of 1,386 second-feet.

Daily gage height, in feet, of Sandusky River at Mexico, Ohio, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.00	1.90	5.60	6.40	1.50	4.10	1.10	1.40	0.60	0.60	1.10	1.20
2	2.90	1.90	4.30	6.00	1.40	4.10	1.00	1.30	.50	.60	1.10	1.20
3	2.80	1.80	4.00	4.90	1.40	3.70	1.00	1.30	.60	.60	1.00	1.20
4	3.10	1.80	5.00	4.70	1.30	3.00	1.00	1.30	.50	.60	1.20	1.20
5	10.20	1.70	9.40	4.20	2.40	2.40	.90	1.20	.50	.60	1.20	1.30
6	10.80	1.70	10.80	3.40	1.90	2.00	.90	2.50	.50	.50	1.10	1.60
7	9.80	1.70	9.20	3.00	2.20	2.00	.90	2.10	.50	.50	1.10	1.40
8	6.10	1.60	6.30	4.80	2.00	2.50	.80	1.60	.60	.50	1.10	1.30
9	4.00	1.60	4.50	5.80	1.80	3.00	.80	1.40	.60	.50	1.10	1.20
10	3.50	1.60	4.00	5.00	1.60	2.40	.80	1.40	.60	.50	1.00	1.20
11	3.50	1.60	7.80	4.10	1.50	2.00	.80	1.40	.60	.50	1.00	1.20
12	3.40	1.60	8.40	3.20	1.40	1.80	.80	1.30	.60	.60	1.00	1.30
13	3.40	1.60	6.50	3.50	1.90	1.70	.70	1.30	.50	.60	1.00	1.60
14	10.20	1.60	4.80	3.40	1.50	1.50	.70	1.20	.50	.80	1.00	1.60
15	15.50	1.60	3.80	3.00	1.40	1.40	1.10	1.20	.50	.80	1.10	1.80
16	17.00	1.50	3.70	2.50	1.30	1.30	1.50	1.00	.50	.80	1.20	1.80
17	15.30	1.50	3.70	2.30	1.30	1.30	1.60	.90	.60	.80	1.20	1.70
18	10.30	1.50	3.90	2.00	2.20	1.20	1.50	.90	.60	.80	1.20	1.90
19	6.30	1.50	11.00	2.00	4.20	1.10	1.40	.90	.60	.70	1.20	2.20
20	4.20	1.50	11.80	1.90	3.20	1.00	1.30	.80	.80	.80	1.20	3.00
21	3.60	1.50	9.30	1.90	2.40	1.00	1.30	.80	.80	1.00	1.20	3.30
22	3.40	8.10	7.30	1.80	2.00	.90	1.30	.80	.70	1.00	1.10	2.80
23	3.20	9.20	9.30	1.80	1.80	.90	1.20	.80	.60	1.00	1.10	2.40
24	3.00	7.20	10.10	1.60	1.70	.80	1.20	.80	.60	1.00	1.20	2.20
25	3.00	5.00	9.50	1.80	1.60	1.30	1.20	.70	.60	1.00	1.20	2.20
26	2.90	5.40	7.40	1.80	1.60	1.20	1.20	.70	.60	1.00	1.20	2.10
27	2.70	9.20	6.40	1.80	1.50	1.20	1.10	.70	.60	1.10	1.20	2.10
28	2.60	8.40	6.00	1.80	1.50	1.20	1.20	.70	.60	1.10	1.30	2.00
29	2.40	.....	5.50	1.70	1.60	1.10	1.50	.60	.60	1.20	1.20	2.00
30	2.20	.....	6.10	1.60	3.40	1.10	1.50	.60	.60	1.20	1.20	1.80
31	2.00	.....	5.90	.....	4.70	.....	1.40	.60	.....	1.20	.....	1.60

SANDUSKY RIVER AT FREMONT, OHIO.

This station, established by H. A. Pressey and B. H. Flynn on November 18, 1898, is at the bridge of the Lake Shore Railroad at Fremont, Ohio. The gagings are made from the board walk on the lower cord of the bridge, the initial point being a cross cut on the bottom lateral at the west end of the bridge. The gage is an iron pipe graduated to feet and tenths, located at the waterworks intake, and is referred to a bench mark cut on top of south end of west abutment of bridge. The elevation of bench mark is 20.1 feet above gage datum. The bed is rocky, the banks high and not subject to overflow. During the summer of 1899, owing to the scarcity of water for the waterworks of Fremont, the rubble dam below the station was rebuilt, affecting the flow of the river and gage readings, especially at time of low water. The observer is Charles F. Reiff, superintendent of the waterworks at Fremont, Ohio. A measurement of discharge was made March 2, 1899, by B. H. Flynn: Gage height, 2.32 feet; discharge, 1,784 second-feet.

Daily gage height, in feet, of Sandusky River at Fremont, Ohio, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.00	1.30	2.95	2.90	0.40	2.20	—0.05	+0.05	0.35	0.75	0.95	0.90
2	1.75	1.20	2.25	2.75	.35	2.15	— .15	.10	.40	.70	.95	.90
3	1.70	1.20	2.05	2.45	.30	1.95	— .25	.05	.35	.75	1.05	.95
4	2.30	1.20	2.75	2.55	.40	1.55	— .25	.00	.40	.75	1.05	1.00
5	5.15	1.20	4.80	2.30	1.55	1.10	— .15	.00	.35	.75	1.05	.95
6	4.90	1.10	4.55	1.95	1.00	.85	— .15	— .10	.40	.70	1.05	.95
7	4.40	1.10	3.75	1.80	.85	.80	— .15	+ .55	.45	.60	.95	.95
8	3.25	1.05	2.95	2.75	.95	.75	— .10	.25	.45	.60	.90	.95
9	2.70	.75	2.40	2.85	.75	1.40	— .20	.10	.45	.60	.90	.95
10	2.35	.70	2.65	2.50	.65	1.30	— .10	.00	.40	.60	.90	.90
11	2.15	.80	4.40	2.10	.50	1.00	+ .05	.00	.40	.60	.90	1.00
12	2.15	.80	4.05	2.00	.45	.75	— .15	.00	.30	.45	.95	1.00
13	2.50	.80	3.15	1.95	.40	.55	— .15	— .15	.30	.50	.95	1.05
14	7.80	.80	2.10	1.75	.40	.35	— .20	— .10	.30	.70	.95	1.20
15	8.25	.80	2.10	1.50	.40	.30	— .20	— .10	.30	.70	.90	1.20
16	7.40	.75	1.95	1.25	.35	.20	+ .60	— .15	.50	.75	.90	1.20
17	6.80	.80	1.90	1.05	.40	.20	.55	— .20	.50	.85	.95	1.10
18	5.00	1.00	2.85	.90	.85	.10	.35	— .15	.50	.85	.95	1.10
19	3.40	1.05	6.70	.80	1.55	.10	.15	— .20	.65	.95	.95	1.50
20	2.90	1.55	5.05	.80	1.55	.10	.10	— .25	.60	.85	1.00	1.90
21	2.55	2.05	4.05	.70	1.00	.00	.00	— .25	.55	.85	.95	1.90
22	2.25	4.25	4.00	.65	.75	.00	.05	— .25	.55	.85	.95	1.70
23	2.20	4.00	4.65	.60	.55	.00	— .10	— .25	.55	.85	.90	1.50
24	2.20	3.30	4.20	.60	.45	— .05	— .10	— .25	.65	.85	.95	1.40
25	2.30	2.50	3.80	1.15	.35	— .05	+ .05	— .35	.80	.85	.95	1.50
26	2.15	3.40	3.60	1.00	.30	.00	— .10	— .40	.70	.85	.95	1.25
27	2.10	4.20	3.10	.75	.35	— .05	— .15	— .30	.70	.85	.95	1.10
28	1.65	3.60	2.85	.70	.55	.00	— .15	— .35	.80	.95	.95	1.10
29	1.55	.....	2.80	.60	1.20	— .05	— .15	— .25	.80	.95	.95	1.10
30	1.45	.....	2.90	.55	2.15	— .05	— .15	— .05	.70	.90	.90	1.00
31	1.35	.....	2.85	.....	2.50	.....	— .05	+ .20	.....	1.05	.....	.95

NIAGARA RIVER BELOW BUFFALO, NEW YORK.

Measurements of Niagara River were made under the direction of the United States Board of Engineers on Deep Waterways, from September, 1897, to September, 1898, the work being in charge of E. E. Haskell, assistant engineer. The results are discussed in a paper prepared by Mr. Clinton B. Stewart, assisting Mr. Haskell, and presented to the Western Society of Engineers in December,

1899.[1] The point of measurement was on the north side of the international bridge, about 3 miles below the head of the river. At this point the total width is 1,806 feet, of which 128.5 feet is taken up by the width of the eight bridge piers. The distance between soundings was about 20 feet. The soundings were made with a 41-pound cast-iron weight attached to a sash chain, in swift and deep water, and with a 25-pound lead in the shallower water. Velocity measurements were made by means of Haskell current meters with high and low pitch wheels. The velocity of the current was determined at points about 80 feet apart and at 0.3 of the total depth. Measurements of velocity near the surface were also taken, with the meter immersed 1 foot, also near the bottom, with the weight just clearing, so that the meter wheel was 1.5 feet above the bottom.

At a water-surface elevation of 567.0 feet above mean tide at New York, the area of cross section was 39,629 square feet. The discharge measurements covered a range of about 2.3 feet in lake level. Taking the elevation of mean level of Lake Erie at 572.78, this being the average at Cleveland for the period 1875 to 1898, the corresponding discharge, when corrected, is placed at 221,500 second-feet. The rate of increase in discharge at this elevation is about 25,000 second-feet per foot rise.

In the results of this investigation published by Mr. Clinton B. Stewart in the Journal of the Western Society of Engineers, the gages showing height of water at the time of measurements were located, one on the American shore and the other on the Canadian shore, each about 2½ miles from the mouth of the river. These were read during the months of July and August, 1898, simultaneously at ten-minute intervals throughout the day. They have been referred to the gage near Buffalo, readings of which were made from 1887 to 1897. The fall from these to the latter is 0.13 foot. No attempt has been made to estimate the daily flow. It is probable that this can be done, as the bed of the river is of rock and not subject to change. The construction of the international bridge about 1870 may have changed the slope conditions slightly, but probably has not influenced the flow by more than a few per cent.

The measurements of the outflow of Lake Erie through Niagara River were continued from September, 1898, by the Corps of Engineers, United States Army, in charge of the survey of northern and northwestern lakes, of which Mr. E. E. Haskell was assistant engineer and Mr. F. C. Shenehon was resident engineer. From the measurements made by these two parties the outflow, by months, for the years 1895 to 1898 has been computed and published.[2] The mean discharge for these thirty-four years is 220,428 second-feet. The following table gives the results, by months, in condensed form:

[1] Journal of Western Society of Engineers for 1899, pp. 450 to 492.

[2] Regulation of the Level of Lake Erie. Fifty-sixth Congress, first session, H. R. Doc. No. 200, pp. 15 and 16.

Mean monthly discharge of Niagara River below Buffalo, New York, for years 1865 to 1898, inclusive, in thousands of cubic feet per second.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
1865.	205	193	200	216	231	230	229	227	226	219	210	206	216
1866.	200	197	205	219	225	231	234	228	226	226	220	220	219
1867.	213	206	215	223	236	244	239	231	221	213	202	197	220
1868.	192	185	197	216	227	237	236	223	216	206	202	198	211
1869.	197	196	206	214	227	237	245	242	235	223	212	221	221
1870.	227	232	227	244	249	249	250	248	241	231	224	221	237
1871.	216	208	219	231	238	238	238	232	228	212	207	198	222
1872.	196	191	189	193	203	211	211	210	205	201	194	189	199
1873.	187	187	189	217	234	236	236	234	224	217	212	221	216
1874.	231	232	233	237	240	241	242	238	226	215	205	201	228
1875.	196	192	195	204	215	225	229	228	225	213	209	214	211
1876.	214	227	244	259	268	272	268	260	255	240	242	233	248
1877.	223	219	214	224	230	232	239	235	233	223	221	223	226
1878.	225	228	232	243	250	250	250	243	240	231	226	228	237
1879.	217	214	214	223	227	229	230	225	216	211	200	206	218
1880.	218	219	222	226	233	236	238	232	226	215	214	206	224
1881.	196	199	206	223	233	239	238	230	221	220	215	220	220
1882.	232	232	244	250	256	260	258	254	247	235	226	214	242
1883.	212	217	221	224	236	255	261	259	250	242	232	232	237
1884.	224	231	236	250	258	260	254	250	238	229	217	216	239
1885.	211	206	203	223	242	256	255	255	251	248	245	243	236
1886.	244	225	220	243	251	254	253	247	241	235	224	226	239
1887.	220	230	252	253	258	259	252	243	237	222	215	216	238
1888.	211	205	207	223	229	232	236	233	222	213	215	212	220
1889.	212	209	205	213	217	228	233	225	216	206	200	206	214
1890.	214	221	224	237	246	256	245	234	229	224	223	218	231
1891.	212	212	223	220	215	219	216	210	206	197	188	189	209
1892.	190	186	187	198	217	236	239	230	222	209	201	195	209
1893.	187	189	193	210	230	235	228	220	210	202	194	195	208
1894.	202	199	200	209	218	225	223	214	210	202	197	195	208
1895.	188	184	184	189	194	196	193	192	189	180	178	181	187
1896.	183	181	180	189	198	204	201	206	198	193	186	186	192
1897.	186	190	198	210	218	220	220	216	210	198	196	195	205
1898.	196	200	206	220	224	225	219	214	205	201	198	195	209

SENECA RIVER AT BALDWINSVILLE, NEW YORK.

This stream has its source in the lake of the same name in central New York; its general course is northeasterly until its junction with the Oneida River in Onondaga County, where the two form the Oswego River, which flows northwesterly, entering Lake Ontario at the city of Oswego. The station is located at the dam on Seneca River at Baldwinsville, where the drainage area is 3,103 square miles. A head or crest gage is placed at each end of the dam and both are read twice daily. Only one tailrace gage was placed. The elevation of the zeros of the crest gages is 93.99 feet, while the elevation of the zero of the tailrace gage is 84.91 feet, or a difference of 9.08 feet. To obtain the effective heads on the water wheels it is necessary to add to the daily readings of the crest gages 9.08 feet, and subtract the readings of the tailrace gage. Ten mills utilize the flow here developed for power purposes, and to get the entire flow of the river it is necessary to keep a record of the different heads on the wheel gates as well as the amount of opening of each. The records at this point, as well as on various other streams in the State of New York, were begun by Mr. George W. Rafter for the United States Board of Engineers on Deep Waterways. The computations of discharge are quite laborious and have been made as noted in Volume XXVI of the Proceedings of the American Society of Civil Engineers, page 308. The following figures are based on Bazin's experiments. The Oswego Canal is fed from Seneca River, and practically its entire flow should be added to that

of the stream to obtain the total yield of the watershed. The discharge of this canal, including both lockage and leakage, was taken as 70 second-feet from June to October, 1899.

Estimated daily discharge, in second-feet, of Seneca River at Baldwinsville, New York, for 1898.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1	.....	2,528	10	.....	2,389	19	3,308	2,151	28	3,119	3,449
2	.....	2,512	11	.....	1,872	20	2,590	2,292	29	2,810	3,191
3	.....	2,609	12	3,011	2,219	21	3,293	2,418	30	2,801	3,326
4	.....	2,379	13	2,625	2,078	22	3,174	2,927	31	.....	3,365
5	.....	2,889	14	3,583	2,056	23	3,234	3,455			
6	.....	2,715	15	3,684	1,982	24	3,236	3,838	Mean	3,142	2,689
7	.....	2,981	16	3,500	2,111	25	3,257	3,661			
8	.....	2,687	17	3,418	2,271	26	3,245	3,630			
9	.....	2,467	18	3,270	1,551	27	2,452	3,368			

Estimated daily discharge, in second-feet, of Seneca River at Baldwinsville, New York, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,630	1,838	3,232	4,599	3,406	2,073	1,067	585	570	134	1,328	1,415
2	2,686	1,791	3,172	4,495	3,521	1,692	156	572	630	658	1,386	1,454
3	2,454	1,953	3,352	4,606	3,230	1,132	771	560	112	650	1,220	1,050
4	2,547	1,794	3,249	4,567	3,032	1,884	163	540	650	608	1,592	1,631
5	2,993	1,835	3,468	4,520	3,007	2,085	1,141	532	505	613	1,270	1,496
6	3,202	1,793	3,855	4,329	2,906	2,058	1,185	70	670	610	1,793	1,450
7	2,977	1,676	4,190	4,072	2,692	1,859	1,142	621	671	653	1,543	1,455
8	2,543	1,653	3,992	4,509	2,799	1,467	825	533	591	70	1,462	1,330
9	2,779	1,293	3,943	4,394	2,842	1,713	678	532	623	635	1,516	1,650
10	2,696	1,267	3,838	5,019	2,705	2,038	1,103	499	158	550	1,597	1,306
11	2,645	1,267	3,783	4,955	2,662	834	1,188	475	521	525	1,631	1,742
12	2,554	1,241	3,623	5,347	2,614	1,631	1,215	491	490	624	1,708	1,759
13	2,535	1,340	3,915	5,181	2,637	1,541	1,258	74	422	646	1,786	1,828
14	2,577	1,419	3,860	5,218	2,302	1,526	1,182	339	409	629	1,527	1,724
15	2,950	1,380	3,860	5,327	2,477	1,608	1,207	575	437	74	1,544	1,501
16	3,186	1,101	3,978	4,874	2,398	1,581	174	521	513	787	1,545	1,533
17	3,628	1,226	3,872	4,939	2,534	1,797	1,226	99	70	765	1,599	1,565
18	3,708	1,502	3,678	5,033	2,355	789	1,155	571	514	765	1,518	1,565
19	3,769	1,652	3,413	4,981	2,415	1,303	922	545	508	765	1,742	1,878
20	3,645	1,494	3,821	4,791	2,536	569	574	70	623	781	1,966	1,470
21	3,469	1,685	3,625	4,606	2,302	583	712	580	488	834	1,712	1,960
22	3,272	2,056	3,563	4,620	2,576	646	543	596	397	301	1,670	2,096
23	3,298	2,403	3,755	4,040	2,309	756	206	614	177	875	1,739	2,045
24	3,310	2,488	4,021	4,311	2,257	895	656	502	562	798	1,757	2,050
25	3,209	2,646	4,091	4,026	2,334	386	585	548	573	787	1,904	2,050
26	3,095	2,482	4,093	3,992	2,296	668	593	529	561	725	1,891	2,055
27	2,358	2,668	4,348	3,883	2,209	625	613	70	643	794	1,879	1,978
28	2,093	2,584	4,278	3,975	1,962	588	586	555	643	822	1,711	2,039
29	1,662	.....	4,776	3,853	2,045	543	531	522	691	351	1,728	2,091
30	2,028	.....	4,702	3,216	2,066	328	238	395	.....	947	1,087	2,089
31	1,871	.....	4,782	.....	2,192	.....	467	375	.....	971	.....	2,089
Mean.	2,851	1,769	3,875	4,543	2,568	1,573	776	455	481	637	1,612	1,722

CHITTENANGO CREEK AT BRIDGEPORT, NEW YORK.

This creek rises in Madison County, New York, and flows in a northerly direction between Madison and Onondaga counties into Oneida Lake, the outlet of which is Oneida River, a tributary of Oswego River. The basin of Chittenango Creek is shown on Chittenango atlas sheet of the United States Geological Survey. Observations for the computation of flow of this creek are made at the milldam in Bridgeport, New York, a short distance above its mouth. The drainage area at this point is 307 square miles. Three times a day observations are made of the river height above the crest of

the dam, head on wheels, and the amount of gate opening. Jefferson Downs, of the flour mill, is the observer. The mill runs three Camden turbines—two of which are 60-inch, and one 54-inch. The dam is of timber, backed with stone. The elevation of the zero of the crest gage is 92.84 feet, while the zero of the tailrace gage is 85.88 feet, the difference between them being 6.96 feet. In computing the flow over the dam the crest is divided into three parts, each of which is considered as a separate weir. The discharge over the dam was first computed from Bazin's experiments, but after July 1, 1899, it was computed from the results of the experiments made at Cornell University. A cross section of the dam and additional facts are given by Mr. Geo. W. Rafter in Volume XXVI of the Proceedings of the American Society of Civil Engineers, page 309.

Estimated daily discharge, in second-feet, of Chittenango Creek at Bridgeport, New York, for 1898.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	------	180	562	427	12	------	196	1,571	434	23	115	465	593	1,293
2	------	205	559	360	13	------	197	1,265	454	24	135	487	569	1,401
3	------	171	434	348	14	------	181	921	442	25	85	472	490	1,075
4	------	172	358	385	15	------	354	790	450	26	142	352	442	857
5	------	156	379	471	16	82	335	694	472	27	149	867	465	726
6	------	309	385	414	17	116	299	615	619	28	214	972	523	541
7	------	235	331	404	18	53	284	500	605	29	154	661	413	480
8	------	204	359	320	19	119	297	506	678	30	198	565	421	630
9	------	130	386	261	20	139	320	675	669	31	------	519	------	630
10	------	165	474	265	21	117	269	728	793					
11	------	194	1,339	465	22	111	463	623	1,155	Mean	129	344	612	597

Estimated daily discharge, in second-feet, of Chittenango Creek at Bridgeport, New York, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	515	520	632	837	447	426	116	84	81	75	60	113
2	571	484	473	795	357	346	55	79	49	90	145	127
3	636	440	385	752	310	234	97	169	45	91	145	143
4	737	465	520	861	172	105	113	126	133	90	160	159
5	1067	385	1260	866	172	184	132	134	81	80	165	149
6	1310	356	1331	864	157	229	99	70	76	141	228	151
7	1282	342	1475	857	95	229	123	125	74	89	128	166
8	1135	465	1069	1420	172	244	132	125	96	45	120	179
9	724	385	860	1675	172	192	45	134	96	107	108	155
10	486	385	852	1369	227	147	89	79	15	117	65	168
11	473	385	659	1306	237	70	262	62	71	101	46	181
12	623	385	565	1274	172	169	271	44	96	101	35	211
13	849	538	1196	1597	172	192	162	15	92	85	72	326
14	738	524	1061	1737	165	182	169	141	56	72	57	395
15	1260	462	970	1614	180	109	99	125	88	15	65	395
16	1280	362	665	1405	174	184	70	103	79	84	60	374
17	1101	449	634	1339	250	192	101	87	25	30	88	355
18	632	354	526	1221	310	70	221	76	89	38	57	466
19	390	385	565	859	374	152	210	91	74	38	25	706
20	395	541	736	861	374	84	204	25	96	45	83	588
21	389	444	766	629	385	92	152	120	117	47	70	298
22	385	619	962	447	281	100	117	109	39	15	78	304
23	399	950	1061	165	265	124	70	96	84	60	100	254
24	372	1074	1345	627	252	134	102	(a)	25	68	102	200
25	311	1314	1061	527	197	70	102	------	67	43	110	139
26	362	1015	885	456	195	141	122	------	49	57	25	238
27	308	645	626	331	227	109	110	------	112	48	109	261
28	332	755	760	279	225	109	88	------	119	25	133	201
29	385	------	1075	359	312	84	109	56	96	20	114	249
30	448	------	1360	295	333	91	45	96	79	65	105	244
31	637	------	1360	------	229	------	141	112	------	65	------	240
Mean.	662	551	893	921	245	161	123	96	76	64	95	281

a Repairing dam; water drawn off August 25 to 28.

ONEIDA CREEK AT KENWOOD, NEW YORK.

This stream rises in Madison County, New York, and flows in a northwesterly direction, crossing the Erie Canal and emptying into Oneida Lake at its southeastern extremity. It is shown on the Oneida atlas sheet of the United States Geological Survey. The station is located at the silk-mill dam in Kenwood, about 3 miles from Oneida, the drainage area at this point being 59 square miles. One gage gives the height of water above the crest of the dam, and two gages are read at the silk mill, giving the head on wheels. From these readings and from the number of gate openings the quantity of water passing over the dam as well as through the wheels is determined, thus giving the discharge of the creek at this point. The dam is of timber, well constructed, and without leakage. Computations of the flow over it have been made from Bazin's experiments of 1894. The computations for the discharge measurements after July 1, 1899, are based on the coefficients determined at Cornell University. The cross section of the dam is shown in Volume XXVI of the Proceedings of the American Society of Civil Engineers, page 309.

Estimated daily discharge, in second-feet, of Oneida Creek at Kenwood, New York, for 1899.

Day.	May.	June.	July.	Oct.	Nov.	Dec.	Day.	May.	June.	July.	Oct.	Nov.	Dec.
1	71	46	18	15	144	23	18	68	30	28	25	22	130
2	60	36	20	21	69	29	19	66	26	26	24	25	97
3	60	36	20	21	56	25	20	91	31	26	24	28	79
4	59	35	20	21	66	27	21	80	26	24	25	24	92
5	54	31	30	21	55	29	22	82	26	25	------	26	80
6	55	31	34	21	44	29	23	63	31	10	25	24	68
7	48	31	21	24	40	25	24	54	31	26	25	26	55
8	53	24	41	------	26	33	25	66	31	21	24	24	70
9	53	24	40	24	26	41	26	43	31	21	25	25	36
10	53	24	51	24	24	125	27	43	31	20	24	26	39
11	54	25	26	21	26	97	28	71	24	21	25	26	27
12	59	26	24	24	27	70	29	108	24	18	------	26	34
13	59	26	24	24	28	70	30	76	21	10	29	26	27
14	48	26	24	24	26	91	31	59	-----	21	31	------	34
15	53	51	21	------	22	82							
16	60	41	20	25	26	73	Mean.	62	30	25	24	33	60
17	61	36	31	25	26	130							

Record not kept for August and September.

WEST BRANCH OF FISH CREEK AT McCONNELLSVILLE, NEW YORK.

This stream rises in the northern part of Oneida County and flows in a southerly direction to its junction with the East Branch, where it forms the main Fish Creek, which stream flows in a westerly direction, emptying into the east end of Oneida Lake. The lower part of the course of Fish Creek is shown on the Oneida atlas sheet of the United States Geological Survey. The station is located at the Harden dam in McConnellsville. The drainage area at this point is 186.7 square miles. The dam is of timber, with a small leakage. The crest has been so repaired by the Board on Deep Waterways that it is horizontal. The record of gage heights is voluntarily kept by

Frank S. Harden, on a gage showing the height of the river above the crest of the dam and also on one at the end of the tailrace. The flow of this dam is computed from Bazin's experiments, series 170, up to July 1, 1899, and after that date they are based on the experiments made at Cornell University, as noted in Volume XXVI of the Proceedings of the American Society of Civil Engineers, page 310.

Estimated daily discharge, in second-feet, of West Branch of Fish Creek at McConnellsville, New York, for 1898.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	------	137	365	237	12	------	87	997	199	23	57	700	216	317
2	------	50	319	245	13	100	124	700	186	24	332	750	300	468
3	------	111	292	217	14	90	134	734	212	25	360	624	329	390
4	------	121	172	195	15	96	397	434	162	26	197	434	319	285
5	------	130	155	182	16	47	360	514	157	27	231	1,097	255	285
6	------	137	120	182	17	47	562	365	147	28	181	871	299	225
7	------	131	146	196	18	50	346	365	120	29	181	686	251	170
8	------	122	138	182	19	98	227	365	187	30	147	440	172	120
9	------	65	135	199	20	81	190	370	157	31	------	464	------	120
10	------	102	557	180	21	57	172	371	190					
11	------	81	1,562	140	22	55	467	220	287	Mean.	134	333	384	210

Estimated daily discharge, in second-feet, of West Branch of Fish Creek at McConnellsville, New York, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1	120	228	402	586	273	18	615	133	567	1644	189
2	126	183	402	520	313	19	615	120	485	1434	374
3	194	183	438	601	243	20	530	183	505	1174	374
4	261	172	595	601	184	21	495	198	433	1085	255
5	321	120	700	601	184	22	360	258	442	1045	303
6	396	212	956	591	184	23	314	338	443	940	244
7	396	156	856	689	120	24	425	438	442	664	194
8	285	156	700	1557	183	25	350	438	442	564	189
9	352	147	856	2110	154	26	325	360	360	470	174
10	422	136	583	1690	154	27	338	403	552	366	134
11	502	117	546	1724	183	28	308	403	599	366	50
12	587	80	700	2055	243	29	225	--------	599	364	700
13	873	99	1178	2440	194	30	278	--------	599	220	455
14	873	132	1178	2920	120	31	278	--------	599	--------	483
15	795	94	1178	3040	189						
16	787	131	972	2410	189	Mean.	435	206	615	1,206	239
17	735	148	782	1720	189						

EAST BRANCH OF FISH CREEK ABOVE POINT ROCK, NEW YORK.

This stream rises in Lewis County, New York, and flows in a southerly direction into Oneida County, where it joins the West Branch to form the main Fish Creek. The station is located at the sawmill of Fowler W. Willson at Point Rock. The dam is of timber and has considerable leakage. The old sawmill located here is seldom used; whenever the wheels are running, however, record is kept of the length of time and of the amount of gate openings. The profile of crest of dam is somewhat irregular and, in order to facilitate computations, has been divided into five sections, the flow through each of which has been computed separately by Bazin's experiments of 1894. The discharge measurements after July 1, 1899, are based on experiments made at

Cornell University, as noted in Volume XXVI of the Proceedings of the American Society of Civil Engineers, page 310.

Estimated daily discharge, in second-feet, of East Branch of Fish Creek at Point Rock, New York, for 1898.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	160	340	325	12	.....	225	820	360	23	155	1,090	370	660
2	.....	100	320	325	13	.....	250	485	340	24	690	710	370	745
3	.....	100	250	360	14	.....	295	450	385	25	420	460	345	880
4	.....	80	245	340	15	.....	600	395	335	26	300	450	325	850
5	.....	210	210	340	16	.....	555	370	510	27	265	1,245	325	805
6	.....	295	385	340	17	.....	350	310	520	28	370	710	340	630
7	.....	240	415	345	18	.....	250	340	520	29	300	490	385	490
8	.....	210	350	360	19	.....	230	345	570	30	160	400	370	610
9	.....	185	400	370	20	.....	310	340	600	31	.....	370	.....	610
10	.....	185	720	350	21	.....	240	310	630					
11	.....	170	1830	360	22	10	860	265	685	Mean.	296	387	424	501

Estimated daily discharge, in second-feet, of East Branch of Fish Creek at Point Rock, New York, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	565	475	748	970	2,745	305	(a)	(a)	(a)	25	650	1,200
2	670	475	810	1,040	2,260	390	.....	.....	.....	21	650	1,230
3	670	420	810	1,090	1,950	270	.....	.....	.....	27	665	1,180
4	805	450	815	1,150	1,340	265	.....	.....	.....	35	660	1,160
5	1,190	420	840	1,420	930	295	.....	.....	.....	40	635	1,120
6	1,280	450	900	1,435	750	295	.....	.....	.....	60	680	1,120
7	1,280	390	1,010	1,330	660	260	.....	.....	.....	68	700	1,040
8	1,090	370	1,010	1,220	635	230	.....	.....	.....	80	710	1,000
9	1,060	420	770	1,150	540	200	.....	.....	.....	100	750	1,040
10	985	390	945	1,240	520	160	.....	.....	.....	110	790	1,000
11	930	370	1,150	1,390	510	150	.....	.....	.....	110	825	1,040
12	900	320	1,245	1,500	520	165	.....	.....	.....	120	840	1,180
13	1,005	440	1,200	1,600	570	150	.....	.....	.....	115	825	1,180
14	1,000	420	1,110	1,660	520	140	.....	.....	.....	120	840	1,040
15	770	500	1,045	1,760	580	130	.....	.....	.....	150	880	1,000
16	680	610	985	1,870	510	115	.....	.....	.....	130	860	990
17	610	640	985	1,900	500	115	.....	.....	.....	180	860	965
18	485	740	1,090	1,900	600	125	.....	.....	.....	190	880	990
19	550	760	1,150	2,030	650	150	.....	.....	.....	190	900	1,000
20	510	810	1,100	2,510	700	170	.....	.....	.....	190	900	990
21	490	750	1,060	3,170	635	175	.....	.....	.....	195	840	965
22	485	780	1,045	3,550	540	175	.....	.....	.....	220	840	915
23	425	820	1,165	4,030	410	170	.....	.....	.....	270	860	915
24	385	825	1,165	4,320	415	150	.....	.....	.....	270	900	880
25	370	900	1,235	4,650	500	120	.....	.....	.....	285	920	810
26	350	945	1,235	4,170	450	105	.....	.....	.....	290	900	960
27	320	1,050	1,165	3,490	410	95	.....	.....	.....	335	940	960
28	370	1,210	1,150	3,110	440	100	.....	.....	.....	415	1,025	1,040
29	320	.....	1,130	2,790	475	80	.....	.....	.....	510	1,080	1,045
30	320	.....	1,200	2,790	450	70	.....	.....	.....	530	1,100	1,060
31	340	.....	1,245	.....	400	.....	.....	.....	.....	620	.....	1,060
Mean.	684	612	1,049	2,208	745	177	.....	.....	.....	194	830	1,035

a Flow during July, August, and September not computed, owing to fact that all water leaked through the dam.

OSWEGO RIVER AT FULTON, NEW YORK.

This stream is formed by the junction of Oneida and Seneca rivers in Onondaga County, New York, and flows northwesterly, emptying into Lake Ontario at the city of Oswego. The station is located at the dam at Fulton, 7 miles above Oswego, the catchment area being 4,916 square miles. The dam is well built of stone and brick and has no leakage. At this point four gages are read—one above the dam,

one in the tailrace of the Fulton Worsted Mill, one in the headrace and one in the tailrace of the Oswego Falls Pulp and Paper Company's mill. The mills are located at each end of the dam, and both use water from the Oswego River. The dam is 404.6 feet in length, and the crest is practically level. During the low-water stages flashboards are placed on the crest of the dam, and in order to compute the discharge of the river at this point it is necessary to take these flashboards into account, as well as the height of the dam, the head on the various wheels, and the number of openings of the same. The records at this point are not at present available. A cross section of the dam is given in Volume XXVI of the Proceedings of the American Society of Civil Engineers, page 309.

OSWEGO RIVER AT OSWEGO, NEW YORK.

Another series of records on this stream besides the one at Fulton have been maintained at the high dam between Oswego and Fulton. The water at this point is used in the State canal and by the Oswego Waterworks Company, whose pump house is on the left side of the stream. This station was established April 1, 1897. The following figures of daily gage height were obtained from Mr. Thomas H. Bennett, superintendent of the Oswego Waterworks Company:

Daily gage height, in feet, of Oswego River at Oswego, New York, for 1897.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.38	.....	5.63	6.56	8.08	8.79	8.33	8.50	7.42
2	3.54	4.58	5.60	6.33	8.08	.....	8.38	8.29	7.42
3	3.71	4.65	5.60	6.42	.....	8.79	.....	8.17	7.33
4	.....	4.73	5.60	.....	8.08	8.83	8.67	8.17	7.44
5	3.71	4.75	.....	6.42	8.17	.....	8.46	8.25	.....
6	3.71	4.83	5.63	6.46	.....	8.92	8.42	8.17	7.08
7	3.71	4.88	5.63	6.58	8.25	8.79	8.42	.....	7.17
8	3.75	.....	5.67	6.79	.....	8.83	8.54	8 21	7.17
9	3.52	4.94	5.67	6.75	8.58	8.75	8.58	8.17	6.88
10	.....	5.00	5.67	6.79	8.50	8.83	.....	8.08	6.83
11	3.54	5.00	5.67	.....	8.50	8.83	8.46	8.17	6.75
12	3.54	.....	.....	6.50	8.42	.....	8.46	8.17	.....
13	3.54	5.04	5.67	6.83	8.50	8.42	8.54	8.25	6.79
14	3.71	5.08	5.75	6.96	8.44	8.29	8.33	8.25	6.83
15	3.71	.....	5.75	6.83	.....	8.38	8.42	.....	6.50
16	3.75	5.04	5.77	6.75	8.58	8.33	8.38	8.04	6.54
17	.....	5.04	5.85	6.75	8.42	8.50	.....	7.98	6.50
18	3.90	5.04	5.90	.....	8.42	8.54	8.79	7.92	6.50
19	4.00	5.17	.....	6.67	8.50	.....	8.42	7.83	.....
20	4.08	5.25	5.96	6.71	8.50	8.67	8.25	7.83	6.50
21	4.13	5.25	6.17	6.67	8.54	8.63	.....	.....	6.63
22	4.17	.....	6.17	6.75	.....	8.58	8.33	7.79	6.75
23	4.21	5.29	6.25	6.71	8.67	8.58	8.33	7.92	6.75
24	4.27	5.38	6.25	6.83	8.71	8.58	.....	7.79	7.17
25	4.48	5.29	6.33	.....	8.71	8.42	8.38	7.79	7.33
26	4.48	5.38	.....	6.42	8.75	.....	8.42	7.79	.....
27	4.48	5.42	6.25	6.33	8.75	8.50	8.46	7.46	7.08
28	4.48	5.42	6.38	6.33	8.75	8.21	8.42	.....	7.25
29	4.50	.....	6.21	a8.00	.....	8.54	8.50	7.17	7.46
30	4.67	5.46	6.31	8.13	8.79	8.46	8.50	7.17	7.17
31	.....	5.46	.....	8.10	8.58	.....	.....	.....	7.25

a 2.01 feet were added to the wall of the dam.

Daily gage height, in feet, of Oswego River at Oswego, New York, for 1898.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.58	6.50	5.88	6.13	.....	7.00	8.29	8.33	7.83	.....	7.00	6.75
2	.....	6.50	5.92	6.17	6.46	.....	8.29	8.33	7.83	7.83	7.00	6.75
3	7.42	6.50	6.00	.....	6.50	6.96	.....	8.33	7.88	.....	7.00	.....
4	7.58	6.67	6.08	6.31	6.29	7.25	.....	8.00	8.17	7.83	7.00	6.46
5	7.29	6.67	6.17	6.35	6.27	7.25	.....	8.17	7.92	7.88	.....	6.75
6	7.46	.....	.....	6.44	6.25	7.25	.....	8.25	7.96	.....	7.08	6.92
7	7.25	6.50	6.29	6.50	6.21	7.25	7.83	8.25	7.96	7.92	7.02	6.75
8	7.33	6.67	6.25	6.58	.....	7.50	.....	8.08	7.67	.....	7.08	6.96
9	.....	6.63	6.25	6.67	6.21	7.50	.....	8.25	7.71	7.88	7.00	7.04
10	7.50	6.63	6.25	.....	6.25	7.58	8.00	8.25	7.67	7.96	6.42	.....
11	7.50	6.63	6.21	6.71	6.33	7.58	8.00	8.33	7.83	8.00	6.38	7.00
12	7.33	6.17	6.13	6.83	.....	7.58	7.92	8.42	7.75	8.00	.....	7.00
13	6.75	.....	.....	6.92	6.42	7.67	7.58	8.50	7.67	8.25	6.08	7.42
14	6.63	6.54	5.92	6.92	6.42	7.75	7.58	8.21	7.83	.....	6.08	7.50
15	6.50	6.63	5.88	7.00	6.46	7.77	.....	8.42	7.92	.....	6.17	7.33
16	.....	6.83	5.88	7.00	.....	.....	.....	8.25	7.92	7.67	6.25	7.25
17	6.25	6.58	5.86	.....	.....	7.90	.....	8.25	7.67	7.75	6.25	.....
18	6.54	6.00	5.88	7.10	6.71	7.90	.....	8.25	8.00	7.67	6.33	7.17
19	6.54	6.00	5.88	7.17	6.71	8.00	.....	8.25	8.00	7.67	.....	7.25
20	6.54	.....	.....	6.92	.....	8.00	.....	8.25	8.00	7.58	6.33	7.17
21	6.29	5.92	5.88	7.13	.....	8.00	.....	8.33	8.00	7.58	6.33	6.75
22	6.21	5.92	5.83	7.17	.....	8.08	.....	8.21	8.00	.....	6.25	6.50
23	.....	5.79	5.83	7.17	6.83	8.08	.....	8.25	8.00	7.33	6.38	6.13
24	5.75	5.67	5.88	.....	.....	8.13	.....	8.33	7.92	7.17	6.42	.....
25	5.75	5.67	5.88	6.50	.....	.....	.....	8.27	7.88	7.17	6.42	6.08
26	5.88	5.67	5.92	6.38	6.92	.....	.....	7.83	8.08	7.13	.....	6.08
27	5.83	.....	.....	6.25	.....	.....	.....	7.92	7.92	7.08	6.50	6.13
28	6.17	5.75	6.00	6.17	.....	8.21	.....	7.92	8.00	6.96	6.50	6.42
29	6.17	.....	6.00	6.27	.....	8.27	.....	7.92	7.92	7.00	6.58	6.25
30	.....	.....	6.04	6.29	.....	8.29	.....	7.75	7.88	.....	6.58	6.25
31	6.83	.....	6.04	.....	6.96	.....	.....	7.75	.....	7.00	.....	.....

Daily gage height, in feet, of Oswego River at Oswego, New York, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	6.54	7.21	6.83	5.92	6.08	7.33	.....	8.42	8.29	8.50	7.92
2	6.71	7.29	6.75	.....	6.08	7.33	8.00	8.33	.....	8.33	7.92
3	6.54	7.21	6.67	5.83	6.08	.....	.....	8.33	9.00	8.33	7.75
4	6.29	.....	6.67	5.83	.....	7.67	8.00	8.33	8.42	8.42	.....
5	.....	7.38	6.33	5.83	6.33	7.67	8.00	.....	8.50	8.42	7.75
6	6.25	7.38	8.25	5.83	.....	7.83	8.17	8.33	8.58	8.42	7.67
7	6.46	7.42	6.25	5.92	6.83	7.83	8.33	8.33	8.33	.....	7.75
8	6.67	8.08	6.42	.....	6.50	8.00	.....	8.50	8.50	.....	.....
9	7.00	8.67	6.50	5.25	6.67	8.17	8.00	8.33	.....	8.50	.....
10	7.08	8.50	6.50	5.33	6.83	.....	8.08	8.42	7.08	8.50	.....
11	7.00	.....	.....	5.25	6.83	8.08	8.00	8.33	8.58	8.50	.....
12	7.00	7.75	6.33	5.17	.....	8.08	8.17	.....	9.00	8.50	.....
13	6.75	7.75	6.33	5.17	.....	8.25	8.17	8.42	8.55	8.67	.....
14	.....	7.58	6.42	5.21	7.08	7.50	8.33	8.50	8.33	8.58	.....
15	6.17	7.38	6.38	.....	7.08	7.50	.....	8.42	8.75	.....	.....
16	6.13	7.25	6.33	5.25	7.00	7.50	8.08	8.33	10.58	8.58	.....
17	6.13	7.33	6.38	5.25	7.00	.....	8.25	8.33	.....	8.67	.....
18	6.25	.....	.....	5.25	7.00	7.50	8.33	9.08	.....	8.42	.....
19	6.29	7.33	6.50	5.33	7.08	7.58	8.33	.....	8.67	8.75	.....
20	6.25	7.21	6.50	5.25	.....	7.58	8.33	9.50	8.50	8.50	.....
21	.....	7.17	6.46	5.50	7.08	7.67	8.42	8.50	9.17	.....	.....
22	6.42	7.00	.....	.....	7.08	7.67	.....	8.33	8.67	8.33	.....
23	6.42	7.00	6.33	5.54	7.08	7.83	8.33	8.42	.....	8.33	.....
24	6.50	7.00	6.38	5.63	7.08	.....	8.33	8.50	9.33	8.33	.....
25	6.33	.....	.....	5.75	7.25	7.67	8.42	8.42	8.50	8.42	.....
26	6.29	6.75	6.13	5.75	7.33	7.50	.....	8.42	8.50	8.50	.....
27	7.42	6.79	6.13	5.79	.....	7.67	8.33	8.50	8.50	8.33	.....
28	7.08	6.79	6.17	5.75	7.33	.....	8.42	8.50	8.50	.....	.....
29	7.42	.....	5.83	.....	7.33	8.17	.....	8.00	8.50	8.08	.....
30	7.25	.....	5.75	6.00	7.33	8.25	8.42	8.17	.....	8.33	.....
31	7.25	.....	5.75	.....	7.33	.....	8.42	8.33	.....	8.33	.....

SALMON RIVER AT ORWELL, NEW YORK.

This river rises in Lewis County, New York, and flows in a westerly direction into Lake Ontario, a portion of its course being shown on the Pulaski atlas sheet of the United States Geological Survey. At a point about a mile below Orwell are Salmon Falls, where the river has a yertical descent of about 110 feet, but at present no attempt

has been made to utilize it. Observations were made at Orwell, at which locality the river has a drainage area of 190.5 square miles. The gages are at an old wooden dam built to furnish power for a sawmill. The dam is considerably out of repair and leaks badly. When the station was first established current-meter measurements were made of this leakage, and it was found to be 88 cubic feet per second. The profile of the crest is irregular, and in order to facilitate computation is divided into four parts, each section being computed separately and the sum total taken as the entire flow. The station was abandoned May 31, 1899, on account of the leakage through the dam, which it was difficult to estimate accurately. The results are not at present available for publication.

BLACK RIVER AT WATERTOWN, NEW YORK.

This river rises in Herkimer County and flows in a northeasterly direction into Black River Bay, an arm of Lake Ontario. A portion of its course is shown on the Watertown atlas sheet of the United States Geological Survey. Observations of the height of water have been made at the dam of the city waterworks of Watertown, located 2 miles above, at Huntingtonville. The station was established on February 22, 1897. The record in the following table has been furnished by Frank A. Hinds, civil engineer. It is the average of two daily readings.

The readings from August 22 to September 16, 1897, do not give reliable data, as the high dam on the opposite channel of the river developed a leak, which gradually increased until it became necessary to open the traps in the dam, letting the water down so that it could be repaired. It is possible that this leak commenced earlier than August 22. The conditions at this point are peculiar, in that the stream flows in two channels with an island between. There is a dam on each channel, the high dam, previously referred to, creating a settling basin for the water supply of the city of Watertown. The other dam, known as the Huntingtonville, on the opposite side of the island, is the one near which the readings given herewith are taken.

In addition to the amount of water which is indicated by the flow over this (the Huntingtonville) dam, there should be added the quantity taken from the other channel above the high dam to supply water for the city of Watertown. There is also constant leakage from seams in the rock underneath the Huntingtonville dam, where the observations are made. This quantity has been variously estimated, but direct measurements have not been made. In the following table the original readings have been diminished by dropping the figure 100; for example, the reading on February 22, 1897, of 103.10 is given below as 3.10. In a few instances this has introduced a minus quantity when the surface dropped below 100, as was the case on October 3, and 8 to 11, 1897.

The crest of the dam is irregular in profile, and for ease of computation is divided into six parts, each of these being considered horizontal.

The discharge of the river was computed by Mr. Robert E. Horton. The results, however, have been revised several times upon the acquisition of new information. Another record of Black River has been kept by the Taggart Company at Felts Mills, about 10 miles above Watertown, covering a somewhat longer period of time than that at Huntingtonville, but the figures are not at present available.

Daily gage height, in feet, of Black River at Huntingtonville dam, for 1897.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.00	4.20	5.01	3.73	2.89	3.20	1.28	0.35	2.68	4.63
2	.....	.....	4.23	4.83	3.58	2.88	3.16	.95	.37	2.84	4.40
3	.....	.....	4.40	4.56	3.40	2.93	3.15	1.26	.02	3.21	3.57
4	.....	.....	4.48	4.41	3.57	2.85	3.03	1.44	.10	3.50	3.45
5	.....	3.32	4.90	4.58	3.72	2.79	2.85	1.14	.18	3.42	3.75
6	.....	3.58	5.03	4.49	3.65	2.71	2.79	1.55	.10	3.25	4.10
7	.....	3.69	5.22	4.43	3.49	2.93	2.70	1.65	.03	3.20	4.26
8	.....	3.74	5.48	4.12	3.40	2.75	2.49	1.55	.02	3.34	4.31
9	.....	3.80	5.60	3.83	3.30	2.73	2.64	1.49	.44	3.35	4.38
10	.....	3.98	5.60	3.59	4.05	2.77	2.70	1.47	.63	3.56	4.40
11	.....	4.35	5.40	3.59	4.48	2.64	3.60	1.23	.10	4.02	4.77
12	.....	4.43	5.05	3.45	4.54	2.67	4.63	.78	.35	4.03	4.83
13	.....	4.58	4.75	3.47	4.43	2.82	4.74	.71	1.68	4.15	4.70
14	.....	4.50	4.64	3.63	4.03	2.69	4.40	.80	2.92	3.92	4.60
15	.....	4.35	4.70	4.08	3.73	2.95	3.75	.35	3.00	3.82	4.73
16	.....	4.20	4.88	4.23	3.55	2.99	3.42	.00	3.45	3.63	4.91
17	.....	4.00	5.07	4.10	3.44	2.95	3.20	1.25	2.83	3.95	5.00
18	.....	3.90	5.15	3.95	3.31	2.90	3.30	1.40	2.98	4.23	4.96
19	.....	3.88	5.24	3.72	3.18	2.87	3.44	1.08	2.95	4.24	4.46
20	.....	4.38	5.18	3.64	3.10	2.89	3.23	1.28	2.88	3.90	3.75
21	.....	5.20	5.24	3.46	3.33	2.90	3.03	1.18	2.83	3.60	3.68
22	3.10	5.10	5.16	3.51	3.53	2.85	2.91	1.33	2.80	3.73	3.68
23	3.10	5.48	4.95	3.65	3.39	2.76	2.89	1.38	2.79	3.57	3.66
24	3.50	6.48	4.82	3.44	3.23	2.70	2.74	1.25	2.60	3.35	3.50
25	3.25	6.10	5.13	3.47	3.07	2.60	2.63	1.25	2.88	3.25	3.43
26	3.75	5.70	5.53	3.90	2.99	2.90	2.66	1.30	2.77	3.74	3.47
27	.....	5.45	5.80	4.13	2.89	2.87	2.67	1.30	2.79	4.90	3.39
28	.....	4.88	6.07	4.03	2.99	2.85	2.44	1.65	2.83	5.13	3.36
29	.....	4.48	6.01	3.92	2.89	3.00	2.34	1.58	2.75	5.28	3.32
30	.....	4.30	5.41	3.85	2.87	3.28	1.97	.33	2.75	4.92	3.30
31	.....	4.30	.....	3.80	.....	3.30	.63	.....	2.73	.....	3.23

Daily gage height, in feet, of Black River at Huntingtonville dam, for 1898.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.21	3.55	3.40	4.75	4.03	3.55	3.09	2.95	3.01	3.14	3.65	3.48
2	3.39	3.60	3.50	4.59	3.73	3.42	3.04	3.15	3.00	2.91	3.53	3.45
3	3.28	3.57	3.40	4.20	3.78	3.31	2.84	2.96	2.95	2.94	3.50	3.45
4	3.30	3.50	3.40	3.90	3.83	3.23	2.80	3.03	2.45	2.95	3.43	3.38
5	3.34	3.55	3.35	3.80	3.89	3.21	2.95	3.10	3.05	3.08	3.40	3.40
6	3.30	3.45	3.35	3.80	4.13	3.14	2.94	3.26	3.22	3.55	3.37	3.38
7	3.25	3.50	3.35	3.75	4.08	3.13	2.98	3.20	3.19	3.70	3.65	3.28
8	3.15	3.50	3.37	3.73	3.75	3.05	2.91	3.15	3.20	3.58	3.60	3.23
9	3.25	3.45	3.52	3.65	3.55	2.98	2.88	3.01	3.28	3.27	3.60	3.18
10	3.23	3.40	3.75	3.63	3.60	3.01	2.76	2.95	3.23	3.28	3.60	3.19
11	3.23	3.68	4.53	3.63	3.45	3.11	2.82	2.95	3.10	3.19	4.98	3.13
12	3.22	4.65	5.75	3.56	3.28	3.03	2.90	2.98	3.11	3.06	5.15	3.23
13	3.63	4.93	6.75	3.51	3.80	3.05	2.90	3.05	3.03	3.03	5.13	3.23
14	4.00	4.75	7.50	3.53	3.86	3.23	2.89	3.02	2.88	3.16	5.05	3.25
15	4.10	4.55	8.10	3.60	3.72	3.35	2.90	2.70	2.90	3.53	4.78	3.25
16	4.04	4.30	7.55	3.59	3.51	3.31	2.90	3.01	2.85	3.77	4.48	3.26
17	3.99	4.05	6.70	3.48	3.50	3.23	2.88	2.90	2.84	4.03	4.08	3.30
18	3.88	3.90	6.20	3.38	3.42	3.13	2.90	2.85	2.62	3.85	3.88	3.25
19	3.78	3.80	6.00	3.48	3.35	2.97	3.09	2.88	2.80	3.62	3.70	3.28
20	3.75	3.73	5.74	3.58	3.48	3.25	2.97	2.87	2.81	3.53	3.61	3.33
21	4.00	3.85	5.83	3.85	3.58	3.35	3.00	2.88	2.96	3.52	3.71	3.33
22	4.35	3.91	5.97	3.99	3.53	3.30	3.00	2.81	2.92	3.61	3.71	3.48
23	4.35	3.89	5.87	4.25	3.44	3.23	3.00	2.95	2.85	4.02	3.63	3.98
24	4.48	3.80	5.55	4.53	3.48	3.18	2.87	3.35	3.10	4.31	3.71	4.34
25	4.43	3.69	5.18	4.73	3.55	3.05	3.03	3.50	3.54	4.08	3.56	4.30
26	4.32	3.60	4.95	5.09	3.58	3.00	3.30	3.65	3.58	3.93	3.48	4.22
27	4.12	3.55	4.65	5.33	3.85	2.93	3.20	3.66	3.55	4.33	3.18	4.00
28	3.90	3.65	4.48	5.24	3.93	3.05	3.05	3.53	3.43	4.60	3.31	3.75
29	3.74	.....	4.51	4.85	3.73	3.04	3.06	3.30	3.39	4.57	3.41	3.65
30	3.59	.....	4.75	4.40	3.69	3.03	3.03	3.10	3.25	4.25	3.50	3.83
31	3.60	.....	4.88	.....	3.66	.....	3.12	3.08	.....	3.90	.....	4.14

Daily gage height, in feet, of Black River at Huntingtonville dam, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.98	3.28	3.79	3.95	6.71	3.65	3.10	2.88	2.89	2.88	3.38	2.98
2	3.91	3.33	3.70	3.89	6.43	3.43	2.91	2.90	3.01	2.88	3.75	2.99
3	3.74	3.31	3.69	3.86	6.20	3.38	2.90	2.95	2.70	3.10	3.93	3.08
4	3.80	3.30	3.72	3.79	5.99	3.23	2.88	2.90	2.95	3.05	3.69	3.33
5	5.38	3.30	3.88	3.80	5.70	3.18	3.07	2.83	2.60	2.98	3.59	3.32
6	5.25	3.30	4.23	3.91	5.20	3.20	3.09	2.73	2.90	2.91	3.53	3.18
7	5.05	3.30	4.43	4.06	4.79	3.18	3.15	2.80	2.85	2.91	3.43	3.10
8	5.05	3.30	4.32	4.65	4.21	3.13	3.10	2.85	2.91	2.73	3.25	3.00
9	4.89	3.30	4.21	4.92	3.95	3.05	2.98	2.90	2.93	2.92	3.24	2.99
10	4.63	3.29	4.08	4.96	3.83	3.13	3.26	2.83	2.91	2.83	3.10	2.95
11	4.30	3.25	3.95	5.09	3.73	3.00	3.50	2.76	3.00	2.88	3.08	3.18
12	4.05	3.29	4.24	5.43	3.83	3.13	3.35	2.73	2.73	2.80	2.93	4.15
13	3.93	3.38	4.93	5.51	3.88	3.05	3.21	2.75	3.05	2.81	3.09	4.98
14	3.90	3.38	4.90	5.71	3.70	3.05	3.13	2.76	2.70	2.81	2.96	4.98
15	4.11	3.38	4.84	5.99	3.60	2.96	3.08	2.92	2.74	2.81	3.00	4.88
16	4.39	3.35	4.65	6.01	3.63	3.10	2.91	2.95	2.98	2.74	3.06	4.35
17	4.41	3.37	4.60	6.06	3.65	3.10	2.87	2.93	2.78	2.90	3.10	3.53
18	4.30	3.29	4.40	6.06	3.83	3.10	2.90	3.16	3.00	2.89	3.10	3.71
19	4.25	3.25	4.25	6.17	3.63	3.18	3.03	2.90	2.98	2.92	2.93	4.11
20	3.65	3.30	4.09	6.61	3.85	3.05	2.88	2.75	2.75	2.94	2.95	4.30
21	3.84	3.33	4.10	7.13	4.05	3.00	2.88	2.63	2.80	2.83	3.01	4.55
22	3.73	3.42	4.09	7.64	4.01	3.00	2.90	2.90	2.93	2.63	2.98	4.60
23	3.68	3.61	4.10	7.71	3.85	3.00	2.89	2.85	2.75	2.90	2.93	4.20
24	3.60	3.76	4.20	7.72	3.77	3.05	3.00	2.83	2.70	2.88	2.99	4.10
25	3.55	3.75	4.17	7.70	3.59	3.02	3.05	3.01	2.99	2.93	2.95	4.00
26	3.59	3.65	4.13	7.72	3.44	3.03	2.96	2.95	2.95	2.95	2.79	3.60
27	3.50	3.75	4.08	7.62	3.46	3.13	2.92	2.83	2.99	2.95	2.94	3.48
28	3.43	3.78	3.98	7.51	3.43	3.05	2.94	2.84	2.99	2.95	2.96	3.40
29	3.30	4.10	3.94	7.34	3.42	2.98	2.82	2.85	2.99	2.93	2.93	3.38
30	3.40	4.10	4.08	7.06	3.73	3.05	2.65	2.90	3.03	3.03	2.86	3.38
31	3.34	-------	3.97	-------	3.75	-------	2.68	2.88	-------	3.28	-------	3.23

ST. LAWRENCE RIVER NEAR MONTREAL, CANADA.

St. Lawrence River receives the outflow of the Great Lakes, and, discharging northeasterly, is joined by Ottawa River near the city of Montreal. About 50 miles below Montreal the river widens into what is known as Lake St. Peter. At the upper end of this lake is the town of Sorel, at which is one of the important gages for recording the height of the stream. The discharge of the river has been measured at a point about 40 miles below Montreal and a mile below the wharf at the town of Lanoraie, this place being chosen because of the excellent form of the channel. The width of the river here is between 3,000 and 3,300 feet, and the depth at low stages about 40 feet. The first measurement was made by Mr. W. J. Sproule, under the direction of the Montreal Flood Commission, by means of rod floats, on November 9 and 13, 1886. At that time the height of water was 11 feet 9 inches on the flats of Lake St. Peter. The area of cross section was 115,298 square feet, and the discharge 311,101 second-feet.[1] The next measurements were made by Prof. C. H. McLeod, of McGill University, Montreal, on November 13 and 14, 1895. At that time the water was 8 feet 9 inches in depth on the flats of Lake St. Peter, the area was 105,432 square feet, and the discharge 215,621 second-feet. The lowest water of that year (1895) occurred in the latter part of October and early in November, the water level being at the time of measurement 7 inches above the lowest

[1] Discharge of the St. Lawrence River, by Prof. C. H. McLeod: Trans. Can. Soc. Civil Engineers, Vol. X, Part I, 1896, p. 129.

point previously recorded. It is estimated that at the lowest stage of that year, which is the lowest on record, the cross section was reduced about 2 per cent, and the discharge was estimated to have been 196,000 second-feet.

On October 23 and 24, 1896, another measurement was made by Professor McLeod, giving an area of cross section of 117,500 square feet and a discharge of 258,500 second-feet. At this date the depth of water on the flats of Lake St. Peter was 10 feet and 7 inches. All depths on these flats have been obtained by reduction from the zero readings taken on the gage at Sorel, the zero of which is said to correspond to 9 feet 6 inches below the level of the flats, and to +0.05 on Steikel's datum, as noted in the Reports of the Public Works Department, Canada, for 1890–91. The height of water at this section is known to be influenced slightly by the tides, but the effect on the discharge has not been investigated.

The discharge of Ottawa River was measured on September 27 and 28, 1899, at a point about 2 miles below the dam at Carillon. The cross section measured 50,000 square feet and the discharge 39,600 second-feet. At the time of the measurement the reading of the gage at Lock No. 1 of Carillon Canal gave 12.0 feet on the lower sill.

MISSISSIPPI RIVER AT ST. PAUL, MINNESOTA.

Measurements of discharge of the Mississippi River at St. Paul, below the mouth of the Minnesota River, have been made for a number of years by the Engineer Corps of the United States Army. The object of the measurements is the determination of the effect of the reservoirs at the head of the Mississippi River in maintaining deep or navigable water during the periods of drought. Measurements and computations of the amount of water discharged from reservoirs at such seasons are made and comparisons had with the behavior of the river at St. Paul and lower places. Observations of river height are made at the United States Weather Bureau gage located on a wharf near the foot of Jackson street. The zero of this gage is at an elevation of 683.334 feet. The measurements are made from a boat, at a section about halfway between Wabash street bridge and Roberts street bridge, in the city of St. Paul. Every time a series of observations are made two wires are stretched across the river parallel to each other and at a distance of 13 feet apart. Upon the completion of the measurement the wires are reeled up separately on apparatus especially constructed for the purpose, as it is impossible to maintain permanent cables across the river, on account of obstructing navigation. The bridges in the city are too high for satisfactory work. Records of height are maintained by the United States Weather Bureau and are furnished to this office. Results of measurements may be found as follows: 1897, Nineteenth Annual Report, Part IV, page 267; 1898, Twentieth Annual Report, Part IV, page 230.

Daily gage height, in feet, of Mississippi River at St. Paul, Minnesota, for 1899.[1]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	Frozen.	Frozen.	Frozen.	Frozen.	6.4	5.7	8.7	4.0	7.5	4.4	7.2	4.7
2	....do..	....do..	....do..	....do..	6.6	6.6	8.7	3.8	7.2	4.3	7.1	4.7
3	....do..	....do..	....do..	....do..	6.8	7.7	8.5	3.7	6.9	4.2	7.0	4.6
4	....do..	....do..	....do..	....do..	7.0	8.2	8.3	3.7	6.7	4.2	6.8	4.5
5	....do..	....do..	....do..	....do..	7.1	8.5	8.0	3.6	6.4	4.2	6.7	4.2
6	....do..	....do..	....do..	....do..	7.2	8.7	7.8	3.5	6.2	4.1	6.6	3.2
7	....do..	....do..	....do..	....do..	7.5	9.2	7.5	3.5	6.2	4.1	6.5	2.5
8	....do..	....do..	....do..	5.0	7.6	9.6	7.3	3.5	6.1	4.1	6.4	2.5
9	....do..	....do..	....do..	6.9	7.5	9.7	7.0	3.5	5.9	4.0	6.2	3.2
10	....do..	....do..	....do..	7.4	7.2	9.8	6.8	3.7	5.8	4.0	6.1	4.2
11	....do..	....do..	....do..	7.5	6.9	9.9	6.5	3.9	5.7	4.0	6.0	4.6
12	....do..	....do..	....do..	8.1	6.7	9.7	6.2	4.0	5.7	4.1	6.0	4.4
13	....do..	....do..	....do..	9.8	6.5	9.9	6.0	4.1	5.7	4.1	5.9	Frozen.
14	....do..	....do..	....do..	10.5	6.2	10.0	5.9	3.8	5.6	4.3	5.8	Do.
15	....do..	....do..	....do..	10.3	6.1	10.3	5.9	3.8	5.6	4.4	5.7	Do.
16	....do..	....do..	....do..	10.4	6.0	10.5	6.0	3.8	5.6	4.6	5.6	Do.
17	....do..	....do..	....do..	10.4	6.1	10.6	5.7	4.0	5.5	5.3	5.5	Do.
18	....do..	....do..	....do..	10.4	6.1	10.8	5.4	4.0	5.3	5.8	5.4	Do.
19	....do..	....do..	....do..	10.1	6.0	10.9	5.2	4.0	5.2	6.7	5.4	Do.
20	....do..	....do..	....do..	9.5	5.9	10.9	5.1	4.3	5.1	7.5	5.3	Do.
21	....do..	....do..	....do..	8.8	5.9	10.9	5.0	4.6	5.0	8.0	5.2	*a*4.8
22	....do..	....do..	....do..	8.0	5.9	11.0	5.0	5.8	5.0	8.4	5.1	*a*4.8
23	....do..	....do..	....do..	7.4	5.9	11.0	5.0	6.6	5.0	8.7	5.0	*a*4.8
24	....do..	....do..	....do..	7.0	5.8	10.9	4.8	8.0	5.0	8.8	5.0	*a*4.8
25	....do..	....do..	....do..	6.7	5.8	10.7	4.7	8.7	4.9	8.7	5.0	*a*4.8
26	....do..	....do..	....do..	6.5	5.8	10.3	4.6	8.8	4.9	8.6	5.0	*a*4.8
27	....do..	....do..	....do..	6.3	5.7	9.9	4.5	8.7	4.8	8.2	4.9	*a*4.8
28	....do..	....do..	....do..	6.1	5.8	9.5	4.3	8.5	4.8	8.0	4.9	*a*4.8
29	....do..	.....	....do..	6.1	5.8	9.2	4.2	8.3	4.7	7.8	4.8	*a*4.6
30	....do..	.....	....do..	6.2	5.7	8.8	4.1	8.0	4.5	7.6	4.8	*a*4.6
31	....do..	.....	....do..	.....	5.7	.....	4.0	7.7	.....	7.4	.....	*a*4.6

a Estimated.

WEST GALLATIN RIVER AT SALESVILLE, MONTANA.

This stream has its source in the northwestern corner of Yellowstone National Park and flows in a northerly direction, joining Madison and Gallatin rivers near Threeforks to form the Missouri River. The upper 75 miles of its course is in a canyon the scenery of which rivals many of the noted canyons of Yellowstone National Park. Surveys for a road up this canyon have been made in order to reach the road system that the Government has built in the park, but the plans have not yet been carried out. About 10 miles above Salesville, Montana, the river leaves its canyon and enters the Gallatin Valley, which has an extent, in round numbers, of 1,200 square miles. This area has been noted for a number of years for its fertility; immense crops of hay and cereals are yearly matured here. The land is irrigated from canals taken from the Gallatin River and a number of tributaries, including Middle Creek, Bozeman Creek, and East Gallatin River. On certain bench lands against the sides of the surrounding mountains dry farming is practiced, or, in other words, crops are raised without irrigation. Two gaging stations are maintained on this river, one near Salesville and the other at Logan, near its mouth. The Salesville station, which has been maintained for a number of years, is located at the highway bridge crossing the stream about 5 miles south of Salesville. Kleinschmidt ditch, having a capacity of 75 second-feet but carrying of late years not over 40 second-feet, diverts water from the river above the station. A gage rod was erected in 1895 and

[1] Records kept by United States Weather Bureau.

spiked to a tree; in 1896 a wire gage was placed on the bridge, and the two gages made to read the same. The bench mark is the head of the southwest bolt in the rim of the southeast cylindrical pier, and its elevation is 13.70 feet above gage datum. The observer is Ira T. Williams, of Salesville, Montana. The results of discharge measurements are shown as follows: 1896, Eighteenth Annual Report, Part IV, page 126; 1897, Nineteenth Annual Report, Part IV, page 276; 1898, Twentieth Annual Report, Part IV, page 241. The following measurements were made under the supervision of Samuel Fortier during 1899:

March 21, gage height, 2.90 feet; discharge, 474 second-feet.
April 6, gage height, 2.80 feet; discharge, 766 second-feet.
April 13, gage height, 3.25 feet; discharge, 719 second-feet.
May 1, gage height, 3.40 feet; discharge, 830 second-feet.
May 9, gage height, 4.00 feet; discharge, 1,056 second-feet.
June 10, gage height, 5.35 feet; discharge, 2,607 second-feet.
August 30, gage height, 3.88 feet; discharge, 711 second-feet.

Daily gage height, in feet, of West Gallatin River at Salesville, Montana, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.10	2.70	.....	.....	3.30	4.70	7.30	4.60	3.80	3.50	.....	.....
2	3.10	.....	.....	2.80	3.20	5.10	7.30	4.50	3.80	3.50	.....	.....
3	3.10	.....	.....	2.80	3.10	5.50	7.30	4.50	3.80	3.50	.....	3.10
4	3.10	.....	.....	2.80	3.20	6.10	7.30	4.50	3.70	3.50	.....	.....
5	3.10	3.10	2.90	2.80	3.30	5.65	7.20	4.50	3.70	3.50	3.50	.....
6	3.10	.....	.....	2.80	3.40	5.00	7.20	4.40	3.70	3.50	.....	.....
7	3.10	.....	.....	2.90	3.50	5.00	7.10	4.40	3.70	3.50	.....	.....
8	3.10	.....	2.90	3.20	3.70	4.95	7.05	4.35	3.70	3.50	.....	.....
9	3.10	.....	.....	3.30	3.90	5.05	7.00	4.30	3.70	3.50	.....	.....
10	3.10	.....	.....	3.30	3.90	4.30	6.95	4.30	3.70	3.50	.....	3.10
11	.....	.....	.....	3.30	4.00	5.70	6.85	4.20	3.60	3.50	.....	.....
12	.....	3.10	2.90	3.30	4.10	6.05	6.75	4.20	3.60	3.50	3.50	.....
13	.....	.....	.....	3.20	4.00	6.15	6.45	4.20	3.60	3.50	.....	.....
14	.....	.....	.....	3.10	3.90	6.50	6.25	4.10	3.60	3.50	.....	.....
15	3.04	.....	.....	3.10	3.90	6.95	5.95	4.10	3.60	3.50	.....	.....
16	.....	.....	.....	3.20	3.90	7.05	5.75	4.10	3.60	3.50	.....	.....
17	.....	.....	2.90	3.10	3.85	7.25	5.55	4.10	3.60	3.50	.....	3.40
18	.....	.....	.....	3.00	3.80	7.60	5.40	4.10	3.60	3.50	.....	.....
19	3.00	3.00	2.90	3.00	3.80	8.10	5.30	4.10	3.60	3.50	3.50	.....
20	.....	.....	.....	3.00	3.80	8.55	5.30	4.10	3.60	3.50	.....	.....
21	.....	.....	.....	3.10	3.90	8.10	5.30	4.00	3.60	3.50	.....	.....
22	.....	.....	.....	3.20	4.15	7.35	5.20	3.90	3.60	3.50	.....	.....
23	.....	.....	.....	3.30	4.30	6.70	5.10	3.90	3.60	3.50	.....	.....
24	.....	.....	2.90	3.30	4.50	6.90	5.00	3.90	3.60	3.50	.....	3.30
25	2.90	.....	.....	3.30	4.55	7.00	5.00	3.90	3.60	3.50	.....	.....
26	.....	2.90	.....	3.40	4.65	7.10	4.90	3.90	3.50	3.50	3.50	.....
27	.....	.....	.....	3.50	4.55	7.20	4.85	3.90	3.50	3.50	.....	.....
28	.....	.....	.....	3.30	4.50	7.20	4.80	3.90	3.50	3.50	.....	.....
29	2.80	.....	.....	3.30	4.60	7.20	4.70	3.80	3.50	.....	.....	.....
30	.....	.....	.....	3.30	4.65	7.30	4.70	3.80	3.50	.....	.....	.....
31	.....	.....	2.80	3.30	4.70	.....	4.60	3.80	.....	.....	.....	.....

MIDDLE CREEK NEAR BOZEMAN, MONTANA.

This creek, a tributary of East Gallatin River, has its source on the northern slope of the Gallatin Range. Although it drains a small area, it is an important stream, on account of its water supply, which is used for irrigation purposes in the vicinity of Bozeman. The gaging station is located 9 miles south of Bozeman and one-eighth of a mile above the old sawmill dam in the creek canyon. Discharge measurements are made from a wire cable placed across the stream in 1898. The gage is about 200 feet below the cable, and consists of a hori-

zontal frame supporting a wire gage. Bench mark No. 1 consists of a spike driven horizontally into a stump 5 feet high about 80 feet east of the gage rod. The middle of this spike is at an elevation of 7.03 feet above gage datum. Bench mark No. 2 consists of an 8-inch bridge spike driven horizontally into a charred stump about 25 feet northeast of the gage, with an elevation of 3.58 feet. Bench mark No. 3 consists of a large rock 93 feet east of the gage, marked "B. M." in black paint, and is 4.84 feet above gage datum. Results of discharge measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 128; 1898, Twentieth Annual Report, Part IV, page 243. The following measurements were made under the direction of Samuel Fortier during 1899:

Measurements of Middle Creek near Bozeman, Montana.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.	*Feet.*	*Sec.-feet.*	1899.	*Feet.*	*Sec.-feet.*
Mar. 14	0.05	78	June 28	1.20	426
Apr. 4	.05	86	July 7	.98	440
Apr. 12	.05	79	July 18	.80	384
May 7	.10	92	July 26	.60	246
June 16	.90	351	Aug. 26	.15	77

Daily gage height, in feet, of Middle Creek at Bozeman, Montana, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1						0.70	1.30	0.40	0.10	0.00
2						1.20	1.10	.40	.10	.05
3	—0.25					1.10	1.00	.40	.13	.00
4						1.70	.95	.40	.10	.00
5						1.00	1.00	.40	.10	.00
6		—0.15				.80	1.00	.35	.10	.00
7			—0.05		0.20	.70	.95	.40	.10	.00
8					.20	.60	1.10	.35	.10	.08
9			— .10		.28	.70	1.00	.35	.10	.00
10					.40	.85	1.20	.30	.08	.00
11					.50	1.10	1.60	.30	.08	.00
12	.00				.43	1.20	.95	.30	.05	.00
13			— .08		.35	.90	.90	.30	.05	.00
14			— .08		.30	.80	.85	.25	.05	.00
15					.20	.80	.80	.20	.05	.00
16					.23	1.10	.80	.20		.00
17	— .10				.30	1.50	.80	.20	.04	.00
18					.28	1.60	.80	.20	.04	.00
19					.30	1.60	.95	.20	.03	.00
20					.28	1.70	.85	.20	.01	.00
21					.25	1.60	.75	.15	.01	.00
22					.23	1.40	.60	.15	.01	.00
23		— .60	— .05		.30	1.60	.55	.15	.01	.00
24	— .10				.68	1.00	.50	.15	.00	.00
25					.70	1.35	.65	.15	.00	.00
26					.65	1.35	.60	.15	.00	.00
27					.60	1.35	.60	.10	.00	.00
28		— .75	— .08		.70	1.15	.50	.10	.00	.00
29					.70	1.50	.50	.10	.00	.00
30	— .10		— .05		.50	1.30	.45	.10	.00	.00
31					.70		.40	.10		.00

GALLATIN RIVER AT LOGAN, MONTANA.

The main Gallatin River is formed by the junction of the East and West Gallatin rivers 5 miles above Logan. The wire gage is located on the east span of the railroad bridge. Bench mark No. 1 is the top

of the northeast corner of the iron plate at foot of diagonal end member of truss east end upper side, and is 13.70 feet above datum. Bench mark No. 2 consists of the head of a bridge spike driven vertically into the top of a pile stump, to which the lower end of the old incline gage is fastened; it is 0.162 foot above gage datum. Discharge measurements are made from the cable across the river 300 feet above the railroad bridge, and show the amount of water available after the diversion as above. The section is a good one, the channel being straight for some distance above and below the gaging cable. The results of measurements are published as follows: 1896, Eighteenth Annual Report, Part IV, page 129; 1897, Nineteenth Annual Report, Part IV, page 278; 1898, Twentieth Annual Report, Part IV, page 240. The following measurements were made under the direction of Samuel Fortier during 1899:

March 18, gage height, 1.00 foot; discharge, 580 second-feet.
April 9, gage height, 1.90 feet; discharge, 1,120 second-feet.
April 24, gage height, 1.60 feet; discharge, 1,089 second-feet.
May 22, gage height, 2.20 feet; discharge, 1,786 second-feet.
July 14, gage height, 3.00 feet; discharge, 1,079 second-feet.
July 30, gage height, 1.90 feet; discharge, 760 second-feet.

Daily gage height, in feet, of Gallatin River at Logan, Montana, for 1899.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.00	1.50	3.05	5.00	1.90	1.50	1.30	1.50	.....
2	.....	1.00	1.50	3.10	5.00	1.80	1.50	1.30	1.50	.....
3	.....	1.00	1.50	3.35	4.45	1.80	1.40	1.30	1.50	.....
4	.....	1.15	1.50	4.10	4.30	1.80	1.40	1.30	1.50	.....
5	.....	1.05	1.50	4.05	4.05	1.80	1.40	1.30	.....	.....
6	1.00	1.40	1.55	3.80	3.90	1.80	1.40	1.30	.....	1.50
7	1.20	1.80	1.60	3.45	3.75	1.80	1.40	1.30	.....	.....
8	1.35	1.95	1.65	3.25	3.55	1.80	1.40	1.30	1.50	.....
9	1.45	2.65	1.85	3.10	3.50	1.80	1.40	1.30	.....	.....
10	1.25	3.25	2.20	3.35	3.50	1.90	1.40	1.30	.....	.....
11	1.10	2.85	2.35	3.65	3.50	1.90	1.40	1.30	.....	.....
12	1.00	3.10	2.45	4.25	3.30	1.90	1.40	1.30	.....	.....
13	1.00	2.70	2.60	4.35	3.05	1.90	1.40	1.30	.....	1.60
14	1.00	2.40	2.75	4.05	3.00	1.90	1.40	1.30	.....	.....
15	1.00	1.85	2.80	3.80	2.90	1.90	1.40	1.30	1.50	.....
16	1.00	2.15	2.75	4.00	2.80	1.80	1.40	1.30	.....	.....
17	1.00	2.00	2.80	4.35	2.70	1.80	1.40	1.30	.....	.....
18	1.00	1.90	2.55	5.25	2.60	1.70	1.40	1.30	.....	.....
19	1.00	1.80	2.00	5.65	2.60	1.70	1.40	1.30	.....	.....
20	1.00	1.80	1.90	5.90	2.45	1.70	1.40	1.30	.....	1.60
21	1.10	1.50	1.90	6.25	2.40	1.70	1.40	1.30	.....	.....
22	1.10	1.75	2.05	5.60	2.40	1.70	1.40	1.30	1.50	.....
23	1.10	1.70	2.15	4.90	2.35	1.65	1.30	1.50	.....	.....
24	1.20	1.60	2.45	4.75	2.25	1.60	1.30	1.70	.....	.....
25	1.50	1.60	2.75	4.85	2.10	1.60	1.30	1.65	.....	.....
26	1.35	1.60	2.90	5.20	2.00	1.60	1.30	1.60	.....	.....
27	1.30	1.60	2.90	5.20	1.90	1.60	1.30	1.50	.....	.....
28	1.10	1.60	2.90	5.00	1.90	1.60	1.30	1.50	.....	.....
29	1.00	1.60	2.90	5.10	1.90	1.55	1.30	1.50	1.60	(a)
30	1.00	1.60	3.00	5.05	1.90	1.50	1.30	1.50	.....	.....
31	1.00	.....	3.05	.....	1.90	1.50	.....	1.50	.....	.....

January 1 to March 6 river frozen; no readings. *a* Frozen.

A measurement of Bridger Creek, a tributary of East Gallatin River, was made August 3 at the highway bridge at the fish hatchery in the canyon, and showed a discharge of 25 second-feet.

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