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OF THE

UNITED STATES GEOLOGICAL SURVEY.

No. 37

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OPERATIONS AT RIVER STATIONS, 1899.—PART III

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WASHINGTON  
GOVERNMENT PRINTING OFFICE  
1900



UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

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OPERATIONS AT RIVER STATIONS, 1899

A REPORT OF THE

DIVISION OF HYDROGRAPHY

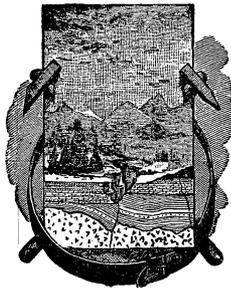
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PART III

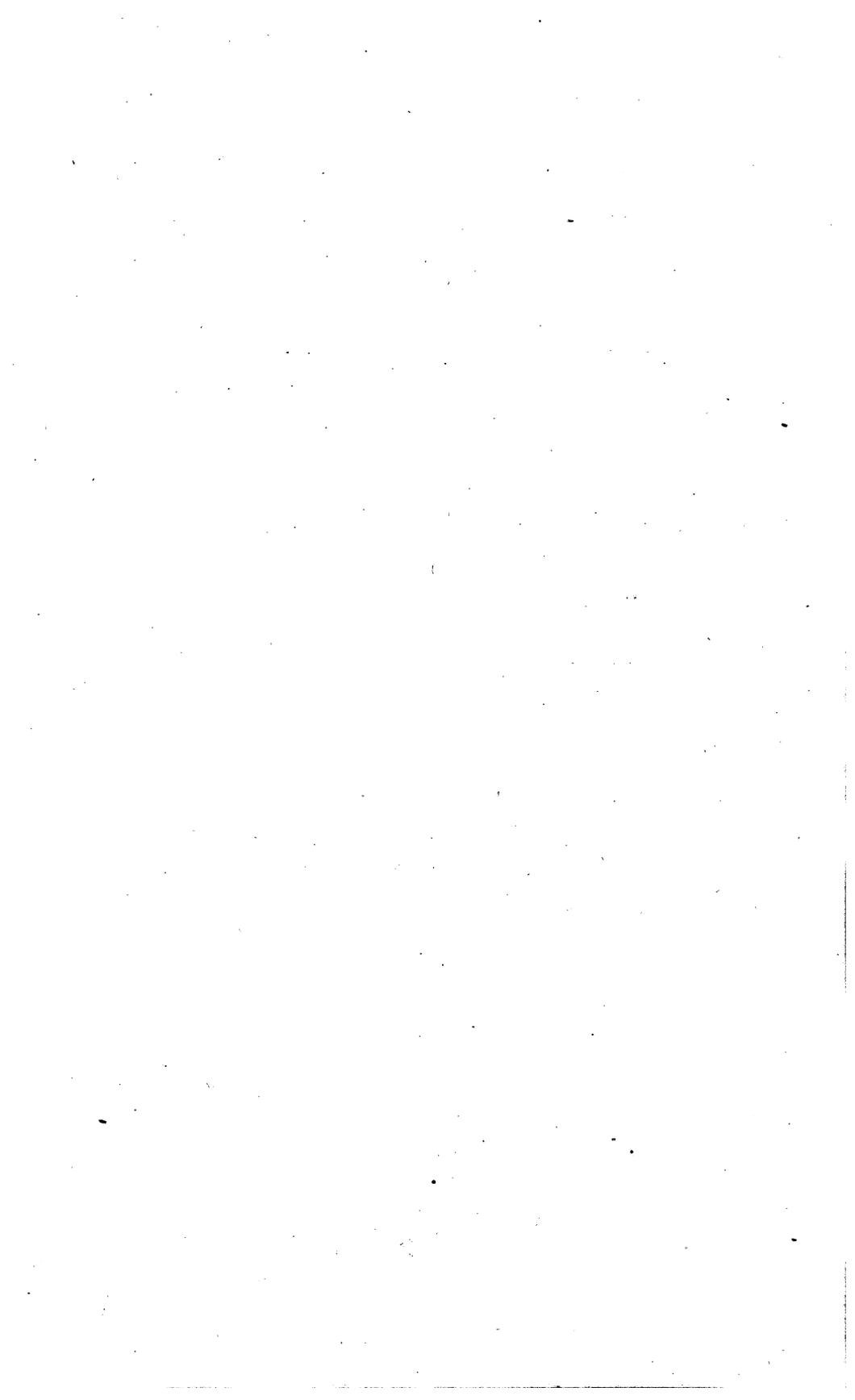
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# OPERATIONS AT RIVER STATIONS, 1899.

## PART III.

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### MEASUREMENTS AT RIVER STATIONS.<sup>1</sup>

#### MADISON RIVER AT REDBLUFF, MONTANA.

This river has its source in the central portion of the Yellowstone National Park, and flows in a general northerly direction, joining the Jefferson and Gallatin rivers near Threeforks to form the Missouri River. Some distance beyond the western boundary of the park an opening of considerable extent occurs, known as the Upper Madison Valley. Below Meadow Creek the bluffs close in again, and the river is in canyon to below the mouth of Cherry Creek. Beyond this it gradually opens into the lower valley. The country about the head waters of the stream is too high for profitable farming, except for summer stock ranging. Less water can be used for irrigation from this stream than from the other two tributaries of the Missouri, but the fall is admirably adapted for power purposes, and a number of surveys have been made in this connection. The gage rod, which was established May 2, 1897, is located at the ranch of the observer, Mrs. S. A. Black, 3 miles below the Redbluff iron county bridge over the Madison and about  $1\frac{1}{2}$  miles below the mouth of Cherry Creek. Discharge measurements are made at the highway bridge above. Cherry Creek enters between the bridge and the gage rod, and it is necessary to measure its discharge whenever a measurement of the main river is made. On June 3 its discharge was 366 second-feet, and on June 29 its discharge was 186 second-feet. Results of measurements are published as follows: 1897, Nineteenth Annual Report, Part IV, page 280; 1898, Twentieth Annual Report, Part IV, page 236. The following discharge measurements, not including Cherry Creek, were made in 1899 under the direction of Samuel Fortier:

June 3, gage height, 2.50 feet; discharge, 4,784 second-feet.

June 30, gage height, 3.30 feet; discharge, 7,616 second-feet.

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<sup>1</sup> Continued from Water-Supply and Irrigation Paper No. 36.

*Daily gage height, in feet, of Madison River at Redbluff, Montana, for 1896.*

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.65	2.60	3.65	1.70	1.40	1.30		
2		1.65	2.60	3.40	1.70	1.40	1.30		
3		1.65	2.70	3.30	1.70	1.40	1.30	1.30	
4		1.65	2.70	3.20	1.65	1.40	1.30		
5		1.65	2.80	3.10	1.60	1.40	1.30		
6		1.65	2.70	2.90	1.70	1.40	1.30		
7		1.65	2.80	2.85	1.80	1.40	1.30		(a)
8		1.70	2.80	2.80	1.80	1.40	1.30		
9		1.75	2.90	2.75	1.85	1.40	1.30		
10		1.75	3.00	2.70	1.80	1.40	1.30		
11		1.80	3.10	2.60	1.75	1.40	1.30		
12		1.80	3.25	2.55	1.70	1.40	1.30		
13		1.85	3.40	2.45	1.70	1.40	1.30		
14		1.10	3.50	2.30	1.70	1.40	1.30		
15		1.10	3.70	2.30	1.70	1.40	1.30		(a)
16	1.60	1.95	3.90	2.10	1.60	1.40	1.30	1.30	
17	1.60	1.90	3.80	2.00	1.60	1.40	1.30		
18	1.60	1.10	3.70	1.90	1.55	1.40	1.30		
19	1.55	1.10	3.70	1.90	1.50	1.40	1.30		
20	1.55	1.10	3.70	1.90	1.40	1.40	1.30		
21	1.60	1.10	3.60	1.95	1.40	1.40	1.30		
22	1.65	1.10	3.60	2.00	1.40	1.40	1.30		
23	1.60	1.10	3.60	2.00	1.40	1.40	1.30	1.30	
24	1.60	1.10	3.65	1.90	1.40	1.40	1.30		
25	1.60	1.55	3.60	1.80	1.40	1.40	1.30		
26	1.55	2.10	3.60	1.80	1.40	1.40	1.30		
27	1.65	2.30	3.60	1.65	1.40	1.40	1.30		
28	1.65	2.50	3.60	1.60	1.40	1.40	1.30		(a)
29	1.65	2.50	3.65	1.60	1.40	1.40	1.30		
30	1.65	2.50	3.70	1.70	1.40	1.40	1.30	(a)	
31		2.60		1.70	1.40		1.30		

January 1 to April 15, river frozen; no readings.

a Ice.

#### JEFFERSON RIVER AT SAPPINGTON, MONTANA.

This river is formed by the union of Bighole and Beaverdam rivers near Twin Bridges, Montana. The former stream has its source in the highest parts of the Rocky Mountains, which form the Continental Divide and the State boundary line between Montana and Idaho. The head-water tributary of Beaverdam River is Redrock Creek, rising in the southwestern part of the State, about 20 miles west of the boundary line of Yellowstone National Park. Jefferson River is one of the main streams that unite at Threeforks to form the Missouri River. This latter name should apply to the Jefferson and its tributary, Redrock Creek, as this is the longest of the three head-water streams of the Missouri. Irrigation is practiced to a limited extent in the upper reaches of the Jefferson, mainly for forage plants. From Twin Bridges downstream to the mouth of the North and South Boulder creeks is an extent of tillable land, which, however, has been little utilized up to the present time. The river is in canyon from Boulder Creek to about Willow Creek, whence the gorge gradually widens out into the Gallatin Valley. The station on this river is located at Sappington, 7 miles above Willow Creek, and was established by Arthur P. Davis November 13, 1894. The wire gage is fastened to the guard rail on the upper side of the Northern Pacific Railway bridge, 1 mile north of the railroad station. Bench mark No. 1 consists of a 6-inch wire nail driven horizontally in the east side of the blocking which forms the south abutment of the railroad bridge and is 6.90 feet above gage

datum. Bench mark No. 2 is a 6-inch wire nail in a telegraph pole, about 30 feet south and east of the south abutment of the bridge, and is at an elevation of 7 feet on the gage. Bench mark No. 3 is the head of the northwest bolt fastening the switch standard to the cross-tie, 30 feet east of the bridge. Its elevation is 15.67 feet. On November 3, 1897, the rod was lowered eight-tenths of a foot, the subsequent readings being adjusted to the new datum. Discharge measurements are made from a cable and car erected a short distance above the bridge. Results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 134; 1897, Nineteenth Annual Report, Part IV, page 281; 1898, Twentieth Annual Report, Part IV, page 238. The following measurements were made during 1899 by Samuel Fortier:

April 10, gage height, 2.70 feet; discharge, 2,891 second-feet.

April 24, gage height, 2.80 feet; discharge, 2,595 second-feet.

May 21, gage height, 4.50 feet; discharge, 6,505 second-feet.

July 13, gage height, 5.40 feet; discharge, 4,847 second-feet.

July 29, gage height, 3.10 feet; discharge, 2,909 second-feet.

*Daily gage height, in feet, of Jefferson River at Sappington, Montana, for 1899.*

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.70	3.00	5.80	7.60	3.10	2.30	2.10	2.90	2.60
2		2.70	3.00	5.80	7.55	3.00	2.30	2.10	2.80	2.60
3		2.70	2.90	6.15	7.35	3.00	2.30	2.10	2.80	2.60
4		2.70	2.85	7.00	7.20	2.90	2.30	2.10	2.80	2.60
5		2.70	2.80	7.30	6.90	2.90	2.30	2.10	2.80	2.60
6		2.70	3.05	7.40	6.70	2.90	2.30	2.10	2.80	2.60
7		2.70	3.20	7.00	6.50	2.90	2.30	2.10	2.80	2.60
8		2.70	3.60	6.50	6.10	2.80	2.30	2.10	2.80	2.60
9		2.70	4.10	6.20	5.85	2.80	2.30	2.10	2.80	2.60
10		2.70	4.55	5.95	5.65	2.80	2.30	2.10	2.80	2.60
11		2.70	4.95	6.10	5.60	2.90	2.30	2.20	2.80	2.80
12		2.70	5.15	6.65	5.50	3.00	2.30	2.30	2.80	2.80
13		2.70	5.35	7.40	5.40	3.00	2.30	2.30	2.80	3.00
14		2.70	5.25	7.80	5.40	2.95	2.30	2.40	2.80	3.60
15		2.70	4.95	8.00	5.25	2.90	2.30	2.40	2.80	
16		2.70	4.60	7.70	5.20	2.80	2.30	2.50	2.80	
17		2.70	4.25	7.30	4.85	2.80	2.30	2.50	2.80	
18		3.00	4.40	7.40	4.75	2.70	2.30	2.60	2.80	
19		2.90	4.50	7.85	4.60	2.60	2.30	2.70	2.80	
20		2.85	4.60	8.50	4.45	2.60	2.30	2.70	2.80	
21		2.70	4.45	9.00	4.35	2.60	2.30	2.80	2.70	
22		2.70	4.40	9.60	4.25	2.60	2.30	2.90	2.70	
23		2.70	4.40	9.65	4.05	2.60	2.30	2.90	2.60	
24		2.70	4.50	9.10	3.85	2.80	2.30	2.90	2.60	
25		2.70	4.65	8.30	3.65	2.80	2.30	2.90	2.60	
26		2.80	5.35	8.00	3.45	2.80	2.20	2.90	2.60	
27		3.00	5.65	8.00	3.25	2.70	2.20	2.90	2.60	
28		3.15	5.90	7.80	3.10	2.70	2.20	2.90	2.60	
29	2.70	3.20	5.90	7.60	3.10	2.50	2.10	2.90	2.60	
30	2.70	3.10	5.80	7.70	3.10	2.50	2.10	2.90	2.60	
31	2.70		5.80		3.10	2.40		2.90		

January 1 to March 23, river frozen; no readings.

December 15 to 31, river frozen; no readings.

## MISSOURI RIVER AT TOWNSEND, MONTANA.

This river is formed by the junction of the Jefferson, Madison, and Gallatin rivers at Threeforks, Montana. Observations of gage heights are maintained at Townsend by the Missouri River Commission, and although the section is not an ideal one, it still seems desirable to make occasional discharge measurements as the station is easily accessible and daily gage observations are taken at no expense to this Survey. The gage is located at the wagon bridge about a mile north of the railroad station. The heights given are the means of two daily readings expressed in feet above the St. Louis directrix, which is 412.73 feet above mean gulf level. In the following table, furnished by Charles Keller, first lieutenant, Corps of Engineers, United States Army, the figures 3,300 have been omitted, and it is therefore necessary to add this amount to obtain the elevation of the water surface above the St. Louis datum. Results of measurements are found as follows: 1896, Eighteenth Annual Report, Part IV, page 124; 1897, Nineteenth Annual Report, Part IV, page 283; 1898, Twentieth Annual Report, Part IV, page 244. The following discharge measurements were made during 1899 under the direction of Samuel Fortier:

May 30, gage height, 92.00; discharge, 13,021 second-feet.

June 15, gage height, 93.80 feet; discharge, 29,832 second-feet.

July 21, gage height, 90.90 feet; discharge, 8,842 second-feet.

*Daily gage height, in feet, of Missouri River at Townsend, Montana, for 1899.*

Day.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....	-----	90.10	91.90	94.10	89.90	89.15	88.90	89.30	89.30
2.....	-----	89.90	92.20	94.05	89.90	89.10	88.90	89.30	89.30
3.....	-----	89.80	92.40	93.95	89.85	89.10	89.00	89.30	89.30
4.....	88.40	89.80	92.85	93.60	89.80	89.10	89.00	89.30	89.10
5.....	88.50	89.80	93.35	93.35	89.70	89.10	89.05	89.35	89.00
6.....	88.80	89.80	93.50	93.05	89.70	89.10	89.00	89.35	89.05
7.....	89.30	89.90	93.30	92.80	89.70	89.05	89.00	89.35	89.10
8.....	89.80	90.30	93.10	92.60	89.75	89.00	89.00	89.35	89.10
9.....	89.90	90.60	92.60	92.55	89.80	89.00	89.00	89.35	89.10
10.....	90.20	91.05	92.30	92.45	89.95	89.00	89.10	89.35	89.10
11.....	90.40	91.25	92.45	92.35	89.95	89.00	89.10	89.35	<i>a</i> 89.10
12.....	90.55	91.55	92.80	92.25	89.90	89.00	89.15	89.40	89.10
13.....	90.85	91.70	93.40	92.05	89.85	89.00	89.20	89.40	89.10
14.....	90.45	91.60	93.70	92.00	89.80	89.05	89.20	89.40	89.10
15.....	90.00	91.60	93.75	91.80	89.70	89.10	89.20	89.40	89.10
16.....	90.00	91.50	93.75	91.65	89.65	89.15	89.20	89.40	<i>a</i> 89.10
17.....	90.05	91.35	93.60	91.50	89.55	89.10	89.20	89.45	89.10
18.....	89.95	91.25	93.70	91.20	89.50	89.10	89.20	89.45	89.10
19.....	89.90	91.15	94.10	91.05	89.50	89.10	89.30	89.45	89.15
20.....	89.75	91.10	94.60	90.95	89.50	89.10	89.40	89.45	89.20
21.....	89.70	91.10	95.20	90.90	89.45	89.00	89.45	89.40	89.25
22.....	89.90	91.05	95.35	90.85	89.50	89.00	89.50	89.30	89.20
23.....	90.00	91.00	95.65	90.70	89.50	89.00	89.55	89.25	89.20
24.....	89.95	91.00	95.75	90.60	89.50	89.05	89.60	89.20	89.30
25.....	89.95	91.05	95.25	90.40	89.45	89.00	89.65	89.20	89.40
26.....	90.15	91.40	94.55	90.30	89.40	89.00	89.60	89.20	89.50
27.....	90.40	91.60	94.40	90.10	89.40	89.00	89.50	89.15	89.55
28.....	90.20	92.05	94.45	90.05	89.30	88.95	89.50	89.20	89.60
29.....	90.10	92.00	94.20	90.00	89.20	88.90	89.40	89.20	<i>b</i> 91.70
30.....	90.10	92.00	94.20	90.00	89.20	88.90	89.40	89.20	90.90
31.....	90.10	91.95	-----	89.95	89.20	-----	89.40	-----	90.90

*a* Ice readings, December 11 to 16.

*b* Ice gorged December 29.

## MILK RIVER AT HAVRE, MONTANA.

This river rises on the eastern slope of the Rocky Mountains in the extreme northern part of Montana. The head-water tributaries have a general northeasterly direction, crossing the international boundary line into British territory, in which there is a large area drained. The river reenters the United States farther eastward and flows in a general southerly direction to Havre. Its course is thence easterly until it joins the Missouri River near Glasgow, Montana, at the southwestern corner of Fort Peck Indian Reservation. The valley of this river is fertile and well adapted for raising the hardier grains. Development in this direction has been somewhat slow until within the past few years. The area drained by Milk River is to a large extent rolling prairie lands, excellent for grazing purposes and covered with a good growth of grass. The discharge measurements show the amount of water available for the canals, a number of which have recently been taken from the river below Havre, as described in the Eighteenth Annual Report, Part IV, page 286. The present station is located at Havre, Montana, and was established by Cyrus C. Babb, May 15, 1898. The gage rod is an especial form described in Water-Supply Paper No. 27, page 68. Measurements of discharge are made from a car and cable of 200-foot span swung across the river a short distance above the gage. The river is subject to violent floods of short duration, and the bed of the river being composed of gravels and clay is liable to change after each freshet. Results of measurements for 1898 are shown in the Eighteenth Annual Report, Part IV, page 245. The following discharge measurements were made by C. W. Ling in 1899:

*Measurements of Milk River at Havre, Montana.*

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.	<i>Feet.</i>	<i>Sec.-ft.</i>	1899.	<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 20.....	3.20	1,410	July 31.....	1.00	223
Apr. 23.....	2.20	807	Aug. 3.....	1.10	252
May 3.....	1.90	732	Aug. 5.....	1.40	379
May 12.....	2.60	1,087	Aug. 11.....	.80	182
May 16.....	2.50	911	Aug. 16.....	.50	111
May 22.....	3.50	1,657	Aug. 19.....	.40	106
May 29.....	3.40	1,653	Aug. 25.....	.60	137
June 3.....	2.90	1,126	Aug. 28.....	.80	158
June 10.....	2.80	1,209	Sept. 2.....	.60	137
June 15.....	2.30	661	Sept. 7.....	.30	99
June 20.....	2.00	586	Sept. 12.....	.20	88
June 28.....	1.90	588	Sept. 15.....	.30	96
July 3.....	1.40	353	Sept. 21.....	1.50	360
July 7.....	1.20	298	Sept. 25.....	1.90	221
July 11.....	1.25	314	Sept. 30.....	1.50	122
July 17.....	.80	181	Oct. 16.....	1.40	109
July 22.....	.60	150	Oct. 24.....	1.70	146
July 27.....	.70	170	Nov. 6.....	2.40	368

*Daily gage height, in feet, of Milk River at Havre, Montana, for 1899.*

Day.	Jan.	Feb.	Apr.	May.	Sept.	Oct.	Nov.	Dec.
1				2.00	0.60	1.40	1.30	
2				1.90	.60	1.30	1.30	
3	1.40			1.90	.50	1.40	1.30	(a)
4		1.80		1.90	.50	1.30	1.30	
5				1.90	.40	1.30	2.40	
6				2.50	.40	1.20	2.40	
7	1.40			2.60	.30	1.10		
8				2.60	.40	1.30		
9	1.40			2.50	.40	1.30		
10				2.50	.30	1.30		(a)
11				2.50	.30	1.20		
12				2.50	.20	1.00	2.20	
13				2.55	.20			
14	1.40			2.60	.20			
15				2.60	.30	1.30		
16				2.60	.20	1.30		
17			4.60	4.30	2.60	1.20		(a)
18			3.90	2.70	1.50	1.10		
19		1.90	3.40	2.70	1.60	1.10	1.10	
20		2.50	3.20	2.70	1.10	1.10		
21	1.80		3.20	2.70	1.90	1.00		
22			3.05	2.95	2.00	1.20		
23			2.80	3.30	2.00	1.10		
24	1.80		2.55	3.20	1.90	1.10		(a)
25			2.50	3.20	1.80	1.00		
26			2.50	2.70	1.70	1.30		
27			2.40	2.80	1.60	1.30	1.90	
28	1.80		2.25		1.40	1.40		
29			2.20		1.50	1.40		
30			2.00		1.60	1.40		
31						1.30		

*a* Frozen.

#### YELLOWSTONE RIVER AT LIVINGSTON, MONTANA.

This river has its source in Yellowstone Lake, in the National Park, and flows in a northerly direction into Montana. Its course is thence easterly to its junction with the Missouri River, near the North Dakota line. Owing to the fact of the numerous springs of the park which contribute to its flow, and also to the fact that the lake acts as a regulator, the discharge when it crosses the Montana line is large for a river of this section of the country. Yellowstone Valley is the largest body of irrigable land in Montana, having a length of about 500 miles. At the present time it is principally utilized as a range for a vast number of cattle and sheep. With its comparatively low altitude of 2,500 feet, the section is well adapted for the future development of irrigation. The gaging station established May 2, 1897, is located at the highway bridge over the Yellowstone River, 5 miles south of Livingston, at the mouth of the canyon. A wire gage is in use. A new bench mark was established in 1899, as follows: The top of the end plate of bridge at upper side of east end, at an elevation of 14.20 feet above zero of gage. The slope of the water surface at gaging station was found to be 0.146 feet in 200 feet on August 29, 1899. The observer is Thomas S. Carter, who lives at the end of the bridge. The results of measurements may be found as follows: 1897, Nineteenth Annual Report, Part IV, page 289; 1898, Twentieth

Annual Report, Part IV, page 248. The following measurements of discharge were made under the direction of Samuel Fortier in 1899:

March 10, gage height, 1.00 foot; discharge, 1,702 second-feet.  
 March 24, gage height, 1.10 feet; discharge, 1,801 second-feet.  
 April 5, gage height, 1.10 feet; discharge, 1,868 second-feet.  
 April 14, gage height, 1.40 feet; discharge, 2,629 second-feet.  
 May 28, gage height, 3.70 feet; discharge, 6,964 second-feet.  
 June 21, gage height, 8.00 feet; discharge, 22,053 second-feet.  
 July 20, gage height, 5.30 feet; discharge, 7,283 second-feet.  
 August 29, gage height, 1.86 feet; discharge, 5,337 second-feet.

Daily gage height, in feet, of Yellowstone River at Livingston, Montana, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			0.85	0.90	1.60	4.20	7.88	4.10	1.70	0.55		
2			.85	.95	1.53	4.35	7.58	4.00	1.70	.50	0.05	
3		(a)	.85	.95	1.43	5.03	7.30	3.90	1.70	.45		0.30
4			.90	1.00	1.40	5.40	7.15	3.80	1.68	.43	.05	
5	0.60		.90	1.10	1.40	5.35	7.08	3.70	1.60	.40		
6			.90	1.10	1.48	4.85	7.00	3.70	1.48	.40		
7			.90	1.10	1.60	4.48	6.93	3.60	1.40	.40		
8			.95	1.10	1.80	4.38	6.95	3.50	1.33	.38		
9			1.00	1.13	2.25	4.35	6.95	3.50	1.30	.35		80
10			1.00	1.30	2.73	5.00	6.75	3.63	1.28	.35		
11			.80	1.30	3.00	5.50	6.65	3.35	1.20	.35	.00	
12	.70		.85	1.30	3.30	6.20	6.55	3.25	1.15	.35		
13		.70	.90	1.50	3.40	5.60	6.20	3.10	1.15	.35		
14			.85	1.43	3.10	5.28	5.93	3.03	1.15	.35		
15			.80	1.25	2.90	5.20	5.75	2.98	1.15	.35		
16			.85	1.38	2.75	5.63	5.65	2.83	1.10	.30		(a)
17		.85	.95	1.40	2.58	6.68	5.55	2.73	1.03	.30		
18			.95	1.35	2.53	7.60	5.38	2.70	1.00	.30	.10	
19			.93	1.28	2.70	8.05	5.30	2.65	.93	.30		
20			.90	1.23	2.90	8.55	5.23	2.53	.90	.40		
21	.90		(a)	1.20	2.90	8.30	5.28	2.43	.85	.35		
22			.88	1.35	2.80	7.15	5.13	2.40	.83	.43		
23			.93	1.50	2.75	6.73	4.85	2.35	.75	.43		50
24		.80	1.05	1.55	3.13	6.95	4.68	2.28	.73	.40		
25			1.15	1.80	4.03	7.25	4.60	2.18	.70	.35	.35	
26	.90		1.05	2.00	4.35	7.60	4.50	2.10	.70	.23		
27			.78	1.95	3.95	7.60	4.48	1.98	.70	.20		
28			.90	1.78	3.85	7.60	4.30	1.90	.65	.18		
29			1.00	1.63	4.00	7.78	4.30	1.83	.60	.15		
30			1.00	1.60	4.25	8.05	4.30	1.80	.58	.15		80
31			.90		4.20		4.15	1.75		.10		

a Frozen.

#### BIGHORN RIVER AT THERMOPOLIS, WYOMING.

A number of discharge measurements were made on this river at Thermopolis, Wyoming, by A. J. Parshall, during the progress of a survey in that vicinity, which he had undertaken for the State. A bench mark was established on the pile near the ferry, and the gage heights noted are the distance of water surface below this bench mark; they are, therefore, in reverse order to the usual records of water heights. Four measurements were made during 1899, as follows:

July 28, gage height, 8 feet below bench mark; discharge, 4,867 second-feet.

August 7, gage height, 8.38 feet below bench mark; discharge, 4,204 second-feet.

August 16, gage height, 8.98 feet below bench mark; discharge, 2,673 second-feet.

September 14, gage height, 9.74 feet below bench mark; discharge, 1,162 second-feet.

SHOSHONE RIVER AT LOVELL, WYOMING.

The source of this river is in the high mountain peaks along the eastern border of the Yellowstone National Park. It has a general northeasterly course and enters Bighorn River about 12 miles above the Montana State line. Irrigation is practiced to a limited extent in the upper headwaters, but principally from the small tributaries, as Trout, Rattlesnake, and Cottonwood creeks. Below the junction of the North and South forks a number of large irrigation enterprises have recently been undertaken. A gaging station was established May 23, 1897, at Lovell, Wyoming. The rod is fastened to the landing pier of the ferry on the south side of the river. The channel is straight for some distance above and below the rod, and the cross section at the gaging point has a uniform depth. The bed of the river is stable. The results of measurements are shown as follows: 1897, Nineteenth Annual Report, Part IV, page 292; 1898, Twentieth Annual Report, Part IV, page 249. No discharge measurements were made at this station during 1899.

Daily gage height, in feet, of Shoshone River at Lovell, Wyoming, for 1899.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	-----	-.80	0.60	3.80	+0.20	-1.10	17	-.90	-.40	3.00	2.60	-.50	-1.50
2	-----	-.80	.60	3.60	+.60	-1.10	18	-.80	-.40	3.90	2.60	-.50	-1.50
3	-----	-.70	3.00	3.40	-.10	-1.20	19	-.70	-.40	4.30	2.70	-.60	-1.50
4	-----	-.70	.60	3.20	-.30	-1.20	20	-.60	+.10	4.20	2.60	-.60	-1.50
5	-----	-.70	.30	3.20	-.20	-1.20	21	-.40	.30	4.00	2.50	-.70	-1.50
6	-----	-.50	.90	3.10	-.30	-1.20	22	-.20	.20	2.70	2.50	-.80	-1.50
7	-----	-.50	.70	3.10	-.20	-1.20	23	-.00	.10	2.50	2.50	-.90	-1.50
8	-----	-.40	.50	3.00	-.30	-1.30	24	+.70	.50	2.50	1.40	-.90	-1.50
9	-----	-.20	.90	3.20	-.30	-1.30	25	+.60	.90	2.90	1.40	-.90	-1.50
10	-----	+.20	1.30	2.90	-.30	-1.30	26	-.60	.70	3.50	1.00	-1.00	-1.50
11	-----	+.30	2.00	2.80	-.30	-1.40	27	-.70	.70	3.30	1.00	-1.00	-1.50
12	-.80	.30	2.80	2.70	-.30	-1.40	28	-.70	.80	3.40	1.40	-1.00	-1.50
13	-.90	.20	2.00	2.80	-.30	-1.40	29	-.70	.70	3.70	1.30	-1.00	-1.50
14	-.90	.10	1.50	2.90	-.30	-1.40	30	-.70	.80	4.00	1.70	-1.00	-1.50
15	-.80	-.40	1.40	2.70	-.40	-1.40	31	-----	.70	-----	1.10	-1.00	-----
16	-.80	-.20	2.20	2.60	-.40	-1.40							

CLEAR CREEK AT BUFFALO, WYOMING.

This creek is one of the most important tributaries of Powder River, having its source in the summit of the Bighorn Mountains. The irrigating system diverting water from this stream has been described in detail in earlier reports. The point of measurement is about 4 miles west of Buffalo, Wyoming, at which point is a flume erected in 1889. Of late years this station is not considered as important as formerly, on account of the diversions of water which have taken place within its basin. The earlier discharge measurements established a rating for the measuring flume, and it has not been necessary to make any since. The results of measurements are shown as follows: 1896, Eighteenth Annual Report, Part IV, page 140; 1897, Nineteenth Annual Report, Part IV, page 298; 1898, Twentieth Annual Report,

Part IV, page 250. No measurements of discharge were made at this point during 1899.

*Daily gage height, in feet, of Clear Creek at Buffalo, Wyoming, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.30				0.60	1.13	1.80	1.35	0.50	0.48	0.50	
2					.50	1.18	1.53	1.27	.49	.50	.45	
3					.50	1.63	1.47	1.18	.47	.49	.43	0.45
4				0.30	.50	1.37	1.46	1.15	.57	.50	.42	
5		0.25	0.25		.45	1.34	1.46	1.12	.57	.49	.42	
6					.52	1.24	1.45	1.03	.58	.49	.48	
7					.73	1.20	1.40	.94	.57	.50	.47	
8	.33				.52	1.15	1.43	.81	.57	.50	.48	
9					.54	1.14	1.41	.70	.56	.57	.49	
10					.87	1.11	1.42	.73	.56	.56	.47	.40
11					.58	1.26	1.39	.69	.50	.56	.48	
12			.30	.40	.64	1.34	1.33	.64	.50	.57	.47	
13					.70	1.39	1.39	.60	.50	.59	.49	
14					.60	1.26	1.37	.59	.50	.58	.50	
15	.30				.69	1.23	1.39	.59	.60	.59	.47	
16					.70	1.23	1.35	.58	.50	.60	.48	
17					.69	1.40	1.20	.56	.48	.60	.48	.40
18					.70	2.15	1.20	.57	.62	.60	.49	
19		.25		.60	.77	2.43	1.25	.53	.61	.59	.49	
20					1.17	2.42	1.21	.54	.61	.58		
21					1.20	2.45	1.23	.58	.60	.56		
22					.90	1.75	1.23	.57	.58	.53		
23					.90	1.45	1.44	.55	.52	.57		
24					1.10	1.46	1.75	.53	.54	.55		.40
25					1.24	1.89	1.73	.52	.51	.44		
26		.25			1.20	2.07	1.73	.50	.50	.42	.45	
27					1.13	1.73	1.70	.50	.51	.49		
28					1.12	1.64	1.70	.49	.50	.48		
29					1.12	1.72	1.58	.48	.49	.47		.40
30				.63	1.21	1.87	1.42	.49	.49	.39		
31					1.14		1.42	.49		.48		

MINNECHADUSA RIVER AT VALENTINE, NEBRASKA.

This stream rises in South Dakota, flows into Nebraska, and empties into Niobrara River near Valentine. Measurements have been made at the times when the regular river station on Niobrara River at Fort Niobrara has been visited. The results are of value as showing the flow available for milling purposes, there being little, if any, opportunity for irrigation. Measurements were made by Glenn E. Smith at a point 1 mile above the town. The channel at this point is straight, and the water moves with moderate velocity. The banks are high and the bed sandy. Most of the measurements were made by wading. Results for 1899 are as follows:

January 27, 26.2 second-feet; February 21, 45.0 second-feet; March 15, 25.7 second-feet; April 26, 32.6 second-feet; May 11, 35.6 second-feet; June 23, 23.0 second-feet; August 12, 19.0 second-feet; September 13, 23.5 second-feet; September 26, 26.5 second-feet; October 20, 30.0 second-feet.

NIORRARA RIVER AT FORT NIOBRARA, NEBRASKA.

This river rises in eastern Wyoming and flows across the State line into Nebraska, continuing along the northern side of that State near the boundary of South Dakota until it enters the Missouri River at the northeastern corner of Nebraska. A gaging station was estab-

lished by O. V. P. Stout on July 22, 1897, three-fourths of a mile south-westerly from Fort Niobrara and above the mouth of Minnehadusa River. It was afterwards discontinued, but was resumed on April 26, 1899, when a rod was located 195 feet downstream from the wagon bridge near Fort Niobrara. The rod is solidly bedded on cross-ties and well fastened with bridge spikes. It is a new 3 by 4 inch oak rod 10 feet long, and is placed on the left bank of the stream. Bench mark No. 1 is the top of a large spike driven in the top of a 2 by 4 inch timber which is set 4 feet in the ground and 12 feet west of the rod, and is 5.63 feet above gage datum. Bench mark No. 2 is the top of the short cap at shoe of truss at west end of the bridge, downstream side, and is 9.98 feet above the zero of the gage. Bench mark No. 3 is the top of the plate of the center pier of the bridge, downstream side, and is 10.03 feet above gage datum. Thomas Dillon, mail carrier between Valentine and Fort Niobrara, is the observer. The results of measurement are shown as follows: 1897, Nineteenth Annual Report, Part IV, page 300; 1898, Twentieth Annual Report, Part IV, page 255. The following discharge measurements were made by Glenn E. Smith during 1899:

*Measurements of Niobrara River at Fort Niobrara, Nebraska.*

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1899.			1899.		
	<i>Feet.</i>	<i>Second-ft.</i>		<i>Feet.</i>	<i>Second-ft.</i>
Jan. 27 .....	Frozen.	623	July 16 .....	1.52	788
Mar. 15 .....	Frozen.	726	Aug. 13 .....	1.30	718
Mar. 15 .....	Frozen.	a 650	Aug. 30 .....	1.35	700
Apr. 25 .....	1.15	952	Sept. 13 .....	1.15	695
May 11 .....	1.18	867	Sept. 26 .....	1.05	732
May 26 .....	1.44	1,081	Oct. 7 .....	1.15	776
June 23 .....	1.24	733	Oct. 20 .....	0.80	849

a Measurement made at point 5 miles south of Valentine.

*Daily gage height, in feet, of Niobrara River at Fort Niobrara, Nebraska, for 1899.*

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	1.13	1.81	1.21	1.31	1.24	17	.....	1.12	1.41	1.51	1.41	1.24
2	.....	1.11	1.81	1.41	1.34	1.24	18	.....	1.14	1.41	1.44	1.44	1.21
3	.....	1.12	1.84	1.34	1.51	1.31	19	.....	1.21	1.34	1.41	1.41	1.14
4	.....	1.12	1.81	1.23	1.41	1.31	20	.....	1.22	1.24	1.41	1.34	1.14
5	.....	1.14	1.31	1.24	1.34	1.24	21	.....	1.23	1.23	1.41	1.32	1.24
6	.....	1.21	1.21	1.34	1.34	1.21	22	.....	1.24	1.23	1.31	1.34	1.21
7	.....	1.13	1.14	1.41	1.31	1.21	23	.....	1.34	1.22	1.31	1.34	1.11
8	.....	1.24	1.12	1.41	1.31	1.21	24	.....	1.44	1.22	1.31	1.34	1.11
9	.....	1.31	1.12	1.41	1.41	1.24	25	.....	1.34	1.51	1.24	1.24	1.14
10	.....	1.14	1.12	1.42	1.34	1.21	26	.....	1.14	1.44	1.21	1.21	1.12
11	.....	1.14	1.24	1.44	1.31	1.21	27	.....	1.14	1.41	1.31	1.24	1.14
12	.....	1.14	1.44	1.44	1.34	1.14	28	.....	1.21	1.42	1.34	1.24	1.11
13	.....	1.14	1.34	1.51	1.41	1.14	29	.....	1.21	1.41	1.34	1.31	1.11
14	.....	1.14	1.21	1.42	1.21	1.14	30	.....	1.13	1.42	1.41	1.31	1.11
15	.....	1.14	1.21	1.51	1.31	1.24	31	.....	1.31	.....	1.31	1.21	.....
16	.....	1.11	1.24	1.54	1.41	1.21							

LARAMIE RIVER AT WOODS LANDING, WYOMING.

This river, a tributary of the North Platte River, entering it at Fort Laramie, Wyoming, has its source in the mountains of northern Colorado, adjoining the head waters of the Cache la Poudre on the west.

Irrigation is practiced on a small scale in Colorado, but principally for hay ranches, as the elevation is too great for diversified farming. One important diversion—that of the Sky-line canal—takes water from the Laramie, carrying it across the divide and into Cache la Poudre drainage. This diversion is working a hardship to the Wyoming appropriators below, as many in this State have prior rights to Sky-line canal, but owing to the present water laws the Wyoming rancher has no redress through the courts. Laramie River, on crossing the Wyoming line, soon leaves its canyon and enters the Laramie Plains, which are extensively irrigated from the main stream and from the various tributaries, notably from Little Laramie River, whose low-water flow is now entirely used. Lower down on its course the river passes through another canyon, to enter finally the plain of the Lower Laramie, which extends from the eastern edge of the Laramie Hills to the mouth of the river. A notable diversion in this section of the country is that of the Wyoming Development Company, taking water from Laramie River about 27 miles southwest of Wheatland. This canal system is more fully described in the Nineteenth Annual Report, Part IV, page 303. Two gaging stations are maintained on the river, one at Woods Landing, a short distance after the river appears in Wyoming, and the other at Uva, near its mouth. The former station is 26 miles from Laramie, Wyoming, and is reached by stage. Measurements of discharge are made from the wagon bridge which spans the river at this point.

The gage rod is fastened to a perpendicular post set firmly in the bed of the stream and braced at the top to adjacent trees, and is about 400 feet above the bridge. The bench mark is a nail in a notch on a cottonwood tree 1 foot in diameter, 6 feet from the rod, and is on a level with the 7-foot mark on the rod. The measurements here show the amount of water available for the use of the irrigators below. The bottom of the stream is composed of large granite boulders, which renders the shape and slope of the channel practically unchangeable, but adds an element of uncertainty to the gaging results, owing to the difficulty of determining the correct cross section. Results of measurements are published as follows: 1896, Eighteenth Annual Report, Part IV, page 147; 1897, Nineteenth Annual Report, Part IV, page 302; 1898, Twentieth Annual Report, Part IV, page 274. The following measurements of discharge were made by A. J. Parshall in 1899:

May 26, gage height, 3.30 feet; discharge, 2,598 second-feet.  
June 8, gage height, 3.10 feet; discharge, 2,319 second-feet.  
June 21, gage height, 4.40 feet; discharge, 4,145 second-feet.  
July 6, gage height, 2.80 feet; discharge, 2,194 second-feet.

*Daily gage height, in feet, of Laramie River at Woods Landing, Wyoming, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			2.00	2.00	1.20	3.15	3.75	1.40	0.80	0.40		
2				2.00	1.10	3.25	3.65	1.40	0.75	0.40		
3	2.00	2.00		2.00	1.00	3.25	3.50	1.55	0.75	0.40		
4				2.00	1.00	3.15	3.50	1.70	0.70	0.40		
5				2.00	1.00	2.95	3.10	1.75	0.60	0.50		
6				2.00	1.20	3.05	2.80	1.70	0.60	0.50		
7				2.00	1.30	3.00	2.70	1.60	0.60	0.65	0.60	0.90
8			2.00	2.00	1.40	3.00	2.60	1.50	0.50	0.75		
9				2.00	1.50	3.00	2.45	1.40	0.50	0.80		
10	2.10	2.00		2.00	1.60	3.05	2.35	1.35	0.50	0.85		
11				2.00	1.75	3.45	2.50	1.20	0.55	0.80		
12				2.00	1.95	3.80	2.65	1.10	0.50	0.80		
13				2.00	2.30	4.30	2.65	1.10	0.50	0.70		
14				2.00	2.55	4.35	2.55	1.03	0.50	0.70	0.70	1.10
15			2.00	2.00	2.60	3.75	2.45	1.00	0.60	0.70		
16				2.00	2.65	3.50	2.30	1.00	0.65	0.70		
17	2.00	2.00		1.90	2.55	3.75	2.20	0.90	0.60	0.70		
18				1.90	2.45	3.85	2.05	0.90	0.60	0.70		
19				1.80	2.60	3.95	2.00	0.90	0.60	0.60		
20				1.80	2.65	4.15	1.85	0.90	0.60	0.70		
21				1.70	2.75	4.25	1.80	0.85	0.50	0.75	0.70	1.00
22			2.00	1.70	2.85	4.45	1.85	0.80	0.50	0.70		
23				1.60	2.95	4.50	1.80	0.80	0.50	0.70		
24	2.00			1.50	3.10	4.40	1.80	0.80	0.50	0.60		
25		2.00		1.50	3.20	4.65	1.75	0.78	0.50	0.60		
26				1.40	3.20	4.55	1.75	0.75	0.40	0.60		
27				1.40	3.10	4.40	1.75	0.70	0.40	0.60		
28				1.30	3.25	4.15	1.90	0.60	0.40	0.60	0.80	1.20
29				1.20	3.35	4.05	1.75	0.60	0.40	0.60		
30				1.15	3.30	3.90	1.60	0.75	0.50	0.60		
31					3.05		1.45	0.90		0.60		

#### LARAMIE RIVER AT UVA, WYOMING.

This station is located 18 miles, by wagon road, from the mouth of the river at Fort Laramie, and the results obtained show practically the amount of water passing out of the State from this drainage area. The rod is fastened to the railroad bridge of the Cheyenne Northern Railway, a half mile from the town of Uva, while discharge measurements are made from the wagon bridge 1,000 feet below. The bench mark is a spike head on the south side of a pile on the east end of railroad bridge, and is 11.95 feet above zero of gage. The bed of the river is sandy and liable to change during high water. The results of measurements are shown as follows: 1896, Eighteenth Annual Report, Part IV, page 149; 1897, Nineteenth Annual Report, Part IV, page 302; 1898, Twentieth Annual Report, Part IV, page 176. The following measurements of discharge were made by A. J. Parshall in 1899:

April 25, gage height, 3 feet; discharge, 863 second-feet.

May 6, gage height, 2.80 feet; discharge, 530 second-feet.

May 30, gage height, 4.40 feet; discharge, 2,022 second-feet.

June 13, gage height, 4.50 feet; discharge, 2,144 second-feet.

June 26, gage height, 5.80 feet; discharge, 3,472 second-feet.

July 13, gage height, 3.95 feet; discharge, 1,607 second-feet.

*Daily gage height, in feet, of Laramie River at Uva, Wyoming, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.80	1.40	1.50	1.50	3.00	4.60	5.30	2.20	1.20	0.90		
2				1.50	2.90	4.70	5.30	2.20	1.20	0.90		1.50
3				1.40	2.90	4.80	5.00	2.20	1.20	0.90		
4				1.40	2.80	4.80	4.90	2.10	1.20	0.90	1.60	
5				1.50	2.80	4.80	5.00	2.10	1.20	0.90		
6				1.60	2.80	4.80	5.10	2.10	1.20	0.90		
7			1.50	1.80	2.80	4.70	4.90	2.00	1.20	0.90		
8	1.00	1.40		1.80	2.60	4.60	4.70	2.00	1.20	0.90		
9				2.00	2.40	4.20	4.70	2.00	1.60	1.00		1.40
10				3.00	2.20	4.10	4.60	2.00	1.50	1.10		
11				3.40	2.00	4.10	4.40	2.00	1.40	1.20	1.40	
12				5.60	1.90	4.20	4.20	1.90	1.30	1.20		
13				5.10	1.90	4.30	4.20	1.90	1.10	1.20		
14			1.60	5.40	1.80	4.30	4.10	1.90	1.10	1.30		
15	1.00	1.50		4.80	1.80	4.80	4.00	1.90	1.10	1.30		
16				4.40	2.55	5.00	4.00	2.00	1.10	1.30		2.00
17				4.30	3.40	5.50	4.00	2.00	1.00	1.30		
18				4.20	3.40	5.50	3.80	2.00	1.00	1.30	1.50	
19				3.20	3.30	5.60	3.60	2.00	1.00	1.30		
20				3.60	4.80	5.60	3.50	1.90	1.00	1.40		
21			1.60	3.00	4.80	5.60	3.30	1.90	1.00	1.40		
22	1.40	1.50		3.00	4.50	5.50	3.10	1.80	1.00	1.40		
23				3.30	4.40	5.50	3.00	1.70	1.00	1.40		1.60
24				3.20	4.60	5.60	2.90	1.60	1.00	1.40		
25				3.00	4.80	5.60	2.80	1.50	1.00	1.50	1.50	
26				3.00	4.90	5.80	2.60	1.40	1.00	1.50		
27				3.10	4.80	6.00	2.60	1.40	0.90	1.60		
28		1.50	1.50	3.00	4.60	5.90	2.50	1.40	0.90	1.60		
29	1.80			3.00	4.50	5.80	2.40	1.40	0.90	1.60		
30				3.00	4.40	5.70	2.40	1.30	0.90	1.60		1.90
31					4.40		2.30	1.30				

#### NORTH PLATTE RIVER AT ORIN JUNCTION, WYOMING.

This river has its source in the mountains of North Park in northern Colorado. The general elevation of the park is 8,000 feet, and it is surrounded by mountains which attain an elevation of 12,000 feet. Irrigation is practiced to a considerable extent from small ditches, which are used almost entirely, however, in flooding native grass lands for forage purposes. The river passes through a short, narrow canyon on entering Wyoming, and thence flows northerly through the upper Platte Valley, which extends from the State line down to Fort Steel. The river thence continues northerly, receiving a number of important tributaries, notably Sweetwater River, in the basin of which considerable irrigation is practiced. The only station maintained in this State on this stream at present is at Orin Junction, at the bridge of the Cheyenne Northern Railway. The rod is attached to the mid-channel pier of the railroad bridge, and is connected with the following bench marks: The spike on top of the cap on the set of piles nearest the water at the east end of the bridge is 11.52 feet above gage datum. The bed of the stream is composed of heavy gravel and sand, the cross section being quite uniform. Measurements at this point are not altogether satisfactory, on account of the occurrence of bridge piers, which interfere with the uniform flow to a considerable extent. Results of measurements are found as follows: 1896, Eighteenth Annual Report, Part IV, page 153; 1897, Nineteenth Annual Report, Part IV, page 307; 1898, Twentieth Annual Report, Part IV,

page 266. The following discharge measurements were made during 1899 by A. J. Parshall:

- April 24, gage height, 4.26 feet; discharge, 5,239 second-feet.
- May 5, gage height, 3.70 feet; discharge, 4,115 second-feet.
- May 19, gage height, 5.70 feet; discharge 13,422 second-feet.
- June 12, gage height, 5.85 feet; discharge, 14,746 second-feet.
- June 26, gage height, 6.85 feet; discharge, 20,855 second-feet.
- July 12, gage height, 5.67 feet; discharge, 10,784 second-feet.
- September 2, gage height, 1 foot; discharge, 239 second-feet.

*Daily gage height, in feet, of North Platte River at Orin Junction, Wyoming, for 1899.*

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		Ice.		4.45	6.10	6.40	3.00	1.00		1.60	
2				4.25	5.95		2.93	.98	1.00		
3				4.00	5.75	6.40	2.83		1.00		
4	4.55	3.00		3.85		6.30	2.73	.95	1.00		
5				3.70	6.15	6.20	2.55	.95	1.00		
6				3.65	6.20	6.15		.95	.98		
7					6.20	5.95	2.58	.95	.93		
8				3.35	6.15	5.75	2.75	.95		1.40	Ice.
9				3.45	5.95		2.73	.95	1.00		
10			2.65	3.85	5.75	5.35	2.70		1.08		
11	4.45	Ice.	2.85	4.15		5.15	2.63	.90	1.25		
12			3.95	4.30	5.95	4.98	2.45	.90	1.18		
13			5.05	4.50	6.10	4.88		.90	1.05		
14			5.45		6.50	4.83	2.08	.90	1.05		
15			5.30	5.45	6.75	4.95	2.03	.95		1.30	Ice.
16				5.75	6.80		1.93	1.60	1.20		
17			5.05	5.85	6.80	4.75	1.83		1.35		
18	5.10	Ice.	4.80	5.95		4.68	1.73	1.40	1.63		
19			4.70	6.05	6.35	4.45	1.60	1.30	1.70		
20			4.45	6.20	6.30	4.20		1.65	1.70		
21			4.10		6.55	4.08	1.60	1.58	1.63		
22			3.85	6.30	6.85	3.85	1.60	1.48		1.30	Ice.
23				6.20	6.95		1.53	1.38	1.50		
24			4.05	6.00	7.15	3.73	1.43		1.50		
25		4.00	4.30	5.75		3.63	1.33	1.23	1.58		
26			4.90	5.55	6.85	3.60	1.23	1.20	1.73		
27			5.70	5.35	6.65	3.45		1.60	1.75		
28	5.15		5.70		6.45	3.28	1.03	1.00	1.83		
29			5.65	5.75	6.40	3.05	1.00	1.00		1.25	Ice.
30				6.05	6.40		1.00	1.00			Ice.
31				6.10		3.00	1.00		1.60		

NORTH PLATTE RIVER AT GERING, NEBRASKA.

This river does not receive any tributaries of importance after passing into Nebraska. A number of canals divert water between the State line and North Platte, at the junction of the North and South Platte rivers, and because of the nonincrease of the flow from important tributaries the water is constantly being reduced. A gaging station was established at Gering, Nebraska, May 29, 1897, and is located at the highway bridge at this point. The rod is fastened to one of the bridge piles. The bench mark is the head of a nail on top of the west end of the first cap at the south end of the bridge, and is 6.61 feet above gage datum. The results of discharge measurements are shown as follows: 1897, Nineteenth Annual Report, Part IV, page 308; 1898, Twentieth Annual Report, Part IV, page 267. The following discharge measurements were made by R. H. Willis during 1899:

*Measurements of North Platte River at Gering, Nebraska.*

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1899.			1899.		
	<i>Feet.</i>	<i>Sec.-feet.</i>		<i>Feet.</i>	<i>Sec.-feet.</i>
Apr. 10 .....	1.48	3,404	July 6 .....	3.09	15,996
Apr. 21 .....	2.10	9,776	July 11 .....	2.75	12,808
May 2 .....	2.35	11,096	July 18 .....	2.38	11,232
May 16 .....	2.10	8,575	July 26 .....	1.90	6,198
May 26 .....	2.90	12,942	Aug. 10 .....	1.48	3,677
June 6 .....	2.70	13,799	Aug. 18 .....	1.40	2,658
June 14 .....	2.90	14,176	Aug. 24 .....	1.18	2,150
June 20 .....	3.00	18,227	Sept. 21 .....	1.05	860
June 26 .....	3.55	23,473	Sept. 30 .....	.95	957

*Daily gage height, in feet, of North Platte River at Gering, Nebraska, for 1899.*

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1 .....		2.35	2.70	3.20	1.65	1.05	0.93
2 .....		2.37	2.71	3.15	1.70	1.02	.95
3 .....		2.35	2.66	3.10	1.75	1.00	.95
4 .....		2.10	2.61	3.07	1.70	1.02	.96
5 .....		2.00	2.60	3.10	1.58	1.04	.95
6 .....		1.95	2.72	3.05	1.55	1.01	.95
7 .....		1.80	3.10	3.00	1.51	1.01	.96
8 .....		1.75	3.00	2.95	1.47	1.00	.96
9 .....		1.73	2.83	2.87	1.48	1.00	.96
10 .....	1.48	1.70	2.73	2.70	1.53	1.00	.97
11 .....	1.41	1.68	2.69	2.75	1.47	1.00	1.06
12 .....	1.53	1.64	2.68	2.68	1.50	1.00	1.07
13 .....	1.85	1.82	2.80	2.55	1.48	1.00	1.07
14 .....	2.22	1.93	2.90	2.46	1.37	.95	1.06
15 .....	2.42	2.00	3.00	2.45	1.35	.95	1.07
16 .....	2.51	2.25	3.20	2.44	1.43	1.00	1.04
17 .....	2.58	2.40	3.25	2.42	1.40	.98	1.10
18 .....	2.38	2.60	3.15	2.37	1.37	1.00	1.02
19 .....	2.43	2.76	3.00	2.30	1.36	1.00	1.16
20 .....	2.20	2.80	2.95	2.25	1.32	1.06	1.20
21 .....	2.21	2.85	3.00	2.13	1.26	1.06	1.23
22 .....	2.08	2.87	3.05	2.05	1.23	.98	1.25
23 .....	1.92	2.87	3.20	2.00	1.23	1.03	1.27
24 .....	1.90	3.10	3.27	2.00	1.20	1.03	1.23
25 .....	1.88	2.85	3.50	1.95	1.20	.98	1.23
26 .....	1.93	2.65	3.55	1.90	1.10	.98	1.23
27 .....	2.12	2.43	3.50	1.85	1.10	1.00	1.27
28 .....	2.40	2.41	3.30	1.81	1.10	.98	1.30
29 .....	2.39	2.43	3.27	1.77	1.13	.91	1.30
30 .....	2.37	2.52	3.25	1.67	1.10	.90	1.30
31 .....		2.70		1.67	1.07		1.30

Closed for winter October 31.

NORTH PLATTE RIVER AT CAMP CLARKE, NEBRASKA.

A third gaging station on this river is located at the bridge at Camp Clarke, Nebraska, and was established on June 27, 1896. The rod consists of an oak timber 2 by 4 inches, 10 feet long, fastened to cross-ties which are bedded in the bank of the river. Bench mark No. 1 consists of a spike driven horizontally in the northeast side of the downstream pile of the bent at the north end of the first truss span, on the south end of the bridge, and is 7.55 feet above gage datum. Bench mark No. 2 is a point on the southeast corner of the window sill at the front of the store, and is 9.74 feet above the zero of the gage. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 154; 1897, Nineteenth

Annual Report, Part IV, page 308; 1898, Twentieth Annual Report, Part IV, page 268. The following discharge measurements were made by R. H. Willis in 1899:

*Measurements of North Platte River at Camp Clarke, Nebraska.*

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1899.			1899.		
	<i>Feet.</i>	<i>Sec.-feet.</i>		<i>Feet.</i>	<i>Sec.-feet.</i>
Apr. 11	2.57	2,823	July 20	3.97	9,855
Apr. 22	3.45	8,625	July 29	3.09	4,747
May 3	3.41	7,982	Aug. 5	2.90	4,187
May 17	3.52	9,646	Aug. 12	2.92	3,272
May 27	3.90	13,492	Aug. 19	2.67	2,359
June 8	4.42	15,607	Aug. 29	2.46	1,492
June 17	4.45	18,237	Sept. 5	2.13	965
June 24	5.05	18,330	Sept. 14	2.05	768
June 28	5.00	22,908	Sept. 23	2.03	794
July 8	4.76	18,705	Sept. 29	2.10	863
July 13	4.25	12,268	Oct. 19	2.15	1,110

*Daily gage height, in feet, of North Platte River at Camp Clarke, Nebraska, for 1899.*

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		3.68	4.12	4.81	2.88	2.28	2.28
2		3.75	4.18	4.83	2.98	2.22	2.27
3		3.90	4.12	4.85	3.10	2.06	2.23
4		3.13	4.10	4.88	3.03	2.03	2.22
5	2.55	3.34	4.09	4.80	2.88	2.11	2.21
6	2.60	3.30	4.22	4.87	2.88	2.16	2.19
7	2.62	2.80	4.40	4.83	2.90	2.00	2.30
8	2.67	2.80	4.35	4.82	2.84	2.10	2.20
9	2.68	2.74	4.25	4.70	2.75	2.12	2.28
10	2.58	2.80	4.21	4.50	2.85	2.16	2.25
11	2.55	2.73	4.02	4.45	2.95	2.11	2.28
12	2.54	2.87	3.97	4.40	2.91	2.02	2.22
13	2.86	2.99	4.02	4.25	3.08	2.03	2.29
14	3.26	3.02	4.08	4.14	2.81	2.15	2.28
15	3.76	3.19	4.22	4.20	2.74	2.13	2.54
16	3.70	3.40	4.45	(a)	2.84	2.15	2.25
17	3.58	3.61	4.48	(a)	2.82	2.17	2.30
18	3.58	3.74	4.25	(a)	2.77	2.13	2.25
19	3.60	3.87	4.10	4.00	2.70	2.21	2.22
20	3.65	4.06	(f)	3.93	2.68	2.23	2.25
21	3.50	4.19	(f)	3.80	2.60	2.21	2.40
22	3.43	4.32	4.80	3.75	2.62	2.19	
23	3.15	4.23	4.95	3.65	2.53	2.22	
24	3.08	4.19	5.08	3.50	2.55	2.40	
25	3.05	4.30	5.30	3.48	2.58	2.30	
26	3.05	4.03	5.35	3.32	2.48	2.25	
27	3.20	3.85	5.20	3.20	2.47	2.20	
28	3.55	3.75	5.00	3.20	2.43	2.30	
29	3.65	3.80	4.85	3.07	2.47	2.32	
30	3.75	3.92	4.85	2.93	2.35	2.25	
31		4.03		3.04	2.34		

Discontinued October 31.                      a Bridge out.                      f Rod out.

**NORTH PLATTE RIVER AT NORTH PLATTE, NEBRASKA.**

The lowest gaging station on this river is located at the wagon bridge at North Platte, Nebraska, and was established in 1894. It is 3.5 miles above the junction of the South Platte River. The bridge is a long, low, pile bridge, having 93 spans of approximately 20 feet each, crossing the main channel of the river. North of this is another bridge crossing a slough, through which no water passes, however, except in time of flood. The gage rod is at the railroad bridge 2 miles

below the wagon bridge. The zero is 12 feet below the top and immediately under the east rail of the track. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 158; 1897, Nineteenth Annual Report, Part IV, page 309; 1898, Twentieth Annual Report, Part IV, page 269. The following discharge measurements were made by Glenn E. Smith and Charles P. Ross during 1899:

*Measurements of North Platte River at North Platte, Nebraska.*

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.			1899.		
	<i>Feet.</i>	<i>Sec.-feet.</i>		<i>Feet.</i>	<i>Sec.-feet.</i>
Apr. 19 .....	3.30	9,111	July 17 .....	3.30	10,351
May 6 .....	3.00	8,239	Aug. 8 .....	2.50	4,637
May 22 .....	3.80	12,962	Aug. 28 .....	1.85	2,013
June 6 .....	3.60	13,310	Sept. 15 .....	1.55	976
June 15 .....	3.60	11,330	Oct. 4 .....	1.70	713
June 19 .....	4.20	16,257			

*Daily gage height, in feet, of North Platte River at North Platte, Nebraska, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.70	3.00	3.00	2.30	3.50	3.55	4.10	2.60	1.90	1.55	1.90	2.10
2	2.70	3.00	3.00	2.10	3.50	3.70	4.20	2.70	1.80	1.50	2.00	2.10
3	2.70	3.00	3.00	2.80	3.40	3.80	4.15	2.70	1.80	1.60	2.00	2.05
4	2.70	3.00	3.00	2.70	3.25	3.80	4.10	2.80	1.80	1.70	2.05	2.05
5	2.70	3.00	3.00	2.60	3.15	3.70	4.10	2.80	1.65	1.70	2.10	2.30
6	2.70	3.00	3.00	2.80	3.00	3.60	4.10	2.70	1.65	1.70	2.15	2.50
7	2.70	3.00	3.00	2.85	3.00	3.65	4.00	2.65	1.70	1.70	2.10	2.50
8	2.70	3.00	3.00	2.55	3.25	3.80	4.00	2.50	1.70	1.60	2.10	2.50
9	2.70	3.00	3.00	2.50	3.15	3.90	4.00	2.50	1.60	1.60	2.10	2.40
10	2.70	3.00	3.10	2.50	2.80	3.90	4.00	2.40	1.55	1.60	2.10	2.40
11	2.70	3.00	3.10	2.50	2.75	3.85	3.90	2.30	1.60	1.60	2.10	2.40
12	2.70	3.00	3.10	2.60	2.60	3.75	3.65	2.30	1.60	1.70	2.10	2.40
13	2.70	3.00	3.10	2.65	2.60	3.65	3.60	2.35	1.60	1.70	2.00	2.40
14	2.70	3.00	3.10	2.60	2.50	3.55	3.60	2.50	1.60	1.65	2.00	2.40
15	2.70	3.00	3.10	2.45	2.60	3.60	3.55	2.50	1.55	1.80	2.05	2.40
16	2.70	3.00	3.10	2.50	2.65	3.70	3.40	2.40	1.50	1.80	2.10	2.40
17	2.70	3.00	3.00	3.25	2.85	3.95	3.30	2.35	1.50	1.80	2.05	2.40
18	2.70	3.00	2.80	3.30	3.05	4.00	3.20	2.40	1.50	1.80	2.00	2.40
19	2.80	3.00	2.80	3.35	3.05	4.20	3.25	2.30	1.50	1.80	2.10	2.40
20	2.80	3.00	2.80	3.40	3.40	4.15	3.30	2.30	1.50	1.80	2.10	2.40
21	2.80	3.00	2.50	3.30	3.60	3.95	3.30	2.30	1.60	1.80	2.20	2.40
22	2.90	3.00	2.80	3.10	3.75	3.85	3.20	2.00	1.60	1.80	2.20	2.40
23	2.80	3.00	2.80	3.10	3.75	3.90	3.15	2.00	1.50	1.80	2.10	2.40
24	2.80	3.00	3.05	3.10	3.80	3.85	3.00	1.90	1.50	1.80	2.10	2.45
25	3.00	3.00	2.90	3.00	3.70	4.15	2.95	1.90	1.50	1.80	2.10	2.55
26	3.00	3.00	2.60	2.90	3.80	4.30	2.80	1.90	1.60	1.90	2.10	2.70
27	3.00	3.00	2.60	3.00	3.85	4.45	2.80	1.90	1.60	2.00	2.10	2.70
28	3.00	3.00	2.55	3.00	3.85	4.40	2.85	1.85	1.55	2.00	2.20	2.70
29	3.00	-----	2.50	3.00	3.75	4.30	2.70	1.75	1.60	2.00	2.10	2.70
30	3.00	-----	2.55	3.10	3.50	4.25	2.70	1.65	1.60	2.00	2.10	2.70
31	3.00	-----	2.60	-----	3.50	-----	2.55	1.75	-----	1.95	-----	2.65

SOUTH PLATTE RIVER.

The headwater tributaries of this stream have their sources in the high mountain peaks surrounding the basin known as South Park. The average elevation of the valley is 8,000 feet, while the peaks attain an elevation of 13,000 feet. Considerable irrigation is practiced on a small scale, but principally for forage crops, as on account of the high altitude only the hardier products can be raised. The

streams have a general northerly direction, and upon issuing from the mountainous area the water is quickly appropriated by the large irrigation enterprises serving land on both sides of the South Platte River in the vicinity of Denver. A number of smaller streams rising on the eastern slope of the Rocky Mountains drain easterly into the South Platte River. The principal tributaries are—in order downstream—Bear Creek, Clear Creek, South Boulder Creek, Boulder Creek, St. Vrain Creek, Big Thompson Creek, and Cache la Poudre River. Gaging stations have been maintained on them also as well as one at Lake Cheesman on the South Fork of South Platte, and one on Goose Creek, which also contributes to the supply of the proposed reservoir. The next one downstream on the main river is at Platte Canyon, the third one at Denver, and the lower one at Orchard, Colorado. Besides the measurements of discharge at regular stations a number of others have been made in this basin during 1899, as follows: April 14 a measurement of the High-line ditch in the South Platte, at a gage height of 1.20 feet, showed a discharge of 98 second-feet. On July 28 the same canal was measured twice, the first time at a gage height of 3.25 feet, showing a discharge of 432 second-feet; the second time at a gage height of 3 feet, with a discharge of 375 second-feet. On the same day also the South Platte River was discharging over the High-line dam, at a gage height of 0.50 foot, 73 second-feet. September 14, South Platte River, at Julesburg, was carrying 2 second-feet. October 4 the river at the dam of the High-line canal, at a gage height of 0.13 foot, was discharging 12 second-feet.

A notable storage proposition on which work was prosecuted during the past season is that of the dam of Lake Cheesman, which is located on the South Fork of South Platte River, below the mouth of Goose Creek. The dam, which is partially completed, will be 215 feet high. Its length at its base is only 20 feet and at the top it will be 520 feet. The abutments are solid granite. The main tunnel for diverting the flow during the course of the construction of the dam is now completed, and work is now progressing on two subsidiary tunnels. The dam is to be rock filled and steel plate faced. The capacity of the reservoir is about 90,000 acre-feet. The object of this enterprise is to develop electric power to be used in the city of Denver, and also to furnish a water supply for the same city.

#### GOOSE CREEK AT LAKE CHEESMAN, COLORADO.

The station on this creek, a tributary of South Platte River, was established August 1, 1899, by J. A. Runner, assistant engineer of the Denver Union Water Company. It was desired to obtain the flow of the South Fork of South Platte River at this point, where the construction of the Cheesman dam has been begun, the discharge of Goose Creek being added to the South Fork of South Platte to give

the total flow at this point. The station is maintained by the Denver Union Water Company. All discharge measurements for 1899 have been made by means of floats. This station is to be considered simply as temporary, as it will be necessary to move it farther upstream when water is stored in the reservoir. The following discharge measurements were made by J. A. Runner during 1899:

- September 8, gage height, 0.95 foot; discharge, 24 second-feet.
- October 8, gage height, 0.84 foot; discharge, 10 second-feet.
- November 19, gage height, 0.72 foot; discharge, 8 second-feet.
- December 3, gage height, 0.76 foot; discharge, 9 second-feet.

*Daily gage height, in feet, of Goose Creek at Lake Cheesman, Colorado, for 1899.*

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1...	1.25	0.97	0.85	-----	0.80	17....	1.04	.90	.86	-----	-----
2...	1.20	.95	.85	-----	-----	18....	1.00	.89	.86	.85	.74
3...	1.30	a .95	.85	-----	.76	19....	.98	.88	.87	-----	-----
4...	1.32	a .95	.85	0.85	-----	20....	.96	.88	.87	-----	.80
5...	1.35	a .95	.86	-----	.74	21....	.96	.88	.88	.84	-----
6...	1.15	a .95	.85	.86	-----	22....	.95	.88	.88	-----	-----
7...	1.25	a .95	.85	-----	-----	23....	.94	a .88	.88	-----	-----
8...	1.25	.95	.84	.87	-----	24....	.93	a .88	-----	.82	-----
9...	1.10	.94	.84	.87	-----	25....	.93	a .88	-----	-----	-----
10...	1.09	.94	.85	-----	.72	26....	.92	.87	-----	.80	-----
11...	1.06	.92	.85	.87	-----	27....	.91	.87	-----	-----	-----
12...	1.05	.90	.85	-----	.73	28....	.90	.86	-----	-----	-----
13...	1.05	.89	.85	-----	-----	29....	.91	.86	-----	.80	-----
14...	1.05	.88	.85	.86	.74	30....	.93	.85	-----	-----	-----
15...	1.04	.89	.85	-----	-----	31....	.96	-----	-----	-----	-----
16...	1.04	.90	.85	.85	.73						

a Estimated.

**SOUTH FORK OF SOUTH PLATTE RIVER AT LAKE CHEESMAN, COLORADO.**

This station was established July 31, 1899, and has been maintained since that time by the Denver Union Water Company, J. A. Runner, assistant engineer, making the discharge measurements. It is located above the mouth of Goose Creek, and is maintained in order to determine the flow available for Lake Cheesman. The discharge here should be added to the discharge of Goose Creek, as the dam for this reservoir is located below the mouth of the latter tributary. It will be necessary in this case, as in the preceding one, to move the station upstream when water has been stored in the reservoir, so the station can be considered merely as a temporary one. It is the intention that both the inflow and the discharge from the reservoir shall be accurately measured after the storage has begun. The following measurements of discharge were made by J. A. Runner by means of floats in 1899:

- July 31, gage height, 3.62 feet; discharge, 806 second-feet.
- September 8, gage height, 1.45 feet; discharge, 184 second-feet.
- October 3, gage height, 1.23 feet; discharge, 95 second-feet.
- November 19, gage height, 1.30 feet; discharge, 107 second-feet.
- December 3, gage height, 1.24 feet; discharge, 97 second-feet.

Daily gage height, in feet, of South Platte River at Lake Cheesman, Colorado, for 1899.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1...	2.55	1.51	1.23	-----	1.26	17....	1.72	1.34	1.30	-----	-----
2...	2.20	1.50	1.23	-----	-----	18....	1.72	1.36	1.20	1.28	1.02
3...	2.60	(a)	1.23	-----	1.24	19....	1.67	1.37	1.20	1.30	-----
4...	3.70	(a)	1.24	1.20	-----	20....	1.60	1.36	1.28	-----	1.10
5...	3.55	(a)	1.26	-----	1.14	21....	1.57	1.37	1.30	-----	-----
6...	3.10	(a)	1.05	1.43	-----	22....	1.56	1.38	1.28	1.24	-----
7...	2.50	(a)	.88	-----	-----	23....	1.54	(a)	1.27	-----	1.20
8...	2.60	1.45	.86	1.45	-----	24....	1.53	(a)	-----	1.29	-----
9...	2.35	1.45	.85	1.41	-----	25....	1.50	(a)	-----	-----	-----
10...	2.15	1.44	.80	-----	.92	26....	1.50	(a)	-----	.98	-----
11...	1.98	1.42	.80	1.41	-----	27....	1.48	1.28	-----	-----	-----
12...	1.95	1.40	.80	-----	.90	28....	1.46	1.27	-----	-----	-----
13...	1.92	1.38	.90	-----	-----	29....	1.44	1.26	-----	1.30	-----
14...	1.87	1.33	1.10	1.40	.92	30....	1.43	1.23	-----	-----	-----
15...	1.79	1.32	1.40	-----	-----	31....	1.48	-----	-----	-----	-----
16...	1.70	1.33	1.40	1.20	1.00						

a No readings.

#### SOUTH PLATTE RIVER AT PLATTE CANYON, COLORADO.

This station has been maintained for sometime by the Denver Union Water Company, but cooperation with this Survey was not begun until April 1, 1899. The station is located at a point about 2 miles above Platte Canyon railway station, on the Colorado and Southern Railroad. The rod is an inclined 2 by 6 timber on the right-hand side of the stream, marked with brass nails. The bench mark is a point chiseled in a circle just south of the Denver Union Water Company's pipe line, and 15 feet south of the zero point of soundings on the bridge. It is on a granite rock and is 10 feet above gage datum. Measurements of discharge are made from the footbridge constructed by the Denver Union Water Company. The channel of the stream is rocky, and at first it was considered that it was not liable to material change; but during a freshet of considerable size erosion took place, making necessary a change in the rating table. This station gives the total discharge of the river at Platte Canyon before any water is taken out for irrigation or any other purposes excepting that taken out by the Denver Union Water Company at a point about 1 mile above the station. The observer, G. E. Carleton, Littleton, Colorado, is superintendent of the filtering plant belonging to the Denver Union Water Company. He furnishes gage readings to the United States Weather Bureau at Denver, where they are published each day. The following discharge measurements were made under the direction of A. L. Fellows during 1899:

April 14, 1899, gage height, 1.8 feet; discharge, 559 second-feet.

May 8, 1899, gage height, 1.5 feet; discharge, 500 second-feet.

June 10, 1899, gage height, 2.9 feet; discharge, 1,127 second-feet.

July 28, 1899, gage height, 1.8 feet; discharge, 633 second-feet.

October 4, 1899, gage height, 0.1 feet; discharge, 146 second-feet.

Daily gage height, in feet, of South Platte River at Platte Canyon, Colorado, for 1899.

Day.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.50	1.40	2.50	3.20	2.50	0.90	0.10	0.40	-0.10
2	.50	1.50	2.50	3.80	2.20	.90	.00	.30	-.40
3	.55	1.50	2.50	4.10	2.60	.90	.00	.40	-.40
4	.60	1.20	2.60	4.10	3.30	.80	.00	.40	-1.10
5	.60	1.10	2.40	3.90	3.30	.70	.10	.40	-1.80
6	.50	1.10	2.40	3.60	2.90	.60	.10	.40	-.60
7	.60	1.20	2.50	3.40	2.70	.60	.10	.30	-.60
8	.60	1.50	2.80	3.40	2.50	.60	-.20	.40	-.70
9	.70	1.90	3.00	3.30	2.30	.60	-.30	.40	-.30
10	.70	2.10	2.90	3.10	2.00	.60	-.30	.30	-.40
11	.80	2.20	3.00	2.80	1.80	.60	-.20	.30	-.20
12	1.20	2.30	3.20	2.70	1.60	.50	-.20	.30	.10
13	1.50	2.50	3.30	2.70	1.60	.50	-.10	.30	.30
14	1.80	2.60	3.50	3.00	1.60	.50	-.10	.30	.00
15	1.90	2.60	3.40	3.00	1.50	.50	.20	.20	.30
16	1.70	2.70	3.50	3.00	1.40	.50	.20	.30	.60
17	1.80	2.60	3.50	3.20	1.40	.50	.30	.10	.70
18	2.00	2.60	3.50	3.30	1.30	.50	.40	.10	.50
19	1.80	2.50	3.50	3.10	1.20	.50	.40	.00	.50
20	1.70	2.50	4.65	3.00	1.10	.50	.30	-.20	.50
21	1.40	2.40	4.20	2.60	1.00	.40	.30	.10	.60
22	1.40	2.30	4.20	2.40	1.00	-.10	.30	.00	.60
23	1.50	2.30	3.90	2.20	.90	+.20	.20	.20	.60
24	1.60	2.40	3.60	2.10	.80	.50	.20	.20	.60
25	1.80	2.40	3.60	2.00	.80	.20	.30	-.20	.50
26	2.10	2.50	3.70	1.90	.70	.30	.30	-.40	.40
27	1.90	2.50	3.60	1.90	.70	.20	.30	-.60	.20
28	1.90	2.50	3.40	1.80	.70	.20	.30	-.30	.30
29	1.70	2.50	3.30	2.20	.70	.10	.30	.10	.30
30	1.60	2.50	3.20	2.80	.70	.10	.30	-.10	.30
31	-----	2.50	-----	3.10	1.10	-----	.30	-----	.40

SOUTH PLATTE RIVER AT DENVER, COLORADO.

The gaging station at this point, established July 15, 1895, is located at the Fifteenth street bridge in the city of Denver, immediately below the mouth of Cherry Creek. The rod at present used is fastened to a post in the left bank of the river and graduated to vertical feet and tenths. The bench mark is a cross on top of east abutment of the Fifteenth street bridge on the north corner, and is 15.15 feet above gage datum. The river is confined between slag embankments, and the bed, although sandy and shifting, did not materially change during 1899. Mr. W. J. Southland, water commissioner of Colorado Irrigation District No. 2, cooperated with this survey in furnishing the gage readings, which are also transmitted to the United States Weather Bureau, and published each day in the Denver daily papers. The station is an important one, and it is fortunate that it can so easily be reached and discharge measurements made without great expense. Results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 165; 1897, Nineteenth Annual Report, Part IV, page 313; 1898, Twentieth Annual Report, Part IV, page 279. The following measurements of discharge were made by A. L. Fellows in 1899:

- April 12, gage height, 6.0 feet; discharge, 422 second-feet.
- May 11, gage height, 6.03 feet; discharge, 355 second-feet.
- June 12, gage height, 6.2 feet; discharge, 764 second-feet.
- July 27, gage height, 5.32 feet; discharge, 213 second-feet.
- August 4, gage height, 6.93 feet; discharge, 1,200 second-feet.
- September 6, gage height, 5.95 feet; discharge, 288 second-feet.
- October 5, gage height, 5.1 feet; discharge, 100 second-feet.

*Daily gage height, in feet, of South Platte River at Denver, Colorado, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.80	4.80	6.10	6.10	5.85	5.90	6.30	6.20	6.00	5.20	5.15	5.55
2	4.70	4.80	6.00	6.05	5.85	5.90	6.65	5.95	5.95	5.20	5.25	5.65
3	4.80	4.80	6.00	6.00	5.75	6.10	6.95	5.90	6.00	5.15	5.35	5.15
4	4.90	4.80	5.90	5.95	5.75	5.90	7.10	7.00	6.00	5.10	5.40	5.25
5	4.90	4.90	5.90	5.90	5.80	6.00	7.00	7.20	5.90	5.10	5.30	5.35
6	4.80	4.90	5.80	5.80	5.95	5.95	6.60	6.95	5.85	5.10	5.25	5.50
7	4.90	4.80	5.80	5.75	5.85	6.30	6.45	6.75	5.90	5.05	5.35	5.50
8	4.90	4.70	5.70	5.80	5.75	6.50	6.40	6.60	5.80	4.90	5.40	5.15
9	4.80	4.80	5.60	5.90	5.75	6.50	6.40	6.45	5.80	4.90	5.25	5.15
10	4.70	4.90	5.50	6.05	6.05	6.45	6.95	6.30	5.80	5.00	5.20	5.30
11	4.80	4.80	5.60	6.15	6.05	6.25	6.15	6.20	5.75	5.00	5.40	5.05
12	4.80	4.90	5.70	6.10	6.10	6.25	6.00	6.20	5.75	5.00	5.70	5.15
13	4.90	5.10	5.60	6.15	6.25	6.45	5.95	6.00	5.70	5.10	5.60	5.15
14	5.00	5.20	5.80	6.20	6.25	6.50	6.40	6.00	5.65	5.20	5.50	5.05
15	4.90	5.30	5.80	6.25	6.35	6.65	6.25	6.00	5.70	5.20	5.55	5.20
16	4.90	5.30	5.90	6.30	6.30	6.60	6.30	5.90	5.75	5.25	5.45	5.30
17	4.80	5.40	6.00	6.20	6.25	6.65	6.40	5.65	5.80	5.15	5.55	5.25
18	4.90	5.70	6.10	6.35	6.20	6.65	6.45	5.65	5.75	5.05	5.35	5.30
19	4.80	6.30	6.15	6.25	6.08	6.65	6.60	5.55	5.75	5.15	5.45	5.35
20	4.80	6.20	6.25	6.05	6.08	6.65	6.30	5.65	5.80	5.20	5.70	5.25
21	4.80	6.00	6.30	5.95	6.00	7.10	6.20	6.05	5.70	5.10	5.65	5.25
22	4.70	5.90	6.20	5.95	5.90	7.00	6.00	6.02	5.65	5.15	5.75	5.25
23	4.80	5.70	6.05	5.95	5.80	6.90	5.90	5.98	5.60	5.25	5.70	5.30
24	4.70	5.60	6.00	6.00	5.88	6.80	5.80	5.92	5.30	5.30	5.70	5.35
25	4.90	5.50	5.90	5.95	5.80	6.80	5.70	5.85	5.00	5.20	5.60	5.40
26	4.80	5.60	5.95	6.10	5.85	6.70	5.60	5.75	5.60	5.20	5.65	5.40
27	4.80	5.80	6.05	6.15	5.88	6.65	5.50	5.65	5.60	5.30	5.65	5.25
28	4.70	6.20	6.10	6.05	5.95	6.55	5.30	5.75	5.65	5.25	5.70	5.30
29	4.80	-----	6.20	5.95	6.30	6.40	5.20	5.80	5.50	5.15	5.60	5.40
30	4.80	-----	6.15	5.90	5.95	6.30	5.90	5.90	5.20	5.25	5.50	5.30
31	4.80	-----	6.10	-----	5.85	-----	6.10	6.00	-----	5.15	-----	5.40

#### SOUTH PLATTE RIVER AT ORCHARD, COLORADO.

This station, on the lower South Platte River, is located one-fourth of a mile southwest of Orchard, Colorado. The gage is vertical and is fastened to a pile of the wagon bridge. The gage rod is not referred to any satisfactory bench mark, and consequently when the pile to which the rod was nailed was raised a number of tenths by ice about March 17, it was necessary that a new rating table be made for observations after that date. The left bank is high and the right low and liable to overflow. The bed of the stream is sandy and shifting, although the section did not materially change during 1899. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 166; 1897, Nineteenth Annual Report, Part IV, page 315; 1898, Twentieth Annual Report, Part IV, page 293. The following measurements of discharge were made under the direction of A. L. Fellows in 1899:

April 14, gage height, 3.2 feet; discharge, 1,258 second-feet.

May 27, gage height, 2.3 feet; discharge, 158 second-feet.

September 12, gage height, 2.05 feet; discharge, 57 second-feet.

November 3, gage height, 2.80 feet; discharge, 614 second-feet.

*Daily gage height, in feet, of South Platte River at Orchard, Colorado, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.50	4.40	5.00	3.20	3.20	2.10	3.40	2.80	2.00	2.30	2.80	3.00
2	4.50	4.40	5.00	3.20	3.20	2.10	3.45	2.75	2.00	2.30	2.80	3.00
3	4.50	4.40	5.00	3.20	3.10	2.10	3.70	2.70	1.90	2.30	2.80	3.00
4	4.50	4.40	5.00	3.20	3.10	2.10	3.90	2.70	1.90	2.30	2.80	3.00
5	4.50	4.40	5.00	3.20	3.10	2.00	4.20	2.90	1.90	2.30	2.80	3.00
6	4.50	4.40	5.00	3.20	3.00	2.00	4.00	4.20	1.90	2.30	2.80	3.00
7	4.50	4.40	4.90	3.20	3.00	2.00	3.80	4.20	1.90	2.30	2.80	3.00
8	4.40	4.40	4.80	3.20	3.00	2.00	3.90	4.00	1.90	2.30	2.80	3.00
9	4.40	4.40	4.50	3.20	3.00	1.90	4.20	3.80	1.90	2.30	2.85	3.00
10	4.40	4.40	4.50	3.20	2.80	1.90	4.00	3.70	1.90	2.35	2.85	3.00
11	4.40	4.40	4.50	3.20	2.80	1.90	3.50	3.40	1.90	2.40	2.90	3.00
12	4.40	4.40	4.50	3.20	2.80	1.85	3.20	3.20	1.90	2.50	2.90	3.00
13	4.40	4.45	4.50	3.20	2.50	1.90	3.00	3.20	1.90	2.60	2.90	3.20
14	4.40	4.50	4.50	3.20	2.50	3.00	3.10	3.20	1.90	2.70	2.90	3.20
15	4.40	4.60	4.00	3.20	2.50	3.20	3.20	2.70	1.90	2.80	2.90	3.20
16	4.40	4.70	4.00	3.20	2.50	3.20	3.50	2.65	1.90	2.80	2.90	3.20
17	4.40	4.75	4.00	3.20	2.50	3.20	3.80	2.60	1.90	2.80	2.95	3.20
18	4.40	4.80	3.50	3.25	2.30	3.20	3.90	2.50	1.90	2.80	2.98	3.20
19	4.40	4.80	3.20	3.30	2.30	3.20	4.00	2.40	1.90	2.80	3.00	3.30
20	4.40	5.00	3.20	3.30	2.20	3.20	3.70	2.40	1.95	2.80	3.00	3.40
21	4.40	5.00	3.20	3.30	2.20	3.90	3.60	2.35	1.95	2.80	3.00	3.60
22	4.40	5.00	3.20	3.30	2.20	4.40	3.30	2.30	2.00	2.80	3.00	3.70
23	4.40	5.00	3.20	3.30	2.20	4.50	3.20	2.30	2.00	2.80	3.00	3.80
24	4.40	5.00	3.20	3.30	2.20	4.60	3.00	2.20	2.10	2.80	3.00	3.90
25	4.40	5.00	3.20	3.30	2.20	4.20	2.90	2.15	2.10	2.80	3.00	3.90
26	4.40	5.00	3.20	3.30	2.20	4.10	2.85	2.10	2.20	2.80	3.00	3.90
27	4.40	5.00	3.20	3.30	2.20	4.00	2.70	2.00	2.20	2.80	3.00	4.00
28	4.40	5.00	3.20	3.30	2.20	3.90	2.60	2.00	2.20	2.80	3.00	4.00
29	4.40	-----	3.20	3.30	2.20	3.70	2.60	2.00	2.30	2.80	3.00	4.00
30	4.40	-----	3.20	3.30	2.20	3.60	2.50	2.00	2.30	2.80	3.00	4.00
31	4.40	-----	3.20	-----	2.20	-----	2.80	2.00	-----	2.80	-----	4.00

The water diversions from this stream in Colorado are so extensive that during the summer season a comparatively insignificant flow reaches Nebraska. Measurements of the South Platte were made near its junction with the North Platte. On April 19, 1899, Glenn E. Smith made a measurement from the wagon bridge south of the town of North Platte, and found the total width to be 1,296 feet, while the discharge was 883 second-feet; on May 6 the discharge was 866 second-feet, and on May 22, 88 second-feet. At this time the water was flowing in a number of small channels scattered across the sandy bed. On June 6 the channel was dry.

BEAR CREEK AT MORRISON, COLORADO.

This stream, a tributary of the South Platte, drains a portion of the eastern slope of the Rocky Mountains and enters the main stream 8 miles above Denver. The station is located in the upper part of the town of Morrison. The present station was established April 16, 1899, by John E. Field, State engineer, and is located about a quarter of a mile above the railway station. The gage rod consists of a 2 by 4 timber placed vertically and marked in feet and tenths, and is fastened to the upper side of the dam which diverts water into the mains of the Denver Union Water Company. At the height of 4 feet on the gage rod water begins to flow over the spillway, making a marked difference in the rating curve. The bench mark consists of the top of a granite boulder about 100 feet above the rod and on the left-hand side of the stream, and is 10.33 feet above gage datum. The station was maintained during the year through cooperation with the Denver Union Water Company. Previous results of measurements may be

found as follows: 1896, Eighteenth Annual Report, Part IV, page 167; 1897, Nineteenth Annual Report, Part IV, page 317; 1898, Twentieth Annual Report, Part IV, page 284. The following discharge measurements were made under the direction of A. L. Fellows during 1899:

April 15, gage height, 3.80 feet; discharge, 64 second-feet.  
 May 9, gage height, 4.25 feet; discharge, 99 second-feet.  
 June 16, gage height, 4.25 feet; discharge, 107 second-feet.  
 August 5, gage height, 4.98 feet; discharge, 192 second-feet.  
 November 14, gage height, 1.35 feet; discharge, 13 second-feet.

*Daily gage height, in feet, of Bear Creek at Morrison, Colorado, for 1899.*

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		4.05	4.05	4.15	4.10	3.35	2.00
2		4.10	4.05	4.40	4.15	3.35	1.90
3		3.20	3.95	4.45	5.25	3.25	1.90
4		3.25	3.85	4.45	5.80	3.25	1.90
5		3.55	3.55	4.20	5.20	3.15	1.80
6		3.65	3.90	4.05	5.05	2.95	1.80
7		3.90	4.20	4.20	4.90	2.80	1.80
8		4.15	4.15	4.20	4.75	2.65	1.80
9		4.20	4.30	4.05	4.65	2.65	1.80
10		4.20	4.15	3.75	4.65	2.55	2.20
11		4.40	4.15	3.65	4.55	2.70	2.10
12		4.55	4.20	3.65	4.55	2.75	2.10
13		4.60	4.30	4.10	4.45	2.70	2.00
14		4.70	4.25	4.25	4.35	2.65	2.00
15		4.70	4.15	4.30	4.25	2.60	2.05
16	4.20	4.65	4.15	4.30	4.15	2.70	2.00
17	4.20	4.60	4.15	4.50	4.20	2.75	1.95
18	4.15	4.50	4.15	4.10	3.95	2.65	1.90
19	4.15	4.45	4.25	4.00	3.75	2.60	1.80
20	3.95	4.45	4.30	4.00	3.65	2.45	1.80
21	3.75	4.25	4.25	3.95	3.45	2.45	1.70
22	4.00	4.25	4.25	3.90	3.35	2.35	-----
23	4.05	4.25	4.15	3.85	3.25	2.25	-----
24	4.20	4.25	4.15	3.75	3.15	2.20	-----
25	4.20	4.25	4.30	3.65	3.05	2.20	-----
26	4.10	4.25	4.15	3.75	3.05	2.15	-----
27	4.10	4.25	4.15	3.75	2.95	2.10	-----
28	4.00	4.25	4.05	3.75	2.75	2.10	-----
29	3.85	4.15	4.05	4.25	2.55	2.05	-----
30	3.65	4.15	4.20	4.15	2.45	2.00	-----
31		4.15	-----	3.90	3.35	-----	-----

Closed for the winter October 21.

#### CLEAR CREEK AT FORKSCREEK, COLORADO.

This stream rises on the eastern slope of the Rocky Mountains almost due west of Denver, and flows in an easterly direction, entering the South Platte River 6 miles below the center of the city of Denver. The small summer flow of this stream is completely utilized for irrigation purposes. The gaging station, established by John E. Field, State engineer, March 29, 1899, is located at the railway station at Forkscreek, on the Colorado and Southern Railway, in Clear Creek Canyon, just below the junction of the North and South forks. The gage consists of a weight fastened to a wire running over a pulley fastened to a rock at the railway station. Bench mark No. 1 is a point on the timber to which the pulley is attached, and is 13.58 feet above gage datum. Bench mark No. 2 is a granite point 49.5 feet east of the first bench mark, and is 15.46 feet above gage datum. The channel is rocky and not liable to serious change. The walls are high and not liable to overflow. On April 20 measurements of the North and

South forks were made separately and gave 43 second-feet and 101 second-feet, respectively. The following discharge measurements were made under the direction of A. L. Fellows during 1899:

- March 29, gage height, 1.50 feet; discharge, 53 second-feet.
- April 20, gage height, 2.10 feet; discharge, 155 second-feet.
- May 10, gage height, 2.75 feet; discharge, 365 second-feet.
- June 7, gage height, 3.70 feet; discharge, 779 second-feet.
- August 12, gage height, 3.08 feet; discharge, 449 second-feet.
- November 15, gage height, 1.70 feet; discharge, 67 second-feet.

*Daily gage height, in feet, of Clear Creek at Forkscreek, Colorado, for 1899.*

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.65	2.55	(a)	4.45	3.35	2.60	2.10	2.10	1.40
2	1.75	2.50	(a)	4.40	3.30	2.75	2.10	2.05	1.40
3	1.65	2.50	(a)	4.30	3.35	2.60	2.10	2.00	
4	1.65	2.25	(a)	4.05	3.40	2.60	2.00	2.00	
5	1.70	2.35	(a)	4.00	3.55	2.60	2.00	1.90	
6	1.55	2.40	(a)	4.05	3.35	2.50	2.00	1.85	
7	1.75	2.45	3.70	4.00	3.30	2.40	2.00	1.75	
8	1.70	2.45	3.75	4.00	3.30	2.40	2.00	1.75	
9	1.85	2.60	3.80	3.95	3.25	2.30	2.00	1.80	
10	1.95	2.85	3.80	3.90	3.15	2.30	2.00	1.80	
11	2.20	3.10	3.90	3.75	3.10	2.30	2.00	1.80	
12	2.20	3.50	4.15	3.70	3.05	2.30	2.00	1.80	
13	2.05	3.75	4.30	3.70	3.00	2.30	2.10	1.80	
14	2.15	4.00	4.40	3.70	3.00	2.30	2.05	1.80	
15	2.20	4.10	4.20	3.70	3.00	2.30	2.10	1.70	
16	2.30	4.25	4.25	3.70	3.00	2.30	2.10	1.70	
17	2.30	4.20	4.30	3.70	2.95	2.30	2.10	1.70	
18	2.30	4.35	4.45	3.60	2.90	2.30	2.10	1.65	
19	2.15	4.45	4.65	3.50	2.85	2.20	2.10	1.60	
20	2.10	(a)	4.70	3.50	2.80	2.20	2.00	1.55	
21	2.20	(a)	4.75	3.50	2.75	2.20	2.00	1.50	
22	2.20	(a)	4.70	3.50	2.70	2.20	2.00	1.55	
23	2.45	(a)	4.40	3.50	2.70	2.20	2.00	1.65	
24	2.50	(a)	4.40	3.40	2.70	2.20	2.00	1.50	
25	2.75	(a)	4.25	3.40	2.70	2.20	2.00	1.40	
26	2.90	(a)	4.25	3.40	2.70	2.20	2.05	1.40	
27	2.80	(a)	4.15	3.40	2.70	2.20	2.10	1.40	
28	2.30	(a)	4.10	3.40	2.60	2.10	2.00	1.40	
29	2.50	(a)	4.10	3.45	2.60	2.10	2.00	1.40	
30	2.45	(a)	4.25	3.40	2.60	2.10	2.00	1.40	
31		(a)		3.40	2.60	2.05			

a Gage broken; no reading.

SOUTH BOULDER CREEK AT MARSHALL, COLORADO.

This stream, the next one of importance entering below Clear Creek, is measured at a point about 3 miles west of Marshall, Colorado. The gage is an inclined 2 by 6 inch timber fastened to a tree and stakes driven into the ground. The bench mark is a stone 15 feet west of the gage, marked with black paint, and is 6.99 feet above gage datum. The gage was verified August 10, 1899. Two ditches divert water at points above the station, viz, the South Boulder and Coal Creek ditch and the Community ditch, and their discharge must be added to the discharge as found at the station to determine the total run-off of the basin. May 6 South Boulder and Coal Creek ditch, at a gage height of 0.7 foot, was discharging 7 second-feet, and on the same date Community ditch, at a gage height of 2.25 feet, was carrying 35 second-feet. C. E. Barber, Langford, Colorado, is the observer. Measurements are usually made by wading, but a footbridge near by can be used in high water. Results of measurements may be found as fol-

lows: 1896, Eighteenth Annual Report, Part IV, page 169; 1897, Nineteenth Annual Report, Part IV, page 318; 1898, Twentieth Annual Report, Part IV, page 287. The following discharge measurements were made under the direction of A. L. Fellows in 1899:

- April 22, gage height, 1.70 feet; discharge, 115 second-feet.
- May 6, gage height, 1.55 feet; discharge, 96 second-feet.
- June 15, gage height, 2.80 feet; discharge, 451 second-feet.
- August 10, gage height, 1.60 feet; discharge, 109 second-feet.
- October 10, gage height, 0.70 foot; discharge, 7 second-feet.

Daily gage height, in feet, of South Boulder Creek at Marshall, Colorado, for 1899.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.90	1.80	2.50	2.65	1.65	1.30	17	1.75	2.65	2.85	2.15	1.40	1.10
2	1.00	1.80	2.55	2.65	1.55	1.30	18	1.75	2.60	2.90	2.10	1.40	1.10
3	.95	1.65	2.50	2.55	1.65	1.30	19	1.80	2.65	2.95	2.10	1.40	1.10
4	1.00	1.65	2.35	2.45	1.85	1.25	20	1.80	2.65	3.00	2.00	1.35	1.00
5	.95	1.60	2.30	2.45	2.00	1.20	21	1.80	2.50	3.00	2.05	1.30	1.05
6	1.00	1.60	2.35	2.40	1.90	1.20	22	1.85	2.45	3.00	2.00	1.30	.90
7	.95	1.65	2.45	2.35	1.80	1.20	23	1.80	2.35	2.85	2.00	1.35	.90
8	1.00	1.70	2.55	2.30	1.85	1.20	24	1.95	2.30	2.80	1.95	1.30	.90
9	1.05	1.90	2.60	2.25	1.70	1.20	25	2.10	2.40	2.70	1.90	1.30	.90
10	1.15	2.25	2.70	2.30	1.60	1.10	26	2.15	2.55	2.65	1.85	1.30	.90
11	1.25	2.25	2.65	2.30	1.60	1.00	27	2.25	2.60	2.65	1.85	1.30	.90
12	1.40	2.35	2.80	2.20	1.60	1.00	28	2.20	2.55	2.55	1.80	1.25	.90
13	1.60	2.35	2.90	2.50	1.50	1.00	29	2.15	2.50	2.55	1.70	1.20	.90
14	1.65	2.55	2.95	2.35	1.50	1.00	30	1.90	2.55	2.60	1.60	1.30	.90
15	1.75	2.60	2.90	2.45	1.40	1.00	31	-----	2.55	-----	1.55	1.30	-----
16	1.80	2.70	2.85	2.25	1.50	1.05							

Closed for the winter September 30.

Daily gage height, in feet, of South Boulder and Coal Creek ditch, Colorado, for 1899.

Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.
1	-----	1.35	1.50	1.20	12	-----	1.50	1.30	1.00	23	1.10	1.50	1.20	-----
2	-----	1.30	1.50	1.20	13	-----	1.50	1.30	1.00	24	1.10	1.50	1.20	-----
3	-----	1.40	1.50	1.20	14	-----	1.50	1.30	1.00	25	1.10	1.50	1.20	-----
4	-----	1.40	1.50	1.20	15	-----	1.50	(a)	.90	26	1.10	1.50	1.20	-----
5	-----	1.40	1.50	1.20	16	-----	1.50	(a)	.90	27	1.10	1.50	1.20	-----
6	-----	1.50	1.40	1.20	17	-----	1.50	1.30	.80	28	1.10	1.50	1.20	-----
7	-----	1.50	1.40	1.20	18	-----	1.50	1.30	.80	29	1.10	1.50	1.20	-----
8	-----	1.50	1.30	1.00	19	-----	1.50	1.20	.80	30	1.30	1.50	1.20	-----
9	-----	1.50	1.30	1.00	20	-----	1.50	1.20	-----	31	1.30	-----	1.20	-----
10	-----	1.50	1.30	1.00	21	0.90	1.50	1.20	-----					
11	-----	1.50	1.30	1.00	22	.90	1.50	1.20	-----					

a Dry.

Daily gage height, in feet, of Community ditch, Colorado, for 1899.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1	-----	2.10	2.20	2.20	12	-----	2.20	2.20	2.10	23	1.50	2.20	2.20	-----
2	-----	2.10	2.30	2.20	13	-----	2.20	2.20	2.10	24	1.70	2.20	2.20	-----
3	-----	2.10	2.30	2.20	14	-----	2.20	2.20	2.10	25	1.80	2.20	2.20	-----
4	-----	2.20	2.30	2.20	15	-----	2.20	2.20	-----	26	1.80	2.20	2.20	-----
5	-----	2.20	2.30	2.20	16	-----	2.20	2.20	-----	27	1.90	2.20	2.20	-----
6	-----	2.20	2.20	2.20	17	-----	2.20	2.20	1.25	28	1.90	2.20	2.20	-----
7	-----	2.20	2.20	2.20	18	-----	2.20	2.20	1.30	29	2.10	2.20	2.20	-----
8	-----	2.20	(a)	2.20	19	-----	2.20	2.20	1.20	30	2.10	2.20	2.20	-----
9	-----	2.20	2.20	2.10	20	-----	2.10	2.20	1.20	31	-----	2.20	-----	-----
10	-----	2.20	2.20	2.10	21	-----	2.10	2.20	1.20					
11	-----	2.20	2.20	2.10	22	-----	2.20	2.20	1.20					

a Dry.

BOULDER CREEK AT BOULDER, COLORADO.

The next drainage of importance entering the South Platte from the west is Boulder Creek, an important tributary, furnishing water for a number of irrigation ditches. The station is located about 1½ miles above the town of Boulder, Colorado. The gage rod is inclined and spiked to stakes driven into the ground. The bench mark is the top of a large stone 22 feet west of the gage, and is 5.72 feet above gage datum. Both banks are high and rocky, and not liable to overflow. Two small irrigating ditches take water from the stream above the station, but the amount thus diverted will probably not exceed 5 or 6 second-feet. Results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 171; 1897, Nineteenth Annual Report, Part IV, page 319; 1898, Twentieth Annual Report, Part IV, page 286. The following discharge measurements were made under the direction of A. L. Fellows in 1899:

- April 21, gage height, 1 foot; discharge, 84 second-feet.
- May 6, gage height, 1.20 feet; discharge, 134 second-feet.
- June 15, gage height, 2.50 feet; discharge, 642 second-feet.
- August 10, gage height, 1.70 feet; discharge, 276 second-feet.
- October 10, gage height, 0.50 foot; discharge, 36 second-feet.

Daily gage height, in feet, of Boulder Creek at Boulder, Colorado, for 1899.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	0.32	1.55	2.15	2.90	1.92	1.52	0.48	0.48
2	.30	1.52	2.12	2.92	1.98	1.50	.48	.45
3	.38	1.40	2.12	2.85	2.22	1.45	.48	.48
4	.45	1.38	2.00	2.85	2.45	1.38	.48	.48
5	.35	1.30	1.98	2.78	2.18	1.22	.45	.42
6	.32	1.20	2.05	2.70	2.02	1.12	.48	.40
7	.42	1.22	2.12	2.65	1.88	1.05	.42	.38
8	.42	1.28	2.18	2.58	1.82	.95	.45	.38
9	.48	1.35	2.28	2.48	1.78	.98	.50	.35
10	.55	1.45	2.45	2.50	1.70	.95	.55	.35
11	.92	1.60	2.48	2.42	1.65	.92	.58	.30
12	1.00	1.70	2.62	2.40	1.68	.90	.60	.30
13	1.05	1.90	2.65	2.48	1.62	.88	.65	.35
14	1.10	2.00	2.68	2.45	1.52	.95	.65	.38
15	1.10	2.12	2.62	2.48	1.60	.98	.60	.42
16	1.25	2.15	2.58	2.40	1.65	.92	.58	.42
17	1.20	2.12	2.60	2.30	1.55	.88	.58	.40
18	1.22	2.08	2.75	2.28	1.52	.82	.52	.35
19	1.15	2.12	2.85	2.18	1.45	.78	.55	.30
20	1.10	2.15	2.85	2.12	1.38	.72	.50	.30
21	1.12	2.10	2.90	2.10	1.38	.72	.48	.28
22	1.20	2.08	2.88	2.05	1.32	.62	.50	.28
23	1.25	2.10	2.90	2.02	1.32	.60	.52	.25
24	1.48	2.05	2.85	1.90	1.28	.58	.55	.25
25	1.62	2.08	2.85	1.92	1.20	.58	.60	.22
26	1.68	2.18	2.85	2.00	1.15	.55	.55	.22
27	1.65	2.12	2.78	2.05	1.22	.58	.50	.25
28	1.60	2.12	2.70	2.10	1.45	.55	.48	.22
29	1.55	2.15	2.72	2.20	1.25	.50	.48	.18
30	1.58	2.15	2.82	2.10	1.50	.50	.48	.18
31		2.12		1.90	1.55		.50	

ST. VRAIN CREEK AT LYONS, COLORADO.

The gaging station on this drainage is located one-half mile south-east of Lyons, Colorado, below the intersections of the North and South forks of St. Vrain Creek. The gage is inclined and fastened to a post driven into the ground. Both banks are low and liable to overflow. The bed of the stream is composed of gravel. On May 5 a new gage rod was established having the same reading as the old one, and connected with a bench mark 150 feet north of the rod. The elevation of the bench mark is 6.51 feet above gage datum. Supply ditch diverts water above the station, and its discharge should be added to that of the river to obtain the total run-off in the basin. On May 5 at the rating flume, it was discharging, at a gage height of 0.65 foot, 35 second-feet. The observer is Miss Bessie Sites, who reads the gage on the creek, as well as that of the ditch. The results of measurements are found as follows: 1896, Eighteenth Annual Report, Part IV, page 173; 1897, Nineteenth Annual Report, Part IV, page 320; 1898, Twentieth Annual Report, Part IV, page 285. The following discharge measurements were made under the direction of A. L. Fellows in 1899:

- April 18, gage height, 3 feet; discharge, 217 second-feet.
- May 5, gage height, 2.75 feet; discharge, 137 second-feet.
- June 14, gage height, 4.15 feet; discharge, 825 second-feet.
- August 9, gage height, 3.20 feet; discharge, 263 second-feet.
- October 7, gage height, 2.10 feet; discharge, 37 second-feet.

Daily gage height, in feet, of St. Vrain Creek at Lyons, Colorado, for 1899.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	2.05	2.90	3.35	4.40	3.45	2.65	2.05	2.00
2	2.15	2.90	3.55	4.40	3.45	2.65	2.05	2.00
3	2.25	2.70	3.45	4.30	3.60	2.60	2.05	2.00
4	2.25	2.55	3.45	4.30	4.05	2.55	1.95	2.00
5	2.20	2.65	3.45	4.30	4.05	2.55	1.95	2.00
6	2.25	2.90	3.40	4.15	3.85	2.55	1.95	2.00
7	2.30	3.00	3.50	4.00	3.75	2.55	1.95	1.95
8	2.25	2.90	3.50	4.05	3.70	2.65	1.95	1.90
9	2.35	3.00	3.55	4.15	3.65	2.65	2.05	1.90
10	2.70	3.10	3.50	4.05	3.55	2.65	2.05	1.90
11	2.75	3.15	3.75	4.05	3.50	2.65	2.15	1.90
12	2.80	3.35	4.05	3.95	3.40	2.55	2.18	1.95
13	3.00	3.30	4.00	4.00	3.20	2.55	2.15	2.00
14	3.05	3.40	4.25	4.10	3.05	2.55	2.25	2.00
15	3.00	3.40	4.10	4.00	2.95	2.55	2.25	2.00
16	2.90	3.35	4.15	3.90	2.90	2.45	2.25	2.00
17	3.10	3.30	4.30	3.65	2.90	2.45	2.22	2.10

Daily gage height, in feet, of Big Thompson Creek at Arkins, Colorado, for 1899.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	0.30	1.00	1.90	2.75	1.80	0.90	(a)
2	.40	.95	1.90	2.70	1.80	.90	(a)
3	.35	.90	1.90	2.60	1.80	.85	(a)
4	.45	.90	1.85	2.65	2.15	.80	(a)
5	.45	.90	1.90	2.50	1.90	.90	(a)
6	.50	.90	1.90	2.40	1.80	.85	(a)
7	.55	.90	1.90	2.40	1.75	.80	(a)

*Daily gage height, in feet, of Supply ditch at Lyons, Colorado, for 1899.*

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	0.10	0.90	0.70	1.40	0.90	0.58	0.15	0.10
2	.10	.80	.70	1.40	.90	.52	.15	.10
3	.10	.70	.70	1.40	.85	.55	.15	.10
4	.10	.70	.70	1.40	.80	.50	.15	.10
5	.10	.70	.60	1.40	.80	.52	.10	.10
6	.10	.70	.50	1.30	.80	.37	.10	.10
7	.10	.70	.50	1.30	.80	.20	.10	.10
8	.10	.70	.50	1.30	.80	.40	.10	.10
9	.10	.70	.55	1.30	.80	.40	.10	.10
10	.25	.70	.60	1.30	.80	.20	.10	.10
11	.40	.70	.95	1.30	.80	.20	.20	.10
12	.40	.95	1.20	1.25	.80	.20	.20	.10
13	.40	.80	1.30	1.20	.85	.28	.20	.10
14	.40	.80	1.30	1.20	.70	.22	.15	.10
15	.45	.80	1.40	1.20	.70	.20	.10	.10
16	.50	.80	1.40	1.20	.70	.20	.10	.10
17	.50	.90	1.40	1.20	.70	.20	.10	.10
18	.10	1.00	1.40	1.20	.70	.20	.10	.10
19	.10	1.00	1.40	1.20	.70	.30	.10	.10
20	.10	1.00	1.40	1.20	.70	.20	.10	.10
21	.10	1.00	1.40	1.05	.50	.20	.10	.10
22	.10	1.00	1.40	.90	.50	.20	.10	.10
23	.10	1.00	1.40	.90	.50	.18	.10	.10
24	.10	.70	1.40	.90	.50	.18	.10	.10
25	.10	.40	1.40	.90	.50	.12	.15	.10
26	.10	.60	1.40	.90	.50	.10	.15	.10
27	.10	.80	1.40	.90	.50	.10	.15	.10
28	.10	.80	1.40	.90	.20	.10	.15	.10
29	.10	.75	1.40	.90	.20	.15	.10	.10
30	.50	.70	1.40	.90	.50	.15	.10	.10
31		.70		.90	.60		.10	

BIG THOMPSON CREEK AT ARKINS, COLORADO.

This stream drains the country immediately south of the headwaters of Cache la Poudre River, and enters the South Platte 8 miles from Greeley. The location of the station was changed April 1, 1899, from its original position to a point 2 miles above, so that the head of the Home Supply ditch is now below the gaging station, while that of the Handy ditch is still above. It is necessary to include the discharge of this latter canal to give the total run-off of the stream. The present location of the station is at a wagon bridge upon the ranch of Mr. John Chasteen. The gage rod consists of a 2 by 4 inch timber spiked to the downstream side of the bridge on the right-hand side of the river. The bench mark is 25 feet south of the gage and is 9.35 feet above the zero. Handy ditch, which heads one-half mile above the station, was measured twice during the year, the first time, on April 17, at a gage height 0.6 foot, the discharge was 41 second-feet; June 13, at a gage height of 2.30 feet, the discharge was 182 second-feet. The observer is Ed. Chasteen, who records the heights of the canal as well as at the main gaging station. The results of measurements are found as follows: 1896, Eighteenth Annual Report, Part IV, page 175; 1897, Nineteenth Annual Report, Part IV, page 322; 1898, Twentieth Annual Report, Part IV, page 288. The following discharge measurements were made under the direction of A. L. Fellows in 1899:

April 17, gage height, 0.90 foot; discharge, 143 second-feet.

May 4, gage height, 0.97 foot; discharge, 173 second-feet.

June 13, gage height, 2.55 feet; discharge, 941 second-feet.

August 8, gage height, 1.73 feet; discharge, 406 second-feet.

October 6, gage height, 0.50 foot; discharge, 34 second-feet.

Daily gage height, in feet, of Big Thompson Creek at Arkins, Colorado, for 1899.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	0.30	1.00	1.90	2.75	1.80	0.90	(a)
2	.40	.95	2.00	2.70	1.80	.90	(a)
3	.35	.90	1.90	2.60	1.80	.85	(a)
4	.45	.90	1.85	2.65	2.15	.80	(a)
5	.45	.90	1.90	2.50	1.90	.90	(a)
6	.50	.90	1.90	2.40	1.80	.85	(a)
7	.55	.90	1.90	2.40	1.75	.80	(a)
8	.35	1.00	2.00	2.30	1.70	.80	0.50
9	.20	1.00	2.10	2.30	1.60	.80	.50
10	.35	1.00	2.15	2.25	1.55	.80	.60
11	.55	1.05	2.25	2.20	1.45	.80	.70
12	.65	1.10	2.30	2.15	1.40	.80	.80
13	.75	1.25	2.45	2.75	1.30	.70	.80
14	.90	1.55	2.60	2.15	1.30	.70	.60
15	.90	1.60	2.65	2.15	1.30	.70	.60
16	.95	1.65	2.75	2.25	1.25	.70	.60
17	.95	1.50	2.80	1.95	1.20	.70	.60
18	.95	1.40	2.80	1.75	1.15	.80	.60
19	1.00	1.40	2.90	2.00	1.20	.70	.60
20	1.10	1.45	3.15	2.00	1.10	.70	.60
21	1.00	1.60	3.15	1.90	1.10	.60	.60
22	1.15	1.40	2.90	2.00	1.05	.60	.60
23	1.20	1.60	2.65	2.00	1.00	.60	.60
24	1.35	1.75	2.50	2.05	1.05	.60	.60
25	1.30	1.85	2.60	1.90	1.00	.65	.60
26	1.45	1.85	2.65	1.85	1.00	.55	.60
27	1.50	2.00	2.55	1.95	.90	.50	.60
28	1.45	2.00	2.70	1.90	.95	.50	.60
29	1.25	1.90	2.80	1.90	.90	.50	.60
30	1.10	1.90	2.75	1.90	.90	.50	.60
31		2.00		1.80	.90		.60

a No readings; closed for the winter October 31.

Daily gage height, in feet, of Handy ditch on Big Thompson Creek, Colorado, for 1899.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1		0.30	0.95	2.30	0.75	0.30	17		1.10	2.20	1.92	0.70	(a)
2		.30	.95	2.30	.75	.30	18		2.00	2.20	1.55	.70	(a)
3		.30	.72	2.30	.75	.30	19		2.00	2.30	1.55	.70	(a)
4		.55	.60	2.30	1.12	.30	20		1.15	2.30	1.15	.70	(a)
5		.80	.60	2.30	1.55	.30	21		1.15	2.30	.75	.70	.30
6		.78	.70	2.30	1.15	.30	22		.75	2.30	.75	.70	.30
7		.75	.75	2.30	1.55	.30	23		.75	2.30	.75	.70	.30
8		.75	.78	2.30	1.30	.30	24		.75	2.25	.75	.70	.50
9		.75	1.10	2.30	1.02	.30	25	0.30	.75	2.30	.75	.50	.40
10		.75	1.55	2.30	.75	.30	26	.30	.75	2.30	.75	.30	.30
11		.75	2.00	2.30	.70	.30	27	.30	.98	2.30	1.12	.30	.30
12		.75	2.00	1.95	.70	.30	28	.30	.98	2.30	1.50	.30	.30
13		.75	2.10	1.95	.70	.30	29	.30	.98	2.30	1.50	.30	.30
14		2.20	2.20	2.30	.70	.30	30	.30	.75	2.30	1.50	.30	.30
15		2.20	2.20	2.30	.70	.65	31		.75		1.13	.30	
16		1.60	2.20	2.30	.70	1.00							

a Dry.

CACHE LA POUDBRE RIVER AT FORT COLLINS, COLORADO.

This stream drains an area of considerable size in northern Colorado, its headwater tributaries joining those of Laramie on the west. As given in the description of this latter stream, the Sky-line Canal diverts water from the Laramie River into Cache la Poudre River, and measurements of discharge in the latter basin include some of the Laramie waters. The station was established in 1884, at a point about 15 miles above Fort Collins, by Prof. L. G. Carpenter, of the Colorado State Agricultural College, and the work has been carried on under his immediate direction. The record is probably the longest and among the best of any of the small streams of the West. The daily discharge for 1893 and 1894 will be found in Bulletin No. 131, page 30. The following table shows the daily discharge through the irrigating season of the river from 1895 to 1899, inclusive:

*Daily discharge, in second-feet, of Cache la Poudre River at Fort Collins, Colorado.*

1895.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1	-----	1,800	1,690	796	357	17	1,100	-----	1,030	417	180
2	-----	1,920	1,510	805	339	18	1,100	-----	996	389	174
3	-----	3,200	1,430	846	300	19	1,350	-----	950	380	180
4	-----	2,800	1,410	666	283	20	-----	-----	942	406	188
5	-----	2,500	1,368	612	264	21	-----	-----	996	398	200
6	-----	2,660	1,240	588	247	22	-----	-----	1,076	375	216
7	-----	2,750	1,210	565	238	23	1,300	-----	1,086	404	216
8	-----	2,940	1,100	541	229	24	1,274	-----	899	415	208
9	-----	3,130	1,085	675	212	25	1,325	-----	867	381	-----
10	-----	3,450	1,114	652	192	26	1,404	-----	800	378	-----
11	-----	3,100	1,200	558	196	27	1,512	1,740	768	312	-----
12	-----	2,500	1,682	512	194	28	2,060	1,920	722	326	-----
13	-----	-----	1,602	471	192	29	1,668	1,830	707	343	-----
14	-----	-----	1,352	487	192	30	1,500	1,715	722	349	-----
15	-----	1,680	-----	1,220	480	31	1,400	-----	-----	378	-----
16	-----	-----	1,142	447	184	-----	-----	-----	-----	-----	-----

1896.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.	
1	-----	531	364	322	17	-----	981	617	320	255
2	-----	538	322	283	18	-----	942	602	192	251
3	-----	512	288	308	19	-----	882	468	320	280
4	-----	487	269	298	20	-----	878	403	294	294
5	-----	468	284	288	21	-----	841	364	283	285
6	-----	456	209	260	22	-----	780	348	422	255
7	-----	432	260	233	23	-----	753	362	517	-----
8	-----	507	238	208	24	-----	753	495	390	-----
9	-----	480	216	268	25	-----	760	453	302	-----
10	-----	409	196	370	26	-----	745	498	269	-----
11	-----	386	173	411	27	-----	707	589	251	-----
12	-----	381	173	361	28	-----	634	468	242	-----
13	-----	381	169	346	29	-----	612	456	266	-----
14	-----	395	166	307	30	-----	559	415	288	-----
15	-----	394	162	278	31	-----	-----	392	358	-----
16	-----	499	158	264	-----	-----	-----	-----	-----	-----

Daily discharge, in second-feet, of Cache la Poudre River at Fort Collins, Colorado—Continued.

1897.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		862	3,013	994	466		<i>a</i> 121
2		964	2,378	910	437		
3		978	1,903	1,051		203	
4		1,171	1,681	945			
5		1,189	1,601	792			
6		1,268	1,485	769	<i>a</i> 420		
7		1,425	1,406	797			
8		1,517	1,451	848			
9		1,486	1,961	1,043			
10		1,474	2,191	1,089		186	
11			2,173	971			
12			2,232	837			
13			2,402	797	<i>a</i> 339		
14			2,074	772			
15			2,328	1,028			
16			2,451	907			
17			1,698	828			
18		2,236	1,381	791			
19		2,298	1,449	816			
20		2,857	1,533	738	<i>a</i> 314		
21		3,106	1,548	626			
22		2,654		558			
23		2,987	1,463	520			
24		3,155	1,303	650		142	
25		2,981	1,339	546			
26		2,822	1,468	478			
27	667	2,998	1,278	449	<i>a</i> 248		
28	810	2,461	1,105	441			
29		2,505	1,086	418			
30	704	2,468	1,043	404			
31		2,658		455			

*a* Average for week.

1898.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		307	1,148	812	211		<i>a</i> 35
2		271	1,410	792	201		
3		267	1,636	704	180	<i>a</i> 112	
4		243	1,481	645	177		
5		244	1,210	586	186		
6		206	1,035	576	206		
7		219	1,131	554	258		
8		251	1,192	523	220		<i>a</i> 50
9		397	1,267	555	176		
10		337	1,247	592		<i>a</i> 97	
11			1,379	580			
12			1,364	686			
13			1,383	893	<i>a</i> 139		
14			1,612	658			
15			1,411	571			<i>a</i> 66
16			1,605	521			
17			1,658	486		<i>a</i> 60	
18		806	1,629	437			
19		756	1,650	396			
20		755	1,432	332	<i>a</i> 133		
21		664	1,414	319			
22		629		297			<i>a</i> 84
23		702	1,349	288			
24		837	1,358	287		<i>a</i> 43	
25		1,308	1,273	296			
26		1,175	1,109	283			
27	294	1,050	951	267	<i>a</i> 115		
28	308	1,280	905	240			
29		1,130	842	212			
30	316	1,115	824	211			
31		1,265		210			

*a* Average for week.

Daily discharge, in second-feet, of Cache la Poudre River at Fort Collins, Colorado—Continued.

1899.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1		1,848	2,710	767	358	116
2		1,924	2,544	765	351	112
3		1,839	2,459	782	365	104
4		1,631	2,415	972	335	100
5		1,472	2,102	974	324	95
6		1,579	2,242	848	302	93
7		1,786	2,136	873	290	92
8		1,912	1,678	760	280	104
9		2,010	1,577	797	263	111
10	636	2,168	1,482	735	231	125
11	684	2,490	1,303	668	213	
12	929	3,103	1,703	629	201	
13	1,144	3,619	1,643	592	196	
14	1,348	2,831	1,477	555	199	
15	1,404	2,702	1,446	504	202	
16	1,452	2,822	1,355	682	220	
17	1,453	2,981	1,161	533	220	
18	1,492	3,040	1,081	469	200	98
19	1,663	3,556	974	431	183	128
20	1,809	3,865	985	399	162	160
21	1,573	3,968	974	381	125	165
22	1,380	3,343	972	344	125	110
23	1,310	2,945	987	307	125	110
24	1,351	2,933	960	301	125	110
25	1,521	2,663	947	286	125	
26	1,911	2,953	841	286	123	
27	2,001	2,943	955	281	141	
28	1,936	2,734	928	328	141	
29	1,803	2,691	918	322	126	
30	2,015	2,606	897	331	120	
31	1,881		809	423		

NORTH LOUP RIVER AT ST. PAUL, NEBRASKA.

This stream has its source among the sand hills in the western portion of Cherry County, Nebraska, and drains the country midway between the Niobrara River on the north and Middle Loup River on the south. It has a general southeasterly direction, joining the Middle Loup at St. Paul to form the main Loup River, which enters Platte River near Columbus, Nebraska. Calamus River is a tributary of the North Loup River, entering it near Burwell, Nebraska. The measurement of its discharge at the bridge 1 mile above the mouth and 2 miles north of Burwell, on May 16, 1899, by Glenn E. Smith, showed a discharge of 372 second-feet; North Loup River, on May 16, from a bridge one-fourth of a mile above Burwell, below the mouth of Calamus River, was carrying 984 second-feet. The gaging station on North Loup River, established in 1895, is located at the wagon bridge 4 miles north of St. Paul. Measurements at this station were not made in 1898, but the station was resumed April 18, 1899, when a new rod was located 200 feet downstream from the line of the hand rail on the wagon bridge. It is a 2 by 3 inch timber, 16 feet long, situated on the left bank of the river, at an angle of 30°. The bench mark is the standard iron pipe, with brass cap, of the United States Geological Survey. It is set with the top 5 inches above the ground, and 102 feet northwest of the gage rod, and is at an elevation of 5.57 feet above gage datum. The zero of the old rod

was 6.54 feet below same bench; so that 0.97 foot should be added to all gage heights after April 18, 1899, to make them comparable with the previous records. The bed of the river is sandy and is liable to change during floods. James Stout, jr., a farmer living about a quarter of a mile from the rod, is the observer. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 176; 1897, Nineteenth Annual Report, Part IV, page 329; 1898, no report. The following discharge measurements were made by Glenn E. Smith during 1899:

*Measurements of North Loup River at St. Paul, Nebraska.*

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1899.			1899.		
	<i>Fect.</i>	<i>Sec. feet.</i>		<i>Fect.</i>	<i>Sec. feet.</i>
Apr. 18 .....	1.81	1,678	Aug. 8 .....	1.70	1,025
May 5 .....	1.77	1,138	Aug. 23 .....	1.47	920
May 18 .....	1.65	877	Sept. 7 .....	1.70	917
June 7 .....	1.58	1,024	Sept. 19 .....	1.50	796
June 27 .....	3.40	7,690	Sept. 30 .....	1.47	776
July 20 .....	1.35	811			

*Daily gage height, in feet, of North Loup River at St. Paul, Nebraska, for 1899. a*

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1 .....		1.85	1.68	1.95	1.34	1.61	1.52
2 .....		1.85	1.65	1.83	1.37	1.68	1.58
3 .....		1.83	1.66	1.75	1.33	1.73	1.55
4 .....		1.80	1.62	1.68	1.39	1.57	1.55
5 .....		1.80	1.61	1.68	1.20	1.62	1.57
6 .....		1.75	1.60	1.59	2.08	1.70	1.52
7 .....		2.30	1.55	1.55	2.05	1.95	1.50
8 .....		2.32	1.57	1.55	2.01	1.98	1.50
9 .....		2.07	1.56	1.56	1.88	1.85	1.60
10 .....		2.00	1.52	1.57	1.80	1.80	1.63
11 .....		1.95	1.55	1.63	1.92	1.72	1.58
12 .....		1.83	1.53	1.53	1.74	1.68	1.53
13 .....		1.72	1.47	1.49	1.92	1.65	1.57
14 .....		1.72	1.42	1.45	1.86	1.62	1.55
15 .....		1.68	1.41	2.12	1.65	1.60	2.08
16 .....		1.71	1.45	2.27	1.65	1.63	2.03
17 .....		1.73	1.48	2.03	1.57	1.53	1.97
18 .....	1.81	1.70	1.50	1.92	1.48	1.55	1.69
19 .....	1.77	1.64	1.50	1.75	1.55	1.50	1.65
20 .....	1.82	1.68	1.50	1.35	1.57	1.50	1.65
21 .....	1.73	2.30	1.47	1.37	1.62	1.50	1.60
22 .....	1.75	2.08	1.50	1.28	1.58	1.51	1.58
23 .....	1.72	1.93	1.53	1.30	1.57	1.50	1.60
24 .....	1.80	1.90	2.30	1.28	1.54	1.55	1.60
25 .....	1.83	1.87	2.00	1.28	1.54	1.52	1.62
26 .....	1.78	1.85	1.80	1.33	1.55	1.50	1.60
27 .....	3.20	1.78	3.30	1.32	1.57	1.52	1.65
28 .....	2.78	1.75	2.54	1.25	1.53	1.55	1.63
29 .....	2.43	1.77	2.12	1.22	1.54	1.55	1.58
30 .....	1.87	1.73	2.03	1.33	1.57	1.58	1.57
31 .....		1.73		1.35	1.59		1.58

a Closed for winter October 31.

MIDDLE LOUP RIVER AT ST. PAUL, NEBRASKA.

This river also has its source in the sand hills of Cherry County, and flows in a general southeasterly direction, joining the North Loup River at St. Paul. Oak Creek is a small stream draining the area east of Loup City and flowing southeasterly into the Middle Loup.

It was measured by Glenn E. Smith, on May 19, 1899, at a point above the backwater from the dam, at which time it showed a discharge of 5 second-feet. The original station was established May 5, 1895, by Glenn E. Smith, but was discontinued during 1898. It was reestablished, however, on April 18, 1899, and is located at the highway and railway bridge about 1 mile south of St. Paul. The rod is located on the right bank of the stream, 130 feet downstream from the line of hand rail of bridge and consists of an oak rod 2 by 3 inches, 16 feet long, set at an angle of 30 degrees. On account of a change in the channel of the river, which threatened to leave the gage rod dry, a second rod was set on the north side on June 7, 1899. The new rod is 2 by 4 inches, hard pine, 12 feet long, set at an angle of 30 degrees, and 200 feet downstream from the bridge. The gage datum is the same for both rods. The observer is instructed to read the rod adjacent to the main channel, on whichever side it may be, and the hydrographer is expected to read both rods. The bench mark is the regulation 4-foot iron post of the United States Geological Survey, and is located 60 feet southeast of the gage rod and 100 feet from the line of the downstream hand rail of the bridge. It is 7.54 feet above gage datum. The zero of the original rod was 7.35 feet below the same bench mark, so that 0.19 foot should be subtracted from all gage heights after April 18, 1899, to make them comparable with the previous records. The observer is A. C. Snyder, a farmer living about one-half mile from the station. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 181; 1897, Nineteenth Annual Report, Part IV, page 330; 1898, no report. The following measurements were made by Glenn E. Smith and Adna Dobson during 1899:

*Measurements of Middle Loup River at St. Paul, Nebraska.*

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1899.			1899.		
	<i>Feet.</i>	<i>Sec. feet.</i>		<i>Feet.</i>	<i>Sec. feet.</i>
Apr. 18.....	2.10	988	Aug. 7.....	2.68	1,612
May 4.....	1.84	964	Aug. 23.....	2.20	1,113
May 18.....	1.70	1,186	Sept. 7.....	2.25	983
June 7.....	2.30	920	Sept. 19.....	2.40	1,112
June 27.....	4.20	14,631	Sept. 30.....	2.25	989
July 20.....	2.18	888			

Daily gage height, in feet, of Middle Loup River at St. Paul, Nebraska, for 1899. (a)

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1.		1.76	1.59	2.00	2.24	2.29	2.24
2.		1.80	1.41	1.87	2.12	2.29	2.20
3.		1.79	1.40	1.90	2.16	2.33	2.35
4.		1.81	1.62	1.90	3.10	2.19	2.34
5.		1.95	1.53	2.12	2.74	2.16	2.37
6.		1.82	1.44	2.78	2.70	2.21	2.40
7.		1.90	1.54	3.17	2.65	2.18	2.37
8.		2.08	1.29	2.71	2.57	2.28	2.34
9.		1.93	1.32	2.42	2.66	2.32	2.36
10.		1.87	1.25	2.16	2.25	2.34	2.36
11.		1.81	1.24	2.12	2.20	2.34	2.34
12.		1.78	1.20	2.09	2.18	2.32	2.37
13.		1.75	1.33	2.18	2.13	2.28	2.36
14.		1.75	1.32	3.10	2.25	2.25	2.40
15.		1.60	1.31	2.65	2.39	2.30	2.39
16.		1.62	1.32	2.55	2.36	2.30	2.49
17.		1.62	1.30	2.36	2.31	2.40	2.47
18.	2.10	1.72	1.28	2.20	2.30	2.38	2.49
19.	2.09	1.66	1.19	2.12	2.27	2.36	2.42
20.	2.12	1.70	1.15	2.12	2.21	2.30	2.40
21.	2.09	1.80	1.32	2.09	2.20	2.30	2.41
22.	2.10	2.15	1.34	2.11	2.15	2.30	2.42
23.	2.00	2.05	1.29	2.12	2.20	2.30	2.41
24.	2.00	1.70	1.29	2.15	2.20	2.27	2.40
25.	2.03	1.68	2.34	2.06	2.15	2.26	2.45
26.	2.60	1.60	4.17	2.02	2.19	2.24	2.42
27.	2.12	1.83	3.51	2.06	2.16	2.27	2.45
28.	2.39	1.92	3.30	2.30	2.12	2.26	2.44
29.	2.00	1.66	2.84	2.20	2.10	2.24	2.47
30.	1.74	1.49	2.35	2.10	2.13	2.22	2.49
31.		1.84		2.42	2.21		2.49

a Closed for winter October 31.

## LOUP RIVER AT COLUMBUS, NEBRASKA.

This river is formed by the junction of the North Loup and Middle Loup rivers at St. Paul, Nebraska, and 60 miles below St. Paul enters the Platte River near Columbus, Nebraska. Cedar River is a tributary of Loup River, and flows southeasterly, emptying into Loup River at Fullerton, 30 miles below St. Paul. At Ericson, Nebraska, a large dam has been built for the purpose of turning Cedar Creek into a canal to be used for irrigation. The dam backs the water for about one-half a mile, forming a pond 1,000 feet in width in some places. May 17, 1899, Glenn E. Smith measured the river 500 feet below the above dam, and below the race of a small mill near by, and found a discharge of 113 second-feet; at the same time the mill race was carrying 10 second-feet, and the Cedar Valley irrigation canal 20 second-feet—this latter being measured about 1,000 feet below the head gates. On the same day a measurement was made by wading, at a point 2 miles from Ericson and above the backwater from the dam, and gave a discharge in Cedar River of 107 second-feet. A tributary known as Dry Cedar enters near this point—there being seldom any discharge from it except during the rainy season. Near the mouth of this tributary are several small springs, not large enough, however, to give a continuous discharge. They were found to be flowing on May 17, at a point about 1 mile north of Ericson, 5 second-feet, while 5 miles above the channel was dry. The gaging station

on the Loup River is located near the iron bridge of the Union Pacific Railway just west of Columbus, Nebraska, and only a short distance above the mouth of the river. The gage rod is 150 feet from the bridge, and is of oak, fastened to a pile which forms part of the training works above the bridge. The bench mark is the regulation 4-foot iron post of the United States Geological Survey, placed 72 feet east of the rod, and is 13.27 feet above gage datum. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 182; 1897, Nineteenth Annual Report, Part IV, page 332; 1898, Twentieth Annual Report, Part IV, page 294. The following measurements of discharge were made by Glenn E. Smith during 1899:

*Measurements of Loup River at Columbus, Nebraska.*

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1899.			1899—Continued.		
	<i>Feet.</i>	<i>Sec.-feet.</i>		<i>Feet.</i>	<i>Sec.-feet.</i>
Jan. 22.....	Frozen.	2,726	July 9.....	5.40	3,435
Apr. 9.....	4.95	3,004	July 23.....	4.25	1,792
Apr. 23.....	5.00	2,699	Aug. 6.....	4.93	3,251
May 7.....	5.05	3,057	Aug. 20.....	4.61	2,267
May 23.....	5.54	4,073	Sept. 3.....	4.40	1,902
June 4.....	4.86	2,628	Sept. 17.....	4.40	1,840
June 18.....	4.75	1,921	Oct. 5.....	4.60	2,402
June 29.....	5.80	7,728	Oct. 15.....	4.80	1,983

*Daily gage height, in feet, of Loup River at Columbus, Nebraska, for 1899.*

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1.....		5.30		5.50	4.30	4.80	4.40
2.....	5.40	4.95			4.25	4.85	4.40
3.....	5.60	4.60	5.00		4.20	4.80	4.40
4.....	5.80	4.70	4.80		4.25	4.80	4.40
5.....	5.70	4.90			4.55	4.70	4.45
6.....	5.00	4.95	5.40		4.93	4.60	4.40
7.....	4.90	5.05			4.90	4.55	4.40
8.....	5.00	4.95			4.80	4.50	4.40
9.....	4.95	5.15			4.85	4.80	4.40
10.....	4.90	5.00		4.40	4.80	4.70	4.40
11.....	5.00	4.95	5.40		4.70	4.60	4.40
12.....	4.90	4.80		4.00	4.85	4.50	4.40
13.....	4.80	4.85		4.20	4.20	4.45	4.40
14.....	4.90	4.97		4.21	4.10	4.40	4.50
15.....	5.10	5.30		4.20	4.50	4.40	4.80
16.....	5.20	5.15	4.80	4.10	4.20	4.40	4.70
17.....	5.15	5.14		4.20	4.40	4.40	4.75
18.....	5.10	4.95	4.70	4.15	4.40	4.40	4.60
19.....	5.00	5.00		4.00	4.50	4.40	4.60
20.....	4.90	5.05		3.98	4.61	4.40	4.50
21.....	4.90	5.40	4.95	4.00	4.80	4.40	4.50
22.....	4.90	5.80		4.10	4.70	4.40	4.70
23.....	5.00	5.54		4.25	4.75	4.40	4.60
24.....	4.90	5.40	5.10	4.20	4.80	4.40	4.60
25.....	4.85			4.21	4.81	4.40	4.55
26.....	4.90			4.20	4.80	4.40	4.55
27.....	5.00		5.90	4.20	4.81	4.40	4.50
28.....	5.40			4.22	4.80	4.40	4.55
29.....	5.60	5.40	5.80	4.22	4.70	4.40	4.60
30.....	5.80			4.50	4.60	4.40	4.65
31.....				4.40	4.70		4.65

## PLATTE RIVER AT COLUMBUS, NEBRASKA.

Lower Platte River is a sandy stream, the bed shifting during the high stages, through which considerable water is lost during the summer season. On September 8 there were only 20 second-feet flowing in the middle channel at the bridge of the Burlington and Missouri Railroad near Central City, Nebraska, this point being 20 miles below Grand Island and 40 miles above Columbus. On September 19, Glenn E. Smith reports that the stream was dry at this point. Mr. Adna Dobson reports the river dry at Grand Island on September 30. The gaging station at Columbus was established in 1895, and is located on the left bank of the main channel of the river, 75 feet above the Meridian bridge south of Columbus. It is about 4 miles above the mouth of the Loup River. The gage consists of an inclined oak timber fastened to cross-ties which are bedded in the bank of the river. The channel is straight both above and below the gage. The bench mark is a standard 4-foot iron post of the United States Geological Survey, and is located 44.5 feet east of the gage, 60 feet north of the north end of the north bridge truss, and 10 feet west of a cottonwood tree 6 inches in diameter. Its elevation is 7.06 feet above gage datum. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 190; 1897, Nineteenth Annual Report, Part IV, page 334; 1898, Twentieth Annual Report, Part IV, page 295. The following discharge measurements were made by Glenn E. Smith and Adna Dobson during 1899:

*Measurements of Platte River at Columbus, Nebraska.*

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.	<i>Feet.</i>	<i>Sec.-feet.</i>	1899.	<i>Feet.</i>	<i>Sec.-feet.</i>
Jan. 22 .....		Dry.	July 9 .....	4.61	17,032
Feb. 19 .....		55	July 23 .....	3.84	8,694
Apr. 9 .....	8.50	6,736	Aug. 6 .....	4.00	9,450
Apr. 23 .....	3.94	8,210	Aug. 20 .....	2.80	3,338
May 7 .....	4.14	10,121	Sept. 3 .....	.90	93
May 23 .....	3.81	7,878	Sept. 17 .....		15
June 4 .....	4.01	9,294	Oct. 5 .....		Dry.
June 18 .....	4.00	9,279	Oct. 15 .....		8
June 29 .....	4.82	18,631			

Daily gage height, in feet, of Platte River at Columbus, Nebraska, for 1899.

Day.	Apr.	May.	June.	July.	Aug.	Sept.
1		3.90	4.30	5.10	3.70	1.20
2	.00	3.73	4.10	4.90	3.65	1.10
3	.00	3.80	4.00	4.80	3.60	.90
4	4.00	3.85	4.01	4.85	3.68	.85
5	4.80	3.93	3.40	4.95	3.88	.80
6	4.50	4.00	3.70	4.98	4.00	.70
7	4.40	4.14	4.00	4.97	3.90	.65
8	3.70	3.96	3.81	4.98	3.96	.60
9	3.45	4.00	3.65	4.61	3.94	.50
10	3.50	3.94	3.64	4.65	3.90	
11	3.55	3.87	4.50	4.62	3.80	
12	3.60	3.80	4.60	4.60	4.00	
13	3.65	3.73	4.80	4.58	3.50	
14	3.20	3.68	4.95	4.56	3.40	
15	3.10	3.60	4.98	4.50	3.30	
16	3.00	3.63	4.99	4.50	2.90	
17	3.10	3.41	4.98	4.40	2.95	
18	3.20	3.36	4.00	4.23	2.85	
19	3.60	3.21	4.00	4.11	2.81	
20	3.80	3.30	4.00	4.10	2.80	
21	4.00	3.91	4.20	4.00	2.81	
22	3.90	4.10	4.40	3.90	2.80	
23	3.94	3.81	4.50	3.83	2.75	
24	3.50	4.50	4.63	3.80	2.70	
25	3.93	4.70	4.40	3.70	2.60	
26	4.50	4.90	4.43	3.72	2.55	
27	3.90	5.05	4.50	3.74	2.40	
28	3.83	4.83	4.75	3.80	2.00	
29	3.90	4.70	4.85	3.90	1.60	
30	3.93	4.60	5.15	3.92	1.50	
31		4.51		3.85	1.35	

June 18-20, gage washed out; gage heights estimated. September 10-October 23, sand bar; no readings. Closed for the winter September 9.

#### ELKHORN RIVER AT NORFOLK, NEBRASKA.

This river rises in the sand hills in Rock County, Nebraska, and flows in a general southeasterly direction, entering the Platte River about 30 miles above its mouth. Two gaging stations are maintained on this river, one at Norfolk, Nebraska, and the other at Arlington, Nebraska. The station at the former place is at the Thirteenth street bridge, 2 miles south of Norfolk and above the mouth of the North Fork of Elkhorn River. The gage consists of an inclined oak timber fastened to cross-ties, which are firmly bedded in the bank of the river. The bench mark is a standard 4-foot iron pipe of the United States Geological Survey, 35 feet west and 7 feet north of the top of gage and 15.5 feet west of an ash tree. Its elevation is 10.70 feet above gage datum. The bed of the river is composed of sand and mud. A number of measurements of the North Fork were made and are given below. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 191; 1897, Nineteenth Annual Report, Part IV, page 335; 1898, Twentieth Annual Report, Part IV, page 296. The following measurements were made by Glenn E. Smith during 1899:

#### Elkhorn River:

January 26; gage height, frozen; discharge, 272 second-feet.

April 27, gage height, 1.94; discharge, 505 second-feet.

May 10, gage height, 2.01 feet; discharge, 572 second-feet.

## Elkhorn River—Continued.

May 25, gage height, 2.72 feet; discharge, 830 second-feet.

July 7, gage height, 1.70 feet; discharge, 427 second-feet.

August 17, gage height, 1.30 feet; discharge, 274 second-feet.

September 25, gage height, 1.12 feet; discharge, 184 second-feet.

## North Fork of Elkhorn River:

February 20, discharge, 119 second-feet.

April 27, discharge, 122 second-feet.

May 25, discharge, 414 second-feet.

August 17, discharge, 81 second-feet.

September 25, discharge, 85 second-feet.

*Daily gage height, in feet, of Elkhorn River at Norfolk, Nebraska, for 1899.*

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		1.94	2.07	2.45	1.20	0.97	1.13
2		2.24	2.03	2.20	1.23	.97	1.19
3		2.30	1.93	1.97	1.27	.76	1.23
4		3.20	1.85	1.66	1.32	.70	1.26
5		2.41	1.85	1.76	1.35	.67	1.22
6		2.31	1.87	1.74	1.35	1.06	1.23
7		2.24	2.45	1.68	1.36	1.08	1.22
8	1.90	2.16	2.22	1.71	1.35	1.12	1.27
9	1.90	2.06	1.92	1.67	1.45	1.15	1.28
10	1.93	2.00	1.82	1.73	1.27	1.13	1.25
11	2.00	1.92	1.75	1.73	1.28	1.13	1.20
12	2.01	1.85	1.74	1.78	1.48	1.10	1.20
13	2.05	1.78	1.64	1.69	1.48	1.06	1.29
14	2.05	1.73	1.63	1.65	1.33	1.02	1.27
15	2.03	1.77	1.64	1.56	1.34	1.06	1.33
16	1.98	1.77	1.65	1.51	1.35	1.11	1.30
17	1.98	1.74	1.60	1.48	1.38	1.09	1.32
18	1.97	1.70	1.53	1.45	1.26	1.11	1.31
19	1.99	1.80	1.57	1.43	1.25	1.04	1.32
20	1.90	3.50	1.57	1.45	1.23	1.03	1.34
21	1.97	3.53	1.57	1.38	1.25	1.02	1.35
22	1.89	3.34	1.53	1.34	1.23	1.03	1.35
23	1.85	2.63	1.45	1.26	1.17	1.04	1.33
24	1.84	2.65	1.55	1.21	1.17	1.17	1.31
25	1.84	2.75	2.07	1.23	1.14	1.11	1.36
26	1.87	2.80	1.75	1.23	1.13	1.10	1.31
27	1.93	2.85	2.65	1.24	1.12	1.12	1.34
28	1.95	2.75	3.75	1.24	.97	1.12	1.34
29	1.89	2.35	3.40	1.24	.95	1.15	1.31
30	1.73	2.20	3.02	1.21	.99	1.12	1.32
31		2.07		1.22	.97		1.30

Closed for winter October 31.

## ELKHORN RIVER AT ARLINGTON, NEBRASKA.

The station at Arlington, Nebraska, was established by Glenn E. Smith April 28, 1899, and is located at the wagon bridge 1 mile west of the town of Arlington. The original rod was fastened to cross-ties, which are solidly bedded in the river bank. It consisted of a new oak stake 3 by 4 inches and 12 feet long. It was placed 200 feet downstream from the bridge on the west bank of the river. Bench mark No. 1 is a large spike driven in a pile 50 feet upstream from the rod, and is 6.36 feet above gage datum. Bench mark No. 2 is a large spike driven in a piling 20 feet back and 10 feet upstream from the rod, and is 9.12 feet above gage datum. Bench mark No. 3 is a vertical spike driven into a small leaning tree 5 feet downstream from the rod, and is 7.43 feet above gage datum. On May 10 the rod was washed out; on May

29 it was replaced by an oak rod 2 by 6 inches and 16 feet long. This rod was placed on the same bank as the first rod, but was set 25 feet farther upstream. The gage datum was not changed. S. P. Ham-mang, a farmer living about 300 yards from the gage rod, is the observer. The following discharge measurements were made by Glenn E. Smith during 1899:

*Measurements of Elkhorn River at Arlington, Nebraska.*

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1899.	Feet.	Sec.-feet.	1899.	Feet.	Sec.-feet.
Feb. 4 .....		337	July 8 .....	2.23	1,016
Feb. 17 .....		269	Aug. 9 .....	1.72	732
Apr. 28 .....	1.78	794	Aug. 18 .....	1.40	606
May 9 .....	3.90	1,779	Sept. 15 .....	.82	344
May 24 .....		1,626	Sept. 24 .....	.75	340
May 29 .....	4.24	2,462	Oct. 13 .....	.90	351
June 22 .....	2.70	1,199			

*Daily gage height, in feet, of Elkhorn River at Arlington, Nebraska, for 1899.*

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1.....		1.84	3.81	2.68	1.32	0.87	0.68
2.....		2.07	3.65	2.68	1.25	.89	.69
3.....		1.86	3.63	3.19	1.17	.76	.68
4.....		1.96	3.50	2.97	1.36	.73	.67
5.....		2.30	3.41	2.81	1.50	.70	.68
6.....		3.00	3.42	2.66	1.40	.72	.73
7.....		4.37	3.54	2.38	1.56	.74	.74
8.....		3.96	2.87	2.23	2.00	.75	.78
9.....		3.91	2.58	2.23	1.70	.74	.79
10.....		( $\alpha$ )	2.38	2.12	1.57	.79	.82
11.....		( $\alpha$ )	2.35	2.13	1.66	.80	.86
12.....		( $\alpha$ )	2.40	2.02	1.40	.82	.88
13.....		( $\alpha$ )	5.35	2.10	1.41	.81	.90
14.....		( $\alpha$ )	4.94	1.94	1.35	.84	.93
15.....		( $\alpha$ )	4.55	1.86	1.42	.79	.93
16.....		( $\alpha$ )	4.12	1.83	1.49	.75	.94
17.....		( $\alpha$ )	4.30	1.76	1.48	.74	.92
18.....		( $\alpha$ )	4.48	1.68	1.39	.73	.91
19.....		( $\alpha$ )	3.67	1.64	1.27	.73	.92
20.....		( $\alpha$ )	3.16	1.63	1.24	.65	.96
21.....		( $\alpha$ )	2.67	1.57	1.09	.66	.98
22.....		( $\alpha$ )	2.76	1.50	1.10	.69	1.02
23.....		( $\alpha$ )	2.75	1.55	1.09	.72	1.04
24.....		( $\alpha$ )	2.65	1.36	1.21	.75	1.10
25.....		( $\alpha$ )	2.51	1.30	1.23	.76	1.12
26.....		( $\alpha$ )	2.21	1.27	1.03	.70	1.11
27.....		( $\alpha$ )	2.32	1.27	1.02	.69	1.12
28.....	1.78	( $\alpha$ )	2.19	1.25	1.07	.66	1.13
29.....	1.76	4.24	2.32	1.26	1.03	.64	1.12
30.....	1.81	4.15	2.64	1.20	1.01	.65	1.13
31.....		4.17		1.22	.85		1.11

Closed for winter October 31.

$\alpha$  Rod washed out.

REPUBLICAN RIVER AT SUPERIOR, NEBRASKA.

This river rises in the northeastern part of Colorado, and after entering Nebraska it flows in a general easterly direction along the southern boundary of the State to 98° west longitude, where it bends into Kansas, and thence flows southeasterly until it joins the Smoky Hill River at Junction to form the Kansas River. All of the tributaries of the Kansas River have their sources in the Great Plains

region, none drawing their supply from a mountain area. They are also different from ordinary streams, in that the rainfall is less at the headwaters, gradually increasing downstream. Two gaging stations are maintained on Republican River, one at Superior, Nebraska, just before it enters Kansas, and the other at Junction, Kansas. The former station was established June 20, 1896, about one mile west from Superior, Nebraska. The old gage rod was first placed just above the river highway bridge, which is itself 75 yards above the dam which diverts water into the mill race. In the spring of 1898 two other gages were located and have been exclusively used during the last season. The first gage was placed in the river a few feet upstream from the crest of the dam the zero being at same elevation as the crest, the second is in the mill race, where it is crossed by a wagon bridge about 50 yards below its head. Discharge measurements of the river are made from the highway bridge, thus determining at once the discharge through the mill race and from the dam. The discharge from the mill race was measured in order that it might be deducted from the total discharge of the river to give the amount passing over the dam. The bench mark for the river gage is a standard 4-foot iron post of the United States Geological Survey, and is situated 83 feet north of the upstream cylinder of the north pier of the bridge, and 1 foot inside of a wire fence. Its elevation is 4.92 feet above datum of gage at dam. The gage of the mill race reads 2 feet higher than that of the river gage, so that its zero is 6.92 feet below the same bench mark. During 1899 Glenn E. Smith made an examination of a portion of the upper Republican River. On September 6, at Oxford, Nebraska, the river channel was dry and was reported to have been in this condition for ten days. At Orleans, about 12 miles below, there was an estimated discharge of 0.3 second-feet—this small amount coming from Sappa River, which enters at this point. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 201; 1897, Nineteenth Annual Report, Part IV, page 339; 1898, Twentieth Annual Report, Part IV, page 317. The following discharge measurements were made by Glenn E. Smith during 1899:

*Measurements of Republican River at Superior, Nebraska.*

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1899.	<i>Foot.</i>	<i>Sec.-feet.</i>	1899.	<i>Foot.</i>	<i>Sec.-feet.</i>
January 24 .....	Frozen.	463	June 26 .....	0.42	204
February 14 .....	Frozen.	131	July 6 .....	.90	732
April 10 .....	0.98	738	July 26 .....	.23	135
May 1 .....	.75	382	August 11 .....	.40	215
May 13 .....	.61	442	September 6 .....		0
June 2 .....	.51	291	September 29 .....		0
June 16 .....	.63	439	October 17 .....		0

*Measurements of mill race at Superior, Nebraska.*

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1899.			1899.		
	<i>Feet.</i>	<i>Sec.-feet.</i>		<i>Feet.</i>	<i>Sec.-feet.</i>
April 10.....	2.98	49	July 6.....	2.80	56
May 1.....	3.00	0	August 11.....	2.70	56
May 13.....	3.10	47	September 6.....	2.60	50
June 2.....	2.60	55	September 29.....	1.20	25
June 16.....	3.50	53	October 17.....	1.50	50
June 26.....	3.40	59			

No water was passing over the dam, and all was in the mill race on September 6 and 29 and October 17. The figures which are noted as gage heights in the mill race during 1899 are, in fact, measurements of the center depth at the gaging section. As expected, this has proved to be a better basis for the computation of areas of cross section there than the gage height observed in previous years.

*Daily gage height, in feet, of Republican River at Superior, Nebraska, for 1899.*

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1.....		0.97	0.74	0.45	1.05	0.91	0.12	(a)
2.....		1.00	.70	.51	.90	.95	.09	(a)
3.....		.95	.73	.60	.80	.82	.20	(a)
4.....		.94	1.18	.60	.80	.68	(a)	(a)
5.....		1.00	.68	.47	.79	.60	(a)	(a)
6.....		.98	.64	.45	.90	.45	(a)	(a)
7.....		1.04	.50	.47	.93	.52	(a)	(a)
8.....		.97	.61	.45	.89	.42	(a)	(a)
9.....		1.00	.68	.40	.63	.41	(a)	(a)
10.....		.97	.63	.40	.51	.41	(a)	(a)
11.....		.94	.63	.41	.45	.40	(a)	(a)
12.....		.89	.60	.35	.42	.41	(a)	(a)
13.....		.90	.61	.33	.52	.50	(a)	(a)
14.....		.90	.67	.70	.47	.60	(a)	(a)
15.....		.88	.63	.53	.42	.44	(a)	(a)
16.....		.74	.69	.63	.45	.39	(a)	(a)
17.....		.85	.65	.42	.45	.62	(a)	(a)
18.....		.85	.64	.41	.46	.52	(a)	(a)
19.....	1.13	.82	.65	.12	.39	.42	(a)	(a)
20.....	.94	.77	.93	.35	.40	.41	(a)	(a)
21.....	.89	.82	1.50	.35	.49	.27	1.25	(a)
22.....	.99	.73	1.02	.32	.42	.35	(a)	(a)
23.....	.99	.63	.80	.60	.35	.31	(a)	(a)
24.....	.96	.75	.74	.63	.20	.20	(a)	(a)
25.....	.92	.70	.70	.39	.26	.30	(a)	(a)
26.....	.94	.73	.80	.42	.26	.45	(a)	(a)
27.....	.93	.75	.73	2.60	.25	.72	(a)	(a)
28.....	.95	.75	.66	2.05	.26	.33	(a)	(a)
29.....	.92	.79	.65	1.31	1.22	.21	(a)	(a)
30.....	.91	.70	.63	1.22	.69	.33	(a)	(a)
31.....	.96	-----	.54	-----	.45	.20	-----	(a)

a September 4 to 20, 22 to 30, no water flowing over dam. Closed for winter October 31.

*Daily gage height, in feet, of mill race at Superior, Nebraska, for 1899.*

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		2.98	2.84	2.54	2.15	3.05	2.86	1.15
2		3.08	2.90	2.06	1.80	2.85	2.12	1.53
3		3.03	2.93	2.65	2.18	2.38	2.79	1.10
4		2.98	3.42	2.67	2.30	1.94	2.19	1.60
5		3.02	2.61	2.50	2.34	1.86	2.00	1.20
6		2.97	2.61	2.49	2.40	2.05	2.06	1.15
7		3.04	2.15	2.59	2.42	2.87	1.41	1.28
8		2.98	3.00	2.48	2.54	2.64	1.63	1.87
9		3.04	3.10	2.41	2.01	2.78	1.56	2.79
10		2.99	3.04	2.46	2.22	2.80	1.84	1.45
11		2.92	3.01	2.69	2.38	2.07	3.62	2.15
12		2.89	3.06	3.20	2.25	2.70	3.44	1.12
13		2.90	3.10	3.22	2.94	2.90	2.88	1.70
14		2.89	3.25	3.52	2.84	3.00	3.54	1.30
15		2.77	3.19	3.35	2.80	2.78	3.88	1.78
16		2.47	3.20	3.50	2.86	2.76	3.74	3.40
17		2.97	3.12	3.38	3.08	2.95	3.79	2.30
18		2.84	3.15	3.27	3.26	2.78	3.65	3.10
19		2.82	3.36	2.56	2.95	2.68	3.53	2.74
20	3.13	2.88	2.77	3.95	3.20	2.90	2.75	3.56
21	2.84	2.83	4.38	3.21	3.03	2.35	3.94	2.75
22	2.94	2.73	3.15	2.95	3.04	2.60	3.70	1.72
23	2.93	2.51	2.97	3.35	2.93	2.48	3.50	3.01
24	2.90	2.70	2.77	3.52	2.81	2.56	3.80	1.86
25	2.81	2.75	2.73	2.43	2.60	2.60	3.43	4.02
26	2.94	2.78	2.82	3.12	2.80	2.66	3.81	3.78
27	2.90	2.83	2.78	5.69	2.70	3.00	2.17	3.63
28	2.90	2.85	2.66	4.51	2.71	3.20	2.83	3.43
29	2.95	2.80	2.83	2.45	3.80	3.10	1.20	3.92
30	2.95	2.75	2.83	2.45	2.93	2.86	1.10	3.82
31	2.96		2.73		3.43	2.90		3.33

#### REPUBLICAN RIVER AT JUNCTION, KANSAS.

The gaging station at this point, established by Arthur P. Davis April 26, 1895, is located at the wagon bridge at the north end of Washington street just above the mouth of the river. The gage consists of two oak timbers bolted to a post and to a cottonwood tree. One bench mark consists of a 60-penny spike driven into the base of the abutment of the bridge at an elevation of 10.67 feet on the rod; the second bench mark is the top of a stone in the base of the bridge abutment 18 feet south of the gage and at an elevation of 14.51 feet above gage datum. The right bank is high, but the left is low and may overflow in high water. The bed of the stream is sandy and liable to change. Results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 205; 1897, Nineteenth Annual Report, Part IV, page 339; 1898, Twentieth Annual Report, Part IV, page 318. The following discharge measurements were made by W. G. Russell in 1899:

April 19, gage height, 3.90 feet; discharge, 737 second-feet.

May 26, gage height, 4.20 feet; discharge, 1,029 second-feet.

June 7, gage height, 4.40 feet; discharge, 1,224 second-feet.

June 15, gage height, 3.80 feet; discharge, 936 second-feet.

October 19, gage height, 2.55 feet; discharge, 85 second-feet.

Daily gage height, in feet, of Republican River at Junction, Kansas, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.40	4.15	4.00	4.20	3.65	3.70	5.90	4.10	3.10	2.65	2.65	2.80
2	3.45	4.15	4.15	4.20	3.90	4.25	5.90	4.55	3.05	2.70	2.85	2.90
3	3.75	4.20	4.35	4.20	4.25	6.95	5.20	5.45	3.00	2.75	2.90	3.20
4	4.00	4.05	4.50	4.15	4.10	10.00	5.70	4.85	3.10	2.60	2.95	3.50
5	3.95	3.75	4.80	4.15	3.85	7.25	6.05	4.70	2.85	2.60	2.80	3.00
6	3.95	3.70	4.85	4.20	3.70	5.20	4.90	4.40	2.80	2.85	2.60	3.80
7	3.80	3.60	4.85	4.15	3.65	4.60	6.00	4.25	2.85	3.25	2.60	3.80
8	3.65	3.65	4.80	4.20	3.90	6.10	6.20	4.00	2.90	2.80	2.70	3.20
9	3.50	3.50	4.70	4.20	5.45	8.80	5.90	3.80	2.90	2.75	2.80	3.00
10	3.65	3.50	4.65	4.20	5.35	7.25	5.60	3.65	2.80	2.70	2.80	3.20
11	3.85	3.50	4.80	4.20	4.10	5.40	5.00	3.55	2.70	2.55	2.50	3.30
12	3.90	3.50	4.90	4.15	4.05	4.40	4.90	3.60	2.65	2.55	2.50	3.50
13	3.95	3.55	5.15	4.10	3.80	4.25	4.40	4.50	2.65	2.70	2.60	3.20
14	3.90	3.60	4.90	4.00	3.75	4.00	4.10	4.45	2.70	2.70	2.40	3.50
15	3.85	3.65	5.25	4.05	3.60	3.80	4.15	4.20	2.60	2.65	2.60	3.20
16	3.70	3.70	5.20	4.00	3.60	3.65	3.90	3.80	2.70	2.50	2.40	3.30
17	3.60	4.05	5.40	4.00	3.60	3.60	3.70	4.05	2.70	2.50	2.60	3.30
18	3.40	3.90	5.35	4.00	3.50	3.50	2.70	3.80	2.55	2.60	2.80	3.20
19	3.50	3.90	4.90	3.90	3.40	3.75	3.85	3.60	2.60	2.55	3.20	3.20
20	3.70	3.95	4.90	3.95	4.35	3.60	3.70	3.40	2.70	2.50	2.80	3.10
21	3.85	4.00	4.85	3.80	6.00	3.55	3.60	3.40	2.70	2.60	2.70	3.40
22	3.85	3.95	4.50	3.80	6.40	3.35	3.55	3.30	2.65	3.25	2.60	3.60
23	3.70	4.05	4.50	3.80	6.15	4.35	3.50	3.35	2.65	3.10	2.80	3.50
24	3.65	4.15	4.10	3.80	4.70	4.30	3.55	3.40	2.60	3.35	2.90	3.50
25	3.65	3.90	4.10	3.80	4.55	4.75	3.30	3.30	2.70	4.20	2.90	3.60
26	3.70	3.85	4.20	3.75	4.20	4.15	3.30	3.00	2.60	4.05	2.70	3.40
27	3.70	4.05	4.15	3.60	8.20	4.10	3.20	3.55	2.65	4.35	2.60	3.40
28	3.75	3.95	4.10	3.70	6.15	4.10	3.20	3.10	2.80	4.05	2.70	3.60
29	3.80	-----	4.10	3.70	4.55	4.80	3.20	3.10	2.90	3.55	2.90	3.90
30	3.85	-----	4.20	3.75	4.00	6.70	3.25	3.25	2.65	3.20	2.90	3.80
31	4.00	-----	4.20	-----	3.95	-----	3.35	3.05	-----	2.20	-----	3.40

SOLOMON RIVER AT NILES, KANSAS.

This river, one of the principal tributaries of Smoky Hill River, rises in western Kansas, and flows in a general easterly direction, entering the Smoky Hill River near Solomon, Kansas. The station at Niles was established May 5, 1897, and is located at a bridge one-half mile west of the town and 7 miles above the mouth of the river. The rod of the wire gage is spiked to the floor of the bridge. The bench mark is the upper of three nails driven into a cottonwood tree 18 inches in diameter, on the north side of the river and 25 feet east of the bridge, at an elevation of 24.96 feet above gage datum. The channel is straight for about 100 feet above and below the section. The current is sluggish; the right bank is high, and the left bank overflows only at very high stages. The bed of the stream is muddy. The discharge measurements may be found as follows: 1897, Nineteenth Annual Report, Part IV, page 342; 1898, Twentieth Annual Report, Part IV, page 214. The following discharge measurements were made by W. G. Russell during 1899:

- April 20, gage height, 4.90 feet; discharge, 120 second-feet.
- May 27, gage height, 5.10 feet; discharge, 129 second-feet.
- May 29, gage height, 11.65 feet; discharge, 1,529 second-feet.
- June 16, gage height, 13.60 feet; discharge, 2,270 second-feet.

*Daily gage height, in feet, of Solomon River at Niles, Kansas, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		5.70	5.85	5.20	4.75	5.30	18.75	6.40	5.10	4.40	5.00	4.40
2	5.30	5.65	5.30	5.25	4.65	5.10	11.85	10.75	5.00	5.10	4.80	4.90
3		5.65	5.30	5.30	5.75	8.35	8.90	10.00	5.10	4.70	4.70	4.60
4	5.20	5.65	5.30	5.25	5.35	20.00	9.65	8.25	5.10	4.45	4.80	4.40
5	5.20	5.70	5.25	5.25	4.90	23.60	8.90	6.30	4.95	4.30	4.90	4.40
6		5.65	5.40	5.25	4.90	16.30	8.30	6.20	4.85	4.40	5.00	4.90
7	5.10	5.65	5.25	5.25	4.85	18.70	8.70	5.80	5.05	4.45		4.70
8	5.30	5.65	5.45	5.35	5.10	16.80	8.60	5.65	4.95	4.45	4.30	4.60
9		5.55	5.65	5.20	6.00	21.50	7.45	5.55	4.90	4.30	4.80	4.70
10	5.20	5.60	5.45	5.25	5.65	21.35	6.85	5.30	4.85	4.40	4.60	4.70
11		5.65	5.55	5.20	6.35	15.60	6.75	5.35	4.85	4.40	4.20	4.90
12	5.20	5.45	5.45	5.30	6.55	10.00	6.60	5.30	4.70	4.40	4.80	4.70
13		5.45	5.15	5.15	6.05	8.75	7.25	5.40	4.60	4.20	4.40	4.90
14		5.45	5.95	5.10	5.65	7.65	10.60	5.25	4.50	4.35	4.40	4.80
15	5.30	5.50	6.50	5.00	5.15	9.80	7.65	5.25	4.60	4.35	4.50	5.00
16		5.55	6.25	5.15	5.00	13.25	6.40	5.35	4.50	4.35	5.00	5.10
17	5.20	5.40	6.25	5.05	5.05	10.10	6.15	6.15	4.50	4.35	4.50	5.00
18		5.45	6.95	4.95	5.00	7.15	6.40	6.55	4.50	4.15	4.40	5.10
19	6.40	5.35	5.70	5.00	4.80	6.55	6.40	6.30	4.45	4.10	4.50	5.00
20		5.45	5.55	5.05	5.00	6.35	6.40	6.30	4.40	4.10	4.50	5.00
21		5.40	5.50	4.85	5.10	6.15	6.40	5.90	4.45	4.20	4.40	5.10
22	6.10	5.45	5.55	4.85	5.45	5.85	6.05	5.60	4.70	4.30	4.90	5.00
23	5.75	5.35	5.25	4.95	5.30	7.15	5.85	5.50	4.55	4.30	4.50	5.00
24	5.50	5.25	5.25	4.95	5.35	8.15	5.65	5.20	4.45	4.20	4.50	4.70
25	5.25	5.40	5.35	4.80	5.20	12.45	5.65	5.15	4.45	4.55	4.70	4.80
26	5.65	5.35	5.25	4.90	5.10	12.90	5.70	5.20	4.40	4.60	4.50	4.90
27	5.50	5.45	5.15	4.85	8.50	11.85	5.40	5.10	4.55	10.25	4.70	4.70
28	5.70	5.30	5.25	4.80	14.45	11.50	5.35	5.10	4.40	8.15	4.60	4.60
29	5.75		5.30	4.70	11.95	14.60	5.40	5.05	4.30	6.15	4.80	4.70
30	5.65		5.25	4.80	7.15	18.60	5.55	4.85	4.45	5.30	4.70	4.60
31	5.60		5.05		5.80		5.25	4.90		5.00		4.70

#### SALINE RIVER AT SALINA, KANSAS.

This river and the Solomon are the two principal tributaries of Smoky Hill River. They are of a similar type to the other tributaries of Kansas River, as they are sand-hill streams. Saline River joins Smoky Hill River a short distance below Salina and 9 miles, by railroad, above the mouth of Solomon River. The station, established May 4, 1897, is located at a bridge 4.5 miles northeast of Salina, near the mouth of the river. The rod of the wire gage is spiked to the floor of the bridge. Bench mark No. 1 is a nail in an elm tree 2 feet in diameter on the north side of the river and 6 feet west of the bridge. Its elevation is 22.90 feet above gage datum. Bench mark No. 2 is six nails driven into a 16-inch box-elder tree on the north side of the river and 35 feet east of the bridge. Its elevation is 22.90 feet above gage datum. The channel is straight for a little distance above and below the station. Both banks are high and not liable to overflow. The bed of the stream is sand and mud. The results of measurements may be found as follows: 1897, Nineteenth Annual Report, Part IV, page 346; 1898, Twentieth Annual Report, Part IV, page 316. The following discharge measurements for 1899 were made by W. G. Russell:

- April 21, gage height, 2.90 feet; discharge, 26 second-feet.
- May 27, gage height, 4.20 feet; discharge, 90 second-feet.
- May 29, gage height, 12.65 feet; discharge, 1,007 second-feet.
- May 30, gage height, 9.30 feet; discharge, 524 second-feet.
- June 16, gage height, 8.60 feet; discharge, 560 second-feet.

Daily gage height, in feet, of Saline River at Salina, Kansas, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				3.35	2.90	4.55	8.95	4.25	3.55	3.20	4.80	3.60
2	3.90	3.30	3.50	3.35	2.90	4.00	7.85	4.35	3.90	3.05	4.90	3.40
3				3.35	3.70	9.95	6.95	4.55	3.75	3.10	4.10	3.60
4	3.80	3.20		3.25	3.70	23.95	6.50	4.50	3.60	3.30	3.90	3.80
5			4.05	3.25	2.95	21.30	6.25	4.35	3.50	3.25	3.70	3.80
6			3.95	3.20	2.90	17.50	6.05	4.25	3.35	3.10	3.70	3.60
7	3.40	3.20	4.00	3.45	3.10	10.50	6.65	4.00	3.30	3.05	3.60	3.60
8			3.75	3.40	3.05	11.40	7.20	3.90	3.30	3.15	3.50	3.60
9	3.60	3.20	3.50	3.35	3.00	21.70	7.05	3.85	3.35	3.00	3.50	3.60
10		3.30	3.80	3.35	2.80	27.15	6.15	3.50	3.35	3.00	3.50	3.60
11	3.70	3.30	3.75	3.30	2.70	23.50	7.55	3.80	3.25	3.00	3.50	3.80
12			3.65	3.35	2.60	21.20	10.05	3.80	3.20	3.20	3.40	3.60
13			4.10	3.10	2.70	15.10	8.60	4.15	3.30	3.10	3.60	3.60
14	3.80	3.10	3.70	3.30	3.00	8.40	6.45	4.10	3.25	3.05	3.60	3.70
15			3.70	3.25	2.95	7.25	6.15	3.95	3.30	3.05	3.50	3.80
16		3.20	3.95	3.15	2.85	8.85	6.00	3.80	3.40	3.15	3.50	3.60
17	3.50		3.75	3.15	2.90	13.45	6.20	3.75	3.55	3.05	3.60	3.90
18		3.10	3.65	2.95	2.85	9.95	5.50	4.05	3.55	3.00	3.60	3.90
19	3.50		3.65	3.00	2.75	7.25	5.30	4.05	3.35	3.10	3.60	3.80
20			3.35	3.00	2.85	5.80	5.15	3.85	3.35	3.05	3.50	3.70
21	3.70	3.30	3.35	2.80	2.75	5.35	4.95	3.70	3.35	3.10	3.60	3.60
22			3.45	3.00	4.35	5.10	4.85	3.65	3.25	3.20	3.60	3.70
23	3.20	3.40	3.15	3.10	11.35	5.40	4.65	3.55	3.25	3.10	3.60	3.60
24			3.25	3.10	9.40	7.50	4.60	3.60	3.35	3.05	3.70	3.40
25		3.40	3.30	3.05	5.70	12.35	4.55	3.55	3.20	3.45	3.60	3.60
26	3.30		3.30	3.10	4.75	15.30	4.45	3.60	3.15	4.00	3.60	3.80
27			3.35	3.05	4.20	17.70	4.35	3.55	3.25	3.65	3.70	3.60
28	3.30	3.90	3.10	2.90	6.85	19.65	4.35	3.50	3.25	3.35	3.50	3.60
29			3.15	2.85	12.60	20.05	4.30	3.30	3.30	7.30	3.60	3.60
30			3.20	2.95	8.15	14.25	4.35	3.25	3.25	6.60	3.80	3.60
31	3.30		3.50		5.20		4.35	3.25		5.50		3.50

SMOKY HILL RIVER AT ELLSWORTH, KANSAS.

This river rises in eastern Colorado, and flows easterly, joining the Republican River at Junction to form the Kansas River. The gaging station, established April 17, 1895, is located at the highway bridge on Douglass avenue, Ellsworth, Kansas. The gage is an inclined ash timber spiked to a post driven in the bed of the river and bolted to an iron post on the bridge pier. The bench mark is a nail driven in the base of a large box-elder tree near the southeast corner of the bridge, 90 feet from the gage, and its elevation is 13.07 feet above the zero of the gage. A slope gage is spiked to the Saint Louis and San Francisco Railroad bridge 2,536 feet upstream, and is referred to the same datum. The channel is nearly straight above and below the gage, and the bed is sandy and shifting. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 214; 1897, Nineteenth Annual Report, Part IV, page 347; 1898, Twentieth Annual Report, Part IV, page 315. Measurements for 1899 were made by W. G. Russell, as follows:

March 20, gage height, 1.25 feet; discharge, 35 second-feet.

June 6, gage height, 2.07 feet; discharge, 184 second-feet.

June 26, gage height, 1.95 feet; discharge, 189 second-feet.

July 7, gage height, 4.75 feet; discharge, 1,675 second-feet.

July 8, gage height, 13 feet; discharge, 10,936 second-feet.

July 8, gage height, 10.95 feet; discharge, 7,348 second-feet.

*Daily gage height, in feet, of Smoky Hill River at Ellsworth, Kansas, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			1.20	1.17	0.98	0.88	1.58	2.25	1.40	1.13	1.30	1.20
2			1.40	1.17	.95	.90	1.38	2.13	1.33	1.10	1.30	1.20
3	1.40		1.50	1.10	.90	5.00	2.33	2.05	1.33	1.30	1.25	1.15
4		1.30	1.45	1.13	.93	3.25	2.33	1.98	1.33	1.10	1.25	1.15
5	1.40		1.30	1.17	.95	1.98	2.00	1.95	1.30	1.10	1.25	1.15
6			1.20	1.23	.98	3.20	1.83	1.88	1.28	1.30	1.20	1.10
7	1.50	1.30	1.30	1.20	.98	4.10	8.60	1.80	1.20	1.50	1.20	1.10
8			1.20	1.17	1.00	3.00	11.35	1.73	1.28	1.50	1.25	1.15
9			1.38	1.15	.95	7.70	6.00	1.73	1.38	1.30	1.25	1.15
10	1.50		1.35	1.17	.93	5.70	5.10	1.73	1.50	1.30	1.25	1.15
11		1.30	1.30	1.17	.93	3.45	4.58	1.68	1.38	1.30	1.25	1.20
12	1.50		1.35	1.17	.93	2.80	3.80	1.60	1.35	1.10	1.20	1.15
13	1.40	1.50	1.40	1.23	1.00	2.20	3.33	1.95	1.50	1.10	1.20	1.15
14	1.05		1.43	1.17	.95	2.00	2.85	1.78	1.50	1.50	1.20	1.20
15	1.20	1.50	1.45	1.20	.98	1.90	2.70	1.68	1.48	1.50	1.15	1.20
16	1.30		1.35	1.17	.95	1.75	2.60	1.63	1.45	1.10	1.15	1.20
17	1.10	1.50	1.38	1.10	.90	1.60	2.70	1.60	1.48	1.10	1.15	1.25
18	1.30		1.30	1.08	.95	1.60	2.40	1.55	1.40	1.50	1.10	(a)
19	1.40	1.50	1.28	1.08	.90	1.53	2.28	1.50	1.33	1.50	1.15	1.25
20	1.25	1.50	1.28	1.08	1.00	1.50	2.23	1.43	1.30	1.05	1.15	(a)
21	1.35	1.55	1.23	1.03	.95	1.45	2.18	1.40	1.28	1.05	1.20	(a)
22	1.35	1.45	1.23	1.03	.93	1.40	2.23	1.40	1.23	1.25	1.25	1.20
23	1.35	1.45	1.13	1.05	.95	3.15	2.23	1.33	1.23	1.25	1.20	1.20
24	1.20	1.40	1.17	1.03	1.03	2.85	2.20	1.30	1.20	1.30	1.20	1.20
25	1.15	1.40	1.15	1.03	1.10	2.25	2.13	1.35	1.20	1.40	1.25	1.15
26	1.30	1.40	1.17	1.03	1.13	2.15	2.10	3.85	1.15	1.75	1.25	1.20
27	1.20	1.40	1.15	1.00	1.08	1.90	2.05	2.75	1.15	1.58	1.20	1.20
28	1.30	1.45	1.15	1.00	.98	2.00	2.35	2.35	1.13	1.50	1.20	(a)
29	1.30		1.10	1.00	.90	1.95	2.90	1.65	1.10	1.45	1.20	1.20
30	1.30		1.20	.98	.93	1.80	2.45	1.50	1.10	1.45	1.20	1.25
31			1.17		.88		2.30	1.43		1.35		1.20

a Frozen.

#### BLUE RIVER AT MANHATTAN, KANSAS.

This stream is one of the principal tributaries of Kansas River, and drains a part of southeastern Nebraska and northeastern Kansas. It enters Kansas River at Manhattan. Its tributaries extend almost to the Platte River. The drainage basin receives a copious rainfall, and therefore the run-off is considerably larger than from the more western tributaries of Kansas River. The gaging station, established April 12, 1895, is at the county bridge 4 miles north of Manhattan. The gage rod consists of three sections, the lower being an ash stick driven into the bottom of the river and bolted to an overhanging cottonwood tree 30 feet east of the bridge. The other two sections of the rod are bolted to the south bridge pier. The bench mark is a cross cut in the capstone of the south bridge pier immediately above the upper gage, and is 32.135 feet above gage datum. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 218; 1897, Nineteenth Annual Report, Part IV, page 348; 1898, Twentieth Annual Report, Part IV, page 319. The following discharge measurements were made by W. G. Russell during 1899:

April 20, gage height, 4.60 feet; discharge, 767 second-feet.

May 23, gage height, 13.70 feet; discharge, 8,952 second-feet.

June 8, gage height, 16.60 feet; discharge, 20,237 second-feet.

June 9, gage height, 18.30 feet; discharge, 19,529 second-feet.

June 10, gage height, 15.60 feet; discharge, 13,616 second-feet.

October 18, gage height, 3.70 feet; discharge, 366 second-feet.

*Daily gage height, in feet, of Blue River at Manhattan, Kansas, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.50	4.80	4.65	4.95	4.88	5.70	6.85	7.05	4.20	3.80	4.25	4.00
2	4.40	4.70	4.65	4.85	5.45	5.95	6.25	5.90	4.15	3.80	4.25	3.95
3	4.40	4.60	4.95	4.75	5.35	12.85	6.85	5.25	4.30	3.80	4.15	4.05
4	4.40	4.70	5.75	4.85	6.05	23.00	6.35	4.90	4.25	3.80	4.05	4.10
5	4.40	4.85	5.80	4.90	5.90	12.65	5.85	5.15	4.15	3.80	4.00	3.95
6	4.50	4.90	5.70	5.15	5.10	8.40	8.35	6.75	4.00	3.80	4.00	4.00
7	4.45	4.80	5.60	5.45	4.75	7.60	10.65	6.00	4.05	3.80	4.15	3.95
8	4.45	4.75	6.00	5.65	5.10	13.95	14.25	5.20	4.05	3.85	4.10	3.90
9	4.45	4.70	6.05	5.65	5.95	18.25	12.90	5.00	4.20	3.80	4.10	4.00
10	4.45	4.80	6.10	5.45	10.55	15.80	10.60	4.70	4.30	3.75	4.10	4.15
11	4.60	4.85	7.40	5.30	10.25	11.25	9.00	4.70	4.10	3.85	4.10	4.20
12	4.75	4.90	7.35	5.15	6.40	8.75	8.35	4.65	4.05	3.80	4.10	4.30
13	4.75	4.80	6.40	5.00	5.80	8.05	7.40	7.00	3.90	3.80	4.05	3.95
14	4.65	4.80	6.00	5.00	5.40	7.20	7.25	11.45	3.95	3.80	4.05	3.75
15	4.55	4.90	9.00	4.95	5.00	6.83	6.55	9.25	3.95	3.80	3.95	4.55
16	4.50	4.60	12.20	4.85	5.00	6.50	6.60	9.20	4.00	3.95	4.05	4.30
17	4.50	4.65	9.95	4.75	5.05	6.60	6.60	8.15	4.00	3.80	4.20	4.45
18	4.50	4.60	8.35	4.75	4.80	6.75	6.10	7.00	3.75	3.80	4.20	4.20
19	4.40	4.65	7.25	4.70	4.30	6.90	5.75	6.10	3.75	3.80	4.20	4.10
20	4.40	4.75	6.60	4.58	13.10	6.95	5.60	5.60	3.90	3.80	4.15	3.90
21	4.45	4.70	6.25	4.53	21.55	6.70	5.50	5.30	3.95	3.75	4.00	4.10
22	4.50	4.75	6.15	4.48	22.85	6.55	5.25	4.90	3.90	3.95	4.00	4.10
23	4.50	4.90	5.90	4.50	13.50	6.25	5.15	4.80	3.90	3.45	3.95	4.15
24	4.50	5.25	5.55	4.50	9.40	6.15	5.10	4.80	3.90	3.80	3.90	4.05
25	4.40	5.20	5.40	4.50	8.30	6.35	4.95	4.50	3.90	3.90	4.05	4.15
26	4.40	5.20	5.25	4.43	9.10	6.40	4.90	4.20	3.80	7.05	4.10	3.95
27	4.50	5.10	5.25	4.45	9.65	6.30	4.85	3.50	3.90	6.80	4.05	3.90
28	4.50	4.95	5.20	5.63	7.25	7.35	5.05	4.50	3.80	5.65	4.05	3.85
29	4.80	-----	5.05	5.70	6.45	6.45	6.90	4.45	3.80	4.95	4.05	3.70
30	4.85	-----	5.05	5.20	6.00	6.45	12.00	4.35	3.80	4.70	4.05	3.70
31	4.90	-----	5.00	-----	6.10	-----	8.25	4.40	-----	4.40	-----	4.05

KANSAS RIVER AT LECOMPTON, KANSAS.

This river, formed by the junction of Republican and Smoky Hill rivers at Junction, Kansas, flows in a general easterly direction into Missouri River at Kansas City. The gaging station at Lecompton was established April 16, 1899, and is located at the new carriage bridge recently built across the river.

The following discharge measurements were made by E. C. Murphy and W. G. Russell during 1899:

*Measurements of Kansas River at Lecompton, Kansas.*

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1899.	<i>Feet.</i>	<i>Sec.-feet.</i>	1899.	<i>Feet.</i>	<i>Sec.-feet.</i>
Apr. 7	3.40	2,935	June 5	9.90	21,762
Apr. 15	3.35	2,747	June 12	6.60	11,549
Apr. 21	3.15	2,251	June 16	3.52	4,326
Apr. 29	5.90	8,744	July 17	6.30	10,500
May 11	6.35	10,859	July 28	3.95	3,349
May 25	11.20	34,213	Oct. 10	2.00	1,889

Daily gage height, in feet, of Kansas River at Lecompton, Kansas, for 1899.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.40	4.50	5.45	5.55	2.60	2.00	2.90	2.10
2		3.35	4.15	6.25	4.45	2.60	2.00	2.80	2.10
3		3.20	4.00	6.20	4.15	2.60	2.00	2.70	2.10
4		3.20	7.10	6.00	3.95	2.60	2.00	2.60	2.10
5		3.20	9.50	5.90	3.85	2.50	2.00	2.50	2.10
6		3.20	8.90	5.75	4.85	2.50	2.00	2.50	2.05
7		3.40	7.90	9.05	4.50	2.40	2.00	2.40	2.00
8		3.40	7.25	11.00	4.40	2.40	2.00	2.40	2.00
9		3.40	9.25	8.85	4.30	2.30	2.00	2.40	2.00
10		3.55	10.00	8.50	3.90	2.30	2.00	2.30	2.00
11		5.80	9.00	7.80	3.50	2.30	2.00	2.30	2.15
12		6.15	7.80	6.70	3.50	2.30	2.00	2.30	2.25
13		5.25	7.30	6.20	3.50	2.30	1.90	2.30	2.45
14		4.45	6.90	5.90	4.00	2.30	1.90	2.30	2.65
15		3.95	6.65	6.40	5.40	2.20	1.90	2.30	2.90
16	3.50	3.65	6.55	6.60	5.50	2.20	1.90	2.30	3.00
17	3.40	3.50	6.10	6.25	5.10	2.20	1.90	2.30	3.00
18	3.30	3.35	5.30	5.85	4.75	2.20	1.90	2.20	2.90
19	3.20	3.30	5.00	5.30	4.40	2.20	1.90	2.20	2.90
20	4.70	3.35	4.95	4.80	4.15	2.20	1.90	2.20	2.80
21	3.40	8.00	4.85	4.45	3.80	2.20	1.90	2.20	2.70
22	3.40	(a)	4.65	4.25	3.55	2.10	1.90	2.20	2.65
23	3.40	(a)	4.50	4.05	3.45	2.10	1.90	2.20	2.60
24	3.40	7.50	4.50	3.85	3.25	2.10	1.90	2.20	2.60
25	3.30	6.15	4.80	3.70	3.05	2.10	1.90	2.20	2.60
26	3.20	5.65	4.90	3.60	2.90	2.10	1.90	2.20	2.50
27	3.20	5.10	5.05	3.60	2.90	2.00	2.05	2.20	2.50
28	3.20	5.90	5.35	3.50	2.90	2.00	2.45	2.10	2.45
29	3.20	6.45	5.55	3.45	2.80	2.00	2.75	2.10	2.40
30	3.20	5.10	5.70	5.15	2.80	2.00	3.00	2.10	2.40
31		4.75		5.30	2.70		3.00		2.40

a Water over gage.

KANSAS RIVER AT LAWRENCE, KANSAS.

The station at this point, 11 miles below the Lecompton station, was established in July, 1895, and is located at the wagon bridge at Lawrence, Kansas. The gage was fastened to the south pier of the bridge, about 50 feet up the river from the crest of the dam. Owing to the impossibility of accurately rating this station, no measurements of discharge were made here during 1899, but gage readings were maintained until November 4, when the station was discontinued. The Lecompton station was established to take the place of this one. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 220; 1897, Nineteenth Annual Report, Part IV, page 350; 1898, Twentieth Annual Report, Part IV, page 322.

*Daily gage height, in feet, of Kansas River at Lawrence, Kansas, for 1899.*

[Sign — indicates that water is below zero of gage.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1.....	0.50	-1.75	.80	1.20	1.20	2.00	2.35	2.85	0.60	0.10	0.80
2.....	.60	— .50	1.10	1.20	1.00	1.90	2.70	1.95	.60	.15	.75
3.....	.60	.00	.90	1.20	1.00	2.10	2.95	1.65	.60	.20	.75
4.....	.80	.10	1.05	1.20	.85	2.70	2.80	1.55	.60	.20	.65
5.....	.90	.00	2.00	1.25	.85	5.60	2.65	1.40	.60	.20	.....
6.....	.70	.40	1.80	1.35	.90	5.50	2.55	1.50	.55	.20	.....
7.....	.65	— .70	.70	1.60	1.20	3.75	4.50	1.80	.50	.20	.....
8.....	.80	— .60	.90	1.80	1.10	3.50	6.55	1.90	.50	.20	.....
9.....	.60	.00	1.05	1.80	1.00	4.60	4.80	1.50	.50	.10	.....
10.....	.50	— .50	1.30	1.75	1.20	6.20	4.50	1.40	.50	.00	.....
11.....	.45	— .80	1.30	1.60	2.90	6.30	3.55	1.30	.50	.00	.....
12.....	.50	— .20	2.80	1.45	2.80	5.40	3.00	1.25	.50	.00	.....
13.....	.50	.60	2.90	1.40	2.60	4.10	2.55	1.10	.50	— .10	.....
14.....	.50	-1.20	2.80	1.25	1.80	3.80	2.65	1.35	.40	— .20	.....
15.....	.50	-1.20	2.60	1.10	1.45	3.50	2.75	1.90	.40	— .20	.....
16.....	.45	-1.40	3.70	1.00	1.20	3.10	3.00	2.65	.35	— .30	.....
17.....	.40	— .15	3.60	1.00	1.00	2.80	3.00	2.25	.40	— .20	.....
18.....	.40	.00	3.50	.90	1.00	2.15	2.70	2.05	.40	— .20	.....
19.....	.40	.50	2.80	.80	1.00	2.00	2.25	1.70	.35	— .20	.....
20.....	.55	.50	2.10	2.70	1.00	2.00	1.95	1.50	.30	— .20	.....
21.....	.75	.55	1.80	1.35	3.40	1.95	1.80	1.35	.30	— .20	.....
22.....	.80	.35	1.80	1.00	5.65	1.85	1.60	1.15	.30	— .30	.....
23.....	.75	.00	1.55	1.00	5.80	1.70	1.60	1.00	.30	— .30	.....
24.....	.75	— .20	1.50	1.00	4.80	1.90	1.50	1.00	.30	— .30	.....
25.....	.70	.00	1.40	1.00	3.10	2.00	1.40	.85	.30	— .35	.....
26.....	.80	.50	1.40	1.00	2.50	2.00	1.40	.85	.20	— .35	.....
27.....	.65	.70	1.40	1.00	2.10	2.10	1.25	.80	.10	— .30	.....
28.....	.35	.80	1.35	1.00	2.70	2.40	1.15	.80	.05	— .35	.....
29.....	.60	.....	1.20	1.00	3.10	2.40	1.10	.80	.00	+ .80	.....
30.....	.40	.....	1.20	1.40	2.60	2.40	1.80	.75	.00	.85	.....
31.....	.60	.....	1.20	.....	1.90	.....	2.35	.65	.....	.85	.....

Station discontinued October 31.

#### ARKANSAS RIVER.

The source of this river is in the vicinity of Tennessee Pass, in the central portion of Colorado. It flows southerly for about 70 miles, then easterly for 50 miles to Canyon, receiving a number of tributaries from the mountainous area on either side, which tends to increase the discharge of the river. At Canyon it suddenly emerges from the Rocky Mountain front and thence flows in an easterly direction, traversing the Great Plains of eastern Colorado, in which section most of the water is diverted for irrigation. After crossing the Kansas line it continues eastward for about 200 miles until the center of the State is reached, when it suddenly bends to the southward and passes into Indian Territory, and from thence into the State of Arkansas, finally entering the Mississippi River about 25 miles above Greenville, Mississippi. Throughout the mountainous area above Canyon the discharge increases, but as soon as the river emerges onto the Great Plains the water is gradually diverted by means of canals, so that by the time the Kansas line is reached the river is usually dry during the summer stages. In its mountainous course the river makes a descent from 10,000 feet at Leadville to 5,300 feet at Canyon, a distance of 120 miles.

During the last year two notable examples of engineering construction have been practically completed in this basin. The first one is the Twin Lakes reservoir, in which a dam 30 feet in height, of solid

masonry, has been completed in a cut below the outlet of the lower lake of Twin Lakes, which is one source of supply of the Arkansas. This is designed to store water for a canal 130 miles below, which heads a few miles below Pueblo. The ditch has been cleaned out during the last season, and it is stated that \$2,000,000 are being spent on a sugar-beet factory receiving water from it.

Twelve miles north of Lamar, Colorado, are a series of depressions in the plains, separated by ridges. Five of these have been connected by ditches, making the continuous reservoir system of The Great Plains Water Company. Their total available capacity is 194,562 acre-feet. It is the intention to fill them from the Arkansas River during the winter and high-water seasons by means of a supply ditch, which is now completed. This ditch is about 90 miles long and heads immediately above La Junta. Its capacity at the head is 2,000 second-feet. A number of gaging stations have been maintained in this drainage basin, and they are described in order down stream:

#### LAKE CREEK AT TWIN LAKES, COLORADO.

This creek enters the Arkansas a short distance above Granite, Colorado. The station was established June 21, 1899, by Mr. O. O. McReynolds, chief engineer of the Colorado Land and Water Company, which has been at work on the reservoir of Twin Lakes during the last year. It was at first contemplated that measurements should be made showing the discharge into the upper lake, between the two lakes, and below the lower lake, but owing to difficulties encountered only a few measurements were made at the two upper points. On July 17 the discharge entering the upper lake, at a gage height of 2.80 feet, was found to be 273 second-feet; on October 12, at the same point, with a gage height of 1.9 feet, the discharge was 27 second-feet. Three measurements of discharge were made at a point between the two lakes: June 21, at a gage height of 3.60 feet, the discharge was found to be 1,007 second-feet; July 17, at a gage height of 1.90 feet, the discharge was 374 second-feet; October 12, gage height, 1.4 feet; discharge, 42 second-feet. A number of discharge measurements at the lower station were made, sufficient for the construction of a rating table covering the period from June 21 to July 20, but after that date the surface of the lakes was raised and lowered periodically through the operations of a placer company which had constructed a dam below the lower lake. The following measurements of discharge were made by A. L. Fellows and O. O. McReynolds during 1899:

June 21, gage height, 3.80 feet; discharge, 1,208 second-feet.

June 27, gage height, 3.20 feet; discharge, 696 second-feet.

July 17, gage height, 2.55 feet; discharge, 391 second-feet.

July 24, gage height, 2.50 feet; discharge, 344 second-feet.

August 14, gage height, 2.50 feet; discharge, 183 second-feet.

October 13, gage height ———; discharge, 22 second-feet.

*Daily gage height, in feet, of Lake Creek at Twin Lakes, Colorado, for 1899.*

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1.	-----	3.10	2.72	2.15	12.	-----	2.65	2.60	-----	23.	3.65	2.50	2.30	-----
2.	-----	3.15	2.72	2.10	13.	-----	2.75	2.55	-----	24.	3.50	2.52	2.30	-----
3.	-----	3.10	2.78	2.10	14.	-----	2.65	2.50	-----	25.	3.40	2.50	2.25	-----
4.	-----	3.05	2.88	2.10	15.	-----	2.55	2.48	-----	26.	3.30	2.45	2.25	-----
5.	-----	2.95	2.95	2.05	16.	-----	2.50	2.45	-----	27.	3.20	2.48	2.22	-----
6.	-----	2.95	2.98	2.05	17.	-----	2.50	2.45	-----	28.	3.10	2.55	2.20	-----
7.	-----	2.90	2.90	2.05	18.	-----	2.50	2.45	-----	29.	3.10	2.65	2.15	-----
8.	-----	2.85	2.88	2.05	19.	-----	2.50	2.40	-----	30.	3.10	2.70	2.15	-----
9.	-----	2.80	2.85	2.00	20.	-----	2.50	2.40	-----	31.	-----	2.70	2.15	-----
10.	-----	2.75	2.75	2.00	21.	3.80	2.55	2.40	-----					
11.	-----	2.70	2.65	2.00	22.	3.70	2.55	2.35	-----					

ARKANSAS RIVER AT GRANITE, COLORADO.

This station is located at the wagon bridge, 250 feet from the railroad station at Granite, Colorado. The gage is a vertical 2 by 6 inch plank spiked to the upper end of the center pier of the bridge. The banks are low and liable to overflow; the bed is rocky, and the current swift. It will be impossible to construct a rating table for this station from the measurements obtained in 1899. The results of measurements may be found as follows: 1897, Nineteenth Annual Report, Part IV, page 354; 1898, Twentieth Annual Report, Part IV, page 330. The following discharge measurements were made by A. L. Fellows during 1899:

May 25, gage height, 5 feet; discharge, 1,476 second-feet.

July 15, gage height, 2.80 feet; discharge, 1,178 second-feet.

October 14, gage height, 1.60 feet; discharge, 130 second-feet.

*Daily gage height, in feet, of Arkansas River at Granite, Colorado, for 1899.*

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	
1.	-----	-----	3.15	3.90	5.80	3.90	2.40	2.00
2.	-----	-----	3.25	3.80	5.75	3.90	2.40	2.00
3.	-----	-----	3.25	3.80	5.25	3.90	2.40	2.00
4.	-----	-----	2.25	3.80	4.80	3.80	2.60	2.00
5.	-----	-----	3.20	3.80	4.50	3.50	2.60	2.00
6.	-----	-----	3.20	3.80	4.60	3.50	2.60	2.00
7.	-----	-----	3.20	3.90	4.85	3.45	2.60	2.00
8.	-----	-----	3.15	3.95	5.00	3.40	2.60	2.00
9.	-----	-----	3.25	4.05	5.00	3.40	2.60	2.00
10.	-----	-----	3.35	4.20	5.00	3.40	2.40	2.00
11.	-----	-----	3.45	4.35	5.40	3.35	2.40	-----
12.	-----	-----	3.45	4.60	6.70	3.30	2.40	-----
13.	-----	-----	3.50	4.95	6.95	3.00	2.40	-----
14.	-----	-----	3.50	5.40	6.90	3.00	2.40	-----
15.	-----	-----	3.50	5.80	6.40	2.80	2.40	-----
16.	-----	-----	3.50	5.80	6.00	2.80	2.00	-----
17.	-----	-----	3.50	5.80	5.85	2.80	2.00	-----
18.	-----	-----	3.50	5.90	5.75	2.80	2.00	-----
19.	-----	-----	3.50	5.90	5.85	2.80	2.00	-----
20.	-----	-----	3.50	5.75	5.85	2.80	2.60	-----
21.	-----	-----	3.50	5.65	5.70	2.80	2.00	-----
22.	-----	-----	3.55	5.00	5.65	2.80	2.00	-----
23.	-----	3.30	3.65	4.80	5.00	2.80	2.00	-----
24.	-----	3.15	3.65	4.95	4.85	2.80	2.00	-----
25.	-----	3.20	3.75	5.00	4.60	2.80	2.00	-----
26.	-----	3.25	3.95	5.35	4.40	2.80	2.00	-----
27.	-----	3.25	4.00	5.65	4.00	2.60	2.00	-----
28.	-----	3.25	4.00	5.75	3.90	2.60	2.00	-----
29.	-----	3.20	3.90	5.60	3.90	2.60	2.00	-----
30.	-----	3.10	3.90	5.90	3.90	2.60	2.00	-----
31.	-----	3.15	-----	6.00	-----	2.60	2.00	-----

## ARKANSAS RIVER AT SALIDA, COLORADO.

This station was established April 11, 1895, and is located at the suspension bridge at Salida, Colorado. The gage consists of a vertical timber bolted to the abutment of the bridge; the banks are high and do not overflow; the bed of the stream consists of sand and gravel. Large bowlders interfere to a considerable extent with the accuracy of the results. Results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 224; 1897, Nineteenth Annual Report, Part IV, page 355; 1898, Twentieth Annual Report, Part IV, page 331. The following discharge measurements were made by A. L. Fellows during 1899:

April 26, gage height, 1.72 feet; discharge, 686 second-feet.

May 25, gage height, 3.10 feet; discharge, 1,999 second-feet.

July 14, gage height, 2.40 feet; discharge, 1,801 second-feet.

November 8, gage height, 0.80 feet; discharge, 317 second-feet.

*Daily gage height, in feet, of Arkansas River at Salida, Colorado, for 1899.*

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		0.80	1.30	3.25	3.20	1.60	0.80
2		.80	1.35	3.35	3.20	1.60	.80
3		.80	1.25	3.10	3.20	1.70	.80
4		.80	1.20	2.85	3.20	2.40	.70
5		.85	1.25	2.65	3.10	2.10	.70
6		.80	1.40	2.60	3.20	2.15	.60
7		.80	1.50	2.85	3.05	1.85	.60
8		.80	1.65	2.90	2.90	1.65	.55
9		.85	1.95	3.05	2.50	1.45	.50
10		.95	2.05	3.20	2.45	1.40	.50
11		1.00	2.10	3.50	2.40	1.35	.50
12		1.02	2.25	3.60	2.35	1.15	.50
13		1.10	2.45	3.70	2.65	1.20	.75
14		1.00	2.70	4.60	2.35	1.20	.90
15		1.05	2.85	4.30	2.45	1.20	1.00
16		1.20	2.90	4.85	2.40	1.20	1.00
17		1.20	2.90	5.00	2.80	1.10	.80
18		1.10	2.95	4.85	2.50	1.10	.70
19		1.15	3.00	4.95	2.40	1.05	.65
20		.95	3.00	5.10	2.80	1.00	.55
21		.90	2.80	5.00	2.00	1.00	.50
22	0.80	.95	2.60	4.50	1.85	.90	.50
23	.80	1.10	2.45	4.20	1.80	.80	.50
24	.80	1.20	2.50	4.20	1.85	.80	.50
25	.80	1.30	2.75	4.10	1.65	.80	.50
26	.90	1.55	2.95	3.85	1.60	.70	.50
27	.70	1.60	3.10	3.50	1.65	.70	.40
28	.70	1.65	3.10	3.20	1.55	.70	.40
29	.70	1.50	3.10	3.20	1.40	.70	.40
30	.70	1.40	3.20	3.20	1.50	.70	.40
31	.70		3.25		1.60	.90	

Closed for the winter September 30.

## ARKANSAS RIVER AT CANYON, COLORADO.

This station, established in 1889, is located at the Hot Springs Hotel,  $1\frac{1}{2}$  miles west of Canyon and about 500 yards below the mouth of Grape Creek. The gage rod is placed on the left bank of the river, just below the suspension foot bridge, and consists of an inclined 4 by 4 inch timber bolted to posts set in the ground. The station is an important one, as it is located at the mouth of the canyon and

above most of the canal diversions. The only two ditches taking water above the gaging station are the North and South Side ditches, which were each measured three times during 1899, as follows: On April 27, August 18, and November 7. North Side ditch, on the first date, was carrying 55 second-feet, and the South Side ditch 48 second-feet; on the second date North Side ditch was discharging 35 second-feet and the South Side ditch 43 second-feet; at the third measurement of discharge the North Side ditch showed 28 second-feet and the South Side 36 second-feet. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 226; 1897, Nineteenth Annual Report, Part IV, page 356; 1898, Twentieth Annual Report, Part IV, page 331. The discharge measurements were made by A. L. Fellows for 1899, as follows:

April 27, gage height, 3.20 feet; discharge, 611 second-feet.

May 26, gage height, 4.55 feet; discharge, 2,189 second-feet.

July 7, gage height, 4.50 feet; discharge, 2,651 second-feet.

August 18, gage height, 2.90 feet; discharge, 553 second-feet.

November 7, gage height, 2.55 feet; discharge, 306 second-feet.

*Daily gage height, in feet, of Arkansas River at Canyon, Colorado, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				2.80	3.25	5.00	5.00	3.60	2.60			
2				2.80	3.10	5.05	5.30	3.50	2.50			a2.70
3				2.80	3.05	5.00	5.00	3.50	2.50			
4		2.60	3.40	2.80	2.90	4.75	4.85	4.10	2.50	a2.20	a2.60	
5				2.80	2.90	4.50	4.75	4.45	2.40			
6	2.60			2.80	2.90	4.45	4.60	3.65	2.40			
7				2.70	3.00	4.65	4.55	3.50	2.30			
8				2.70	3.15	4.70	4.40	3.50	2.30			
9				2.70	3.35	4.75	4.30	3.40	2.30			a2.70
10				2.75	3.55	4.85	4.20	3.30	2.30			
11		2.50	3.00	2.80	3.65	5.05	4.10	3.10	2.20	a2.40	a2.80	
12				3.00	3.90	5.45	4.05	3.00	2.20			
13				3.00	4.25	5.85	4.45	3.00	2.20			
14	2.60			3.05	4.50	6.00	4.25	3.00	2.20			
15				3.00	4.70	5.95	4.25	2.90	2.30			
16				3.05	4.80	5.95	4.40	2.80	2.30			a2.50
17				3.00	4.85	5.95	4.10	2.95	2.60			
18		2.10	2.70	3.00	4.65	6.05	4.05	2.90	2.50		a2.90	
19				2.95	4.75	6.10	4.50	2.85	2.40			
20				3.00	4.80	6.10	4.10	2.80	2.40	a2.40		
21	2.60			2.75	4.65	6.05	3.90	2.70	2.30			
22				2.70	4.40	5.95	3.80	2.70	2.30			
23				2.75	4.20	5.75	3.70	2.60	2.30			a2.50
24				2.90	4.15	5.60	3.70	2.60	2.30			
25		3.00	2.70	3.05	4.50	5.50	3.60	2.50	2.30		a3.00	
26				3.20	4.60	5.30	3.50	2.50	2.30			
27				3.30	4.80	5.25	3.50	2.50	2.20			
28	2.60			3.35	4.80	5.00	3.60	2.50	2.20	a2.50		
29				3.40	4.80	5.05	3.55	2.50	2.20			
30				3.25	4.90	4.95	3.65	2.40	2.20			a2.80
31					5.00		3.60	2.50				

*a* Average for week.

ARKANSAS RIVER AT PUEBLO, COLORADO.

This station was established in September, 1894, and is at present located at Main street bridge in the city of Pueblo. The gage is a 2 by 6 inch plank bolted to the masonry wall at the south end of the bridge. The bench mark consists of a point on the stone coping at the south end of the bridge, and is 17.30 feet above gage datum.

Gage readings are furnished by the city engineer of Pueblo. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 230; 1897, Nineteenth Annual Report, Part IV, page 357; 1898, Twentieth Annual Report, Part IV, page 336. The following discharge measurements for 1899 were made under the direction of A. L. Fellows:

*Measurements of Arkansas River at Pueblo, Colorado.*

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1899.			1899.		
	<i>Feet.</i>	<i>Sec.-feet.</i>		<i>Feet.</i>	<i>Sec.-feet.</i>
Apr. 27 .....	0.8	695	Aug. 5 .....	1.46	1,938
May 26 .....	2.2	2,221	Aug. 14 .....	1.20	1,496
June 3 .....	2.55	2,856	Sept. 10 .....	-0.5	180
June 17 .....	3.60	4,565	Sept. 18 .....	-0.10	388
July 1 .....	2.22	2,959	Oct. 6 .....	-0.20	331
July 8 .....	1.61	2,098	Nov. 7 .....	0.05	411
Aug. 1 .....	0.72	1,199			

*Daily gage height, in feet, of Arkansas River at Pueblo, Colorado, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			0.59	0.49	0.75	2.50	2.10	c 1.00	-0.23	(b)	0.05	-0.10
2	0.40	0.36	.75	.45	.80	2.50	2.10	.80	.22	-0.35	.02	.12
3	.35	.52	.59	.50	.80	2.50	2.40	.90	(b)	.30	.07	(b)
4	.30	.57	.68	.44	.60	2.20	2.10	1.15	.20	.31	.04	.10
5	.55	.62	.68	.44	.60	2.20	2.10	1.15	.20	.31	.04	.10
6	.55	.60	.60	.40	.55	1.90	1.90	1.55	.25	.26	(b)	.30
7	.58	.62	.51	.47	.50	1.70	1.80	(b)	.35	.20	.00	.25
8	.43	.60	.62	.47	.55	2.00	2.20	1.10	.38	.30	.05	.30
9	.43	.62	.63	.47	.65	2.10	1.60	.97	.40	(b)	.00	.18
10	.45	.60	.59	.34	.65	2.20	1.50	.85	.32	.28	.02	.20
11	.47	.58	.61	.30	.75	2.30	1.40	.60	(b)	.32	.01	(b)
12	.39	.75	.47	.29	.85	2.40	1.20	.30	.50	.30	.01	.15
13	.37	.72	.45	.29	1.30	2.80	1.80	.35	.48	.33	(b)	.28
14	.45	.70	.40	.40	1.70	3.30	2.00	(b)	.60	.25	.00	.05
15	.48	.70	.27	.40	2.00	3.30	1.90	d 1.90	.55	.20	.02	.00
16	.49	1.05	.20	.45	2.15	3.60	1.90	.40	.50	(b)	.01	.08
17	.49	1.05	.18	.50	2.25	3.70	1.65	.27	.38	.15	.05	.25
18	.50	1.19	.69	.50	2.25	3.60	1.50	.25	(b)	.30	.12	(b)
19	.50	.95	.40	.50	2.35	3.50	1.80	.10	.05	.25	.15	.05
20	.50	.85	.40	.45	2.25	3.60	2.00	.07	.20	.28	.13	.12
21	.50	.72	.22	.40	2.45	3.80	1.50	(b)	.18	.25	(b)	(e)
22	.47	.70	.30	.50	2.25	3.70	α 1.30	.05	.15	.20	.15	.28
23	.50	.70	.25	.20	2.05	3.70	1.10	.20	.25	(b)	.16	(e)
24	.55	.70	.20	.20	1.75	3.30	1.10	.10	.30	.05	.18	(e)
25	.52	.45	.35	.20	1.65	2.90	1.10	.15	(b)	.11	.10	(b)
26	.45	.67	.35	.40	2.05	2.80	.90	.30	.35	.15	.08	(b)
27	.40	.65	.45	.45	2.28	2.60	.80	.35	.39	.03	(b)	.05
28	.30	.50	.45	.70	2.50	2.60	1.10	(b)	.40	.00	.20	.05
29	.37	.59	.31	.78	2.55	2.20	1.00	.33	.42	.02	.22	.08
30	.37		.36	.90	2.45	2.20	.80	.35	.45	(b)	.20	.10
31	.37		.33	.80	2.50	2.30	1.10	.45	.45	.03	(b)	.05
	.35		.40		2.50		.90	.40		.03		(b)

a New rating table from June 21.

b No record.

c Gage heights after July 31 are from city engineer's records.

d August 13, storm in Pueblo; water rose to 7 feet in night.

e Ice gorge; discard readings.

**ARKANSAS RIVER AT NEPESTA, COLORADO.**

This station, established September 8, 1897, is located 1,000 feet north of Nepesta, Colorado, at a wagon bridge. The gage consists of a vertical timber securely fastened to the upstream cylinder of bridge, on the left side of the river. The channel above and below the sta-

tion is straight for several hundred feet, while the bed is sandy and shifting, and the results, therefore, are not altogether satisfactory for the purpose of making a rating table. This station is maintained by The Great Plains Water Company. The results of discharge measurements may be found as follows: 1897, Nineteenth Annual Report, Part IV, page 358; 1898, Twentieth Annual Report, Part IV, page 337. The following discharge measurements were made under the direction of A. L. Fellows in 1899:

- May 29, gage height, 4.60 feet; discharge, 1,810 second-feet.
- June 7, gage height, 4.63 feet; discharge, 1,636 second-feet.
- August 3, gage height, 4 feet; discharge, 610 second-feet.
- August 25, gage height, 3.10 feet; discharge, 215 second-feet.
- October 2, gage height, 3.12 feet; discharge, 213 second-feet.

Daily gage height, in feet, of Arkansas River at Nepesta, Colorado, for 1899.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.		3.50	4.80	5.50	4.10	3.40	3.00	5.20	3.10
2.		3.60	4.70	5.30	4.00	3.10	3.00	3.70	3.10
3.		3.50	4.80	5.70	4.20	3.10	3.00	3.70	(b)
4.		3.50	4.50	5.50	4.90	3.10	3.10	3.50	
5.		3.40	4.30	5.20	5.80	3.00	3.20	3.20	
6.		3.30	4.30	5.10	5.50	3.00	3.20	3.30	
7.		3.40	4.70	5.00	5.10	3.00	3.20	3.50	
8.		3.50	4.70	5.20	4.20	3.00	3.20	3.50	
9.		3.50	4.70	4.90	4.20	3.00	3.10	3.50	
10.		3.70	4.80	4.90	3.90	2.80	3.10	3.40	
11.		3.70	5.00	4.50	3.60	3.00	2.90	3.50	
12.		3.90	5.30	4.70	3.40	2.90	3.00	3.60	
13.		4.50	5.20	4.20	3.20	2.90	3.10	3.50	
14.		4.60	5.10	5.10	a 7.50	2.80	3.30	3.50	
15.		4.60	5.30	5.80	4.40	3.00	3.10	3.30	
16.		4.60	5.50	6.00	3.50	3.40	3.00	3.30	
17.		4.60	5.50	5.90	3.40	3.10	3.10	3.20	
18.		4.60	5.40	5.50	3.10	3.30	3.20	3.30	
19.		4.60	5.50	5.40	2.40	3.20	3.10	3.20	
20.		4.50	5.60	5.20	3.40	3.10	3.10	3.20	
21.	3.50	4.50	5.80	4.90	3.20	3.10	3.20	3.10	
22.	3.40	4.50	5.70	4.70	3.30	3.10	3.20	3.10	
23.	3.00	4.50	5.70	5.00	2.90	3.00	3.30	3.20	
24.	3.20	4.40	5.50	5.80	3.00	3.00	3.30	3.20	
25.	3.20	4.50	5.30	4.00	3.10	3.10	3.30	3.30	
26.	3.30	4.70	5.20	4.00	3.20	3.00	3.40	3.10	
27.	3.50	4.80	5.10	4.00	3.20	3.00	3.40	3.10	
28.	3.50	4.80	5.10	5.00	3.20	2.90	3.50	3.00	
29.	3.40	4.60	5.00	7.00	3.10	2.80	3.40	3.00	
30.	3.40	4.60	5.10	4.90	3.00	2.90	3.40	3.00	
31.		4.90		4.90	3.00		3.50		

a Flood at Pueblo.

b Records discontinued December 2.

ARKANSAS RIVER AT ROCKYFORD, COLORADO.

This station is located 2 miles northeast of Rockyford, Colorado, and was established May 3, 1897. The gage consists of a vertical timber fastened to the abutment of the wagon bridge on the left side of the stream. Both banks are low, but not liable to overflow, excepting at very high water. The bed is sandy and shifting. S. W. Cressy, commissioner of Colorado irrigation district No. 17, is the voluntary observer. On October 16 Rockyford ditch near by was measured at the rating flume, at a gage height of 1.13 feet, and gave a discharge of 41 second-feet. The results of measurements may be

found as follows: 1898, Twentieth Annual Report, Part IV, page 338. The measurements for 1899, made by A. L. Fellows, are as follows:

May 30, gage height, 1.88 feet; discharge, 1,042 second-feet.

October 16, gage height, 0.88 foot; discharge, 136 second-feet.

*Daily gage height, in feet, of Arkansas River at Rockyford, Colorado, for 1899.*

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.34	1.10	2.12	2.10	1.82	0.81	0.68	1.70	0.80
2		1.30	1.15	2.10	2.20	1.45	.97	.52	1.90	.80
3		1.32	1.30	2.08	2.35	1.19	.95	.50	1.25	.80
4		1.31	1.05	2.01	3.10	1.45	.74	.65	1.18	.80
5		1.25	.90	1.89	2.28	4.40	.83	.72	1.18	.88
6		1.12	.90	1.62	2.10	2.85	.90	.74	1.00	1.00
7		1.02	.89	1.91	2.00	2.85	.90	.72	1.03	1.00
8		1.02	.90	2.10	2.58	2.20	.88	.79	1.04	.95
9		1.10	.89	2.40	2.05	1.78	.76	.79	1.05	α1.00
10		1.05	.92	2.05	1.85	1.59	.70	.75	1.08	
11		1.00	1.28	1.98	1.78	1.34	.72	.74	1.05	
12		.99	1.35	2.15	1.65	1.20	.74	.65	1.09	
13	1.35	.95	1.43	2.20	1.48	1.11	.76	.68	1.12	
14	1.30	.95	1.63	2.20	3.40	2.25	.78	.80	1.14	
15	1.23	.95	1.81	2.50	3.30	2.25	.82	.89	1.16	
16	1.25		1.79	2.60	3.20	1.48	.87	.88	1.03	
17	1.10	1.20	1.80	2.70	3.85	1.27	1.02	.85	1.00	
18	1.05	1.20	1.80	2.75	2.40	1.18	1.01	.86	.85	
19	1.00	1.22	1.91	2.65	3.00	1.10	1.12	.92	.75	
20	1.00	1.16	1.75	2.80	2.80	1.07	1.25	.94		
21	.97	1.10	1.85	2.85	2.40	1.19	1.00	.95	1.20	
22	.93	1.16	2.05	2.85	2.15	1.17	1.00		1.00	
23	.90	1.17	1.95	2.98	1.95	1.08	.98		.98	
24	1.10	1.02	1.90	2.72	1.88	.95	1.00	1.00	1.00	
25	1.15	.90	1.80	2.68	2.01	.80	.94	1.00	.95	
26	.90	.90	1.95	2.50	1.48	.75	.90	1.01	.92	
27	.90	.95	2.02	2.30	1.25	.88	.80	1.02	.91	
28	1.27	.97	2.05	2.20	1.12	.88	.82	1.06	.91	
29	1.25	.95	2.08	2.05	3.20	.90	.84	1.09	.94	
30	1.20	1.10	1.90	1.92	2.45	.90	.72	1.13	.82	
31	1.38		1.85		2.92	.80		1.10		

α Readings discontinued December 9.

#### ARKANSAS RIVER AT LA JUNTA, COLORADO.

This station is situated at the head of the Fort Lyons canal, measurements being taken of the water in the rating flume of the canal, of that in its wasteway, and of that passing over the dam at the head of the canal. The station is maintained by The Great Plains Water Company. On May 30, at gage height of 3.90 feet, the discharge of the canal was 772 second-feet, and 22 second-feet was in the wasteway. October 17 the canal was carrying, at a gage height of 1.89 feet, a discharge of 159 second-feet, with 44 second-feet in the wasteway. Continuous records of gage heights were not kept throughout the year. Three measurements of discharge were made by A. L. Fellows of the amount of water passing over the dam, for the purpose of securing a rating table for the form of weir of which the Fort Lyons dam is typical. The first, on May 30, at a gage height of 0.05 foot, gave a discharge of 246 second-feet. The second, on June 13, with a gage height of 0.47 foot, showed a discharge of 857 second-feet, and the last measurement, on June 20, with a gage height of 0.67 foot, gave a discharge of 1,181 second-feet.

PURGATORY RIVER AT TRINIDAD, COLORADO.

This stream is one of the principal tributaries entering the Arkansas River from the south; it rises in northern New Mexico and flows in a general northeasterly direction across the plains, entering the main stream a short distance below Las Animas. The rod is attached to the downstream side of the cylindrical pier of the Las Animas street bridge in the city of Trinidad, and has been maintained for a number of years. Owing, however, to the unsatisfactory condition of the river at this locality, the station was discontinued July 31, 1899. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 232; 1897, Nineteenth Annual Report, Part IV, page 359; 1898, Twentieth Annual Report, Part IV, page 341. Two measurements of discharge were made in 1899 by A. L. Fellows. The first one, on April 28, at a gage height of 3.60 feet, gave a discharge of 52 second-feet; one on July 12, at a gage height of 3.30 feet, showed a discharge of 4 second-feet.

*Daily gage height, in feet, of Purgatory River at Trinidad, Colorado, for 1899.*

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1..	3.50	3.95	3.70	3.40	12...	3.50	3.80	3.60	3.85	23...	3.75	3.75	3.60	4.15
2..	3.50	3.85	3.70	3.75	13...	3.50	3.80	3.55	4.65	24...	3.80	3.60	3.70	3.65
3..	3.50	3.75	3.70	3.95	14...	3.55	3.80	3.50	4.80	25...	3.80	3.60	3.55	3.60
4..	3.50	3.70	3.70	3.75	15...	3.60	3.85	3.55	4.70	26...	3.85	3.60	3.40	3.50
5..	3.50	3.80	3.70	3.60	16...	3.70	4.00	4.20	4.15	27...	3.90	3.60	3.40	3.50
6..	3.50	3.70	3.55	3.50	17...	3.70	4.00	4.00	3.95	28...	3.90	3.60	3.30	4.75
7..	3.50	3.70	3.50	3.55	18...	3.80	3.90	3.90	4.25	29...	3.90	3.60	3.30	4.90
8..	3.50	3.65	3.50	3.70	19...	3.85	3.85	3.75	4.05	30...	3.95	3.60	3.30	4.20
9..	3.50	3.80	3.55	3.60	20...	3.90	3.90	3.60	3.85	31...	-----	3.70	-----	3.85
10..	3.50	3.80	3.60	3.50	21...	3.95	3.90	3.60	3.70					
11..	3.50	3.80	3.50	3.40	22...	3.75	3.95	3.55	3.60					

ARKANSAS RIVER AT AMITY CANAL HEAD GATES, COLORADO.

This station is located at the head of Amity canal, 7 miles west of Lamar, Colorado, and is maintained by the Amity Canal Company. The observations here are not as satisfactory as they might be for determining the total flow of the river. The following measurements were made by A. L. Fellows on the canal and wasteway: May 31, the canal, at a gage height of 2.63 feet, was discharging 249 second-feet, while there were 129 second-feet in the wasteway; on June 18 the amount of water in the wasteway, at a gage height of 2.15 feet, was 114 second-feet. No measurements of the main river were made during 1899.

The Arkansas River at the head of the Colorado and Kansas canal, 12 miles west of Lamar, was measured September 8, 1899, and at a gage height of 0.20 feet on the dam was discharging 16 second-feet.

Daily gage height, in feet, of Arkansas River at Amity canal head gates, Colorado, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1.....	1.50	1.40	5.60	2.10	0.40	17.....	1.80	2.00	4.50	1.50	2.10
2.....	1.50	1.40	5.80	1.90	.30	18.....	1.80	2.00	2.50	1.50	2.10
3.....	1.80	1.40	5.60	1.90	.10	19.....	1.80	2.40	2.50	1.50	2.70
4.....	1.80	1.40	5.80	1.80	.10	20.....	2.00	2.40	2.50	1.70	2.20
5.....	2.00	1.40	5.80	1.80	.10	21.....	2.20	2.40	2.20	1.60	2.60
6.....	2.00	1.40	5.00	1.70	1.30	22.....	2.80	2.80	2.10	1.60	2.00
7.....	2.00	1.40	4.80	1.90	.60	23.....	2.60	2.80	2.00	1.20	1.80
8.....	2.00	1.40	4.80	1.80	.30	24.....	2.80	2.80	2.00	1.10	3.30
9.....	2.00	1.40	4.80	1.90	.40	25.....	2.40	2.60	1.90	1.10	3.10
10.....	2.00	1.40	4.80	2.00	.20	26.....	2.40	2.60	2.00	.90	3.30
11.....	2.00	1.40	4.80	2.20	.20	27.....	2.40	2.60	1.80	.80	3.10
12.....	1.80	1.60	4.80	2.20	.20	28.....	2.40	2.60	2.50	.50	3.90
13.....	1.80	1.60	4.00	2.20	.20	29.....	2.60	-----	2.10	.30	4.00
14.....	1.80	1.80	4.00	2.10	.60	30.....	2.20	-----	2.40	.30	3.90
15.....	1.80	1.80	4.60	1.80	1.20	31.....	1.90	-----	2.00	-----	3.30
16.....	1.80	2.00	4.60	1.60	1.80						

ARKANSAS RIVER AT GRANADA, COLORADO.

This station was established July 24, 1898, and is located at the head gates of the Buffalo Creek canal, 2 miles northeast of Granada. There is an earth dam across the river at this point, with a footbridge over it, from which measurements were to have been attempted, but, owing to an occasional breaking of the dam during high stages of the river, none have been made since the station was established. The gage is vertical, well painted, and nailed to the head gates of the canal.

Daily gage height, in feet, of Arkansas River at Granada, Colorado, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....	0.40	1.40	2.40	0.30	0.40	0.60	0.60	2.20	0.60	0.80	1.00	0.80
2.....	.40	1.40	2.40	.30	.60	.40	.60	1.80	.60	.80	1.20	.80
3.....	.50	1.40	2.40	.30	.80	.40	.80	1.00	.60	.80	3.00	.80
4.....	.40	1.60	2.40	.30	1.00	.80	.80	1.80	.60	.80	2.00	.80
5.....	.40	1.60	2.40	.30	1.00	.60	3.00	1.40	.60	.80	1.00	1.00
6.....	.40	1.60	2.00	.30	1.00	.80	2.60	5.40	.60	.80	1.00	1.00
7.....	.40	1.60	1.60	.30	.80	.80	1.00	3.60	.60	.80	1.00	1.20
8.....	1.00	1.60	1.60	.30	.60	.80	.80	2.50	.70	.80	.80	1.20
9.....	1.00	1.60	1.40	.30	.60	1.00	.80	1.90	1.00	.80	.80	1.40
10.....	1.00	1.60	1.40	.30	.60	1.00	2.00	1.60	1.00	.80	.80	1.50
11.....	1.00	1.60	1.40	.30	.80	1.00	1.60	1.00	1.00	.80	.80	1.50
12.....	1.00	1.60	1.40	.30	.80	1.20	1.00	.60	.80	.80	.80	1.50
13.....	1.40	1.60	1.40	.20	.50	.80	2.00	.60	.60	.80	.80	2.00
14.....	1.40	1.80	1.40	.30	.50	.60	3.50	.60	.60	.80	.50	2.00
15.....	1.40	1.80	1.40	.80	.50	1.20	4.00	.60	.60	.80	.80	2.00
16.....	1.40	1.80	1.40	.80	.60	1.40	3.80	2.00	.60	.80	.80	2.50
17.....	1.40	1.80	1.40	.80	.60	1.00	4.00	1.50	.60	.80	.80	2.50
18.....	1.00	1.80	1.40	.60	.60	1.00	4.60	1.00	.60	.80	.80	2.50
19.....	1.00	2.00	.80	.60	.80	2.40	3.60	.80	.60	.80	.80	2.50
20.....	1.00	2.00	.60	.80	.80	.60	5.00	.80	.80	.80	.86	2.50
21.....	1.60	2.00	.60	.60	.60	.60	2.80	.80	.80	.80	.80	2.50
22.....	1.60	2.00	.60	.80	.60	1.20	2.00	.60	.80	.80	.80	2.50
23.....	1.80	2.00	.60	.60	.60	2.00	1.60	.60	.80	.80	2.20	3.00
24.....	1.40	2.00	.30	.60	.60	3.00	1.00	.60	.80	.80	1.10	3.00
25.....	1.40	2.40	.30	.40	.60	2.20	.80	.70	.80	.80	.80	3.00
26.....	1.40	2.40	.30	.60	.80	2.30	.80	.80	.80	.80	.80	3.00
27.....	1.40	2.40	.30	.60	.60	2.30	.80	.60	.80	.80	.80	3.00
28.....	1.60	2.40	.30	.60	.60	1.40	.80	.60	.80	.80	.80	3.00
29.....	1.60	-----	.50	.60	.80	1.00	3.00	.60	.80	.80	.80	3.00
30.....	1.80	-----	.50	.60	1.00	.80	1.60	.60	.80	.80	.80	3.00
31.....	1.40	-----	.40	-----	1.20	-----	2.80	.60	-----	.80	-----	3.60

ARKANSAS RIVER AT HUTCHINSON, KANSAS.

The Arkansas River, after crossing the Kansas and Colorado State line, is not systematically measured until Hutchinson, in about the center of the State, is reached. The station here was established May 13, 1895, and is located at the wagon bridge at the south end of Main street. The gage consists of an oak timber spiked to a pile a few feet above the bridge. Bench mark No. 1 is the upper crosspiece of the pier guard, with an elevation of 8.35 feet above zero of the gage. Bench mark No. 2 is the top of the iron doorsill of the first brick building next to the river, and its elevation is 8.12 feet above gage datum. The channel is straight for some distance above and below the bridge; the bed is sandy and very shifting. Results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 233; 1897, Nineteenth Annual Report, Part IV, page 361; 1898, Twentieth Annual Report, Part IV, page 343. Discharge measurements for 1899 were made by W. G. Russell, as follows:

May 2, gage height, 1.45 feet; discharge, 63 second-feet.

June 13, gage height, 3.95 feet; discharge, 2,790 second-feet.

June 14, gage height, 3.85 feet; discharge, 2,772 second-feet.

October 17, gage height, 1.20 feet; discharge, 30 second-feet.

*Daily gage height, in feet, of Arkansas River at Hutchinson, Kansas, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.80	2.00	2.15	2.20	1.50	1.40	2.10	2.95	1.60	1.30	1.70	1.70
2	1.90		2.50	2.20	1.55	1.35	2.10	2.80	1.50	1.20	1.70	1.70
3	1.95		2.95	2.20	1.60	1.50	2.20	2.75	1.50	1.20	1.65	1.70
4	2.00	2.00	2.85	2.15	1.65	2.30	2.20	2.65	1.50	1.20	1.55	1.70
5	2.00	(a)	2.90	2.15	1.60	2.15	2.15	2.60	1.50	1.20	1.50	1.70
6	2.00	(a)	3.15	2.20	1.60	2.00	2.10	2.55	1.50	1.20	1.50	1.70
7	1.90	(a)	3.20	2.20	1.50	2.00	2.20	2.55	1.50	1.20	1.50	1.70
8	1.90	(a)	3.25	2.20	1.50	2.65	2.20	2.60	1.50	1.20	1.50	1.70
9	2.00	(a)	3.00	2.20	1.50	3.10	2.05	2.55	1.50	1.20	1.50	1.70
10	2.00	(a)	2.90	2.15	1.60	3.30	2.00	2.80	1.55	1.20	1.50	1.70
11	1.70	(a)	3.05	2.05	1.55	3.35	2.00	4.15	1.50	1.20	1.50	1.70
12	1.70	(a)	2.85	2.00	1.50	4.35	1.95	3.80	1.50	1.20	1.50	1.80
13	1.70	(a)	2.80	2.00	1.45	3.90	1.90	3.65	1.40	1.20	1.50	1.90
14	1.70	(a)	2.90	1.90	1.40	3.80	1.90	3.60	1.40	1.20	1.50	1.90
15	1.70	(a)	2.90	1.85	1.40	3.65	1.90	3.35	1.40	1.20	1.50	1.90
16	1.80	(a)	2.65	1.80	1.40	3.30	1.85	3.05	1.45	1.20	1.50	2.00
17	1.80	2.30	2.60	1.80	1.40	2.90	1.80	2.75	1.50	1.20	1.50	2.00
18	2.10	2.30	2.60	1.80	1.40	2.65	1.80	2.55	1.50	1.20	1.50	2.00
19	2.10	2.15	2.50	1.70	1.40	2.45	1.80	2.50	1.40	1.20	1.50	2.00
20	2.10	2.05	2.50	1.70	1.40	2.40	1.80	2.35	1.40	1.20	1.50	2.00
21	2.00	2.10	2.50	1.70	1.40	2.25	1.95	2.20	1.40	1.20	1.50	2.00
22	2.00	2.25	2.50	1.65	1.50	2.20	3.95	2.20	1.40	1.20	1.60	2.00
23	2.00	2.30	2.45	1.60	1.50	2.30	4.55	2.15	1.40	1.20	1.70	2.00
24	2.10	2.30	2.40	1.60	1.55	2.30	4.35	2.00	1.30	1.20	1.70	2.00
25	2.00	2.30	2.35	1.60	1.50	2.35	4.45	1.90	1.30	1.50	1.70	2.00
26	2.00	2.30	2.30	1.60	1.40	2.40	4.05	1.90	1.30	1.75	1.70	1.90
27	2.10	2.25	2.45	1.60	1.40	2.40	3.70	1.80	1.30	1.80	1.70	1.80
28	2.10	2.15	2.35	1.55	1.40	2.40	3.35	1.75	1.30	1.80	1.70	1.80
29			2.20	1.50	1.40	2.30	3.25	1.70	1.30	1.80	1.70	1.80
30	2.00		2.20	1.50	1.40	2.15	3.20	1.65	1.30	1.80	1.70	1.80
31			2.25		1.30		3.20	1.60		1.80		1.80

*a* Frozen.

VERDIGRIS RIVER AT LIBERTY, KANSAS.

This river rises in the southeastern corner of Chase County, Kansas, and has a general southerly direction, passing out of the State near Coffeyville into Indian Territory. It enters Arkansas River 1 mile above the mouth of Grand, or Neosho, River near Fort Gibson.

It is essentially a surface run-off stream; its water is muddy, the fall flood large, the summer flow small, and the fluctuations in height rapid. There are a number of fine water powers located on the main stream and its various tributaries, and many of them were utilized several years ago. In the years 1880 to 1890 it is said that there were eleven dams on the Verdigris River, but at the present time not more than three or four are utilized. The drainage area is mapped on the Independence, Fredonia, Emporia, Eureka, Sedan, Eldorado, Cottonwood Falls, Parkerville, Newton, and Abilene atlas sheets. The station was established in August, 1895, and is located at a wagon bridge about 250 feet below McTaggart's mill dam, about 3 miles southwest of the town of Liberty, Kansas. The gage is a vertical timber fastened to the floor of the mill. Bench mark No. 1 is the heads of three large nails in the flume, and is at an elevation of 12.46 feet above the zero of the gage. Bench mark No. 2 is the head of a spike in the root of a cottonwood tree 40 feet south of the gage, and is at an elevation of 10.98 feet above gage datum. The bed is rocky, composed of gravel and subject to very little change. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 235; 1897, Nineteenth Annual Report, Part IV, page 369; 1898, Twentieth Annual Report, Part IV, page 344. The following discharge measurements were made by E. C. Murphy and W. G. Russell during 1899:

May 19, gage height, 3.03 feet; discharge, 311 second-feet.

June 10, gage height, 21.30 feet; discharge, 16,906 second-feet.

July 6, gage height, 21.50 feet; discharge, 16,505 second-feet.

October 11, gage height, 1.70 feet; discharge, 17 second-feet.

*Daily gage height, in feet, of Verdigris River at Liberty, Kansas, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1 ----	3.80	2.80	4.10	4.10	3.65	6.75	2.80	4.50	2.00	1.70	1.90	1.90
2 ----	3.70	2.70	3.80	4.10	3.75	5.15	2.80	4.20	2.00	1.70	1.90	1.90
3 ----	3.20	2.70	3.60	3.80	4.05	3.70	2.75	3.60	2.00	1.70	1.90	1.90
4 ----	3.00	2.70	3.50	3.60	7.35	5.55	12.40	3.15	2.00	1.70	1.90	1.90
5 ----	3.30	2.70	3.50	3.40	6.75	6.35	15.40	3.05	2.00	1.70	1.90	1.90
6 ----	3.30	2.70	3.40	3.60	4.70	8.60	15.95	2.80	2.00	1.70	1.90	1.90
7 ----	3.20	2.70	3.30	3.80	4.85	9.35	8.55	2.75	2.00	1.70	1.80	1.90
8 ----	3.20	2.60	3.20	4.10	5.05	5.80	26.90	2.60	2.00	1.70	1.80	1.90
9 ----	3.20	2.60	3.10	4.00	4.65	10.35	30.45	2.60	2.00	1.70	1.80	1.90
10 ----	3.10	2.60	3.20	3.80	4.45	21.45	19.75	2.50	2.00	1.70	1.80	1.90
11 ----	3.10	2.60	3.20	3.70	4.15	24.05	8.75	2.50	2.00	1.70	1.80	1.90
12 ----	3.10	2.60	7.10	3.60	4.00	24.75	4.90	2.50	2.00	1.70	1.80	2.00
13 ----	3.30	2.50	6.30	3.50	3.85	19.10	4.55	2.40	2.00	1.70	1.80	2.00
14 ----	3.20	2.50	6.00	4.30	3.65	9.15	4.25	2.75	2.00	1.70	1.80	2.00
15 ----	3.10	2.50	5.60	3.70	3.45	5.75	4.20	5.55	2.00	1.70	1.80	2.00
16 ----	3.20	2.50	5.90	3.30	3.20	7.50	4.25	3.40	2.00	1.70	1.80	2.00
17 ----	3.10	2.40	5.00	3.30	3.20	5.65	6.40	2.90	2.00	1.70	1.80	2.00
18 ----	3.20	2.40	4.80	3.70	3.00	4.80	7.65	2.65	2.00	1.70	1.80	2.00
19 ----	3.10	2.40	4.90	3.85	3.00	4.40	7.05	2.45	1.90	1.70	1.80	2.00
20 ----	3.00	2.40	5.80	7.15	6.60	4.05	7.20	2.40	1.90	1.60	1.90	1.90
21 ----	3.00	3.10	4.80	6.45	10.20	3.85	7.65	2.30	1.90	1.60	1.90	1.90
22 ----	3.00	3.20	4.60	8.45	5.10	3.60	7.70	2.30	1.90	1.60	1.90	1.90
23 ----	2.90	3.10	4.10	11.20	6.70	3.40	6.40	2.30	1.90	1.60	1.90	2.00
24 ----	2.90	3.00	3.90	6.50	14.65	3.25	4.75	2.20	1.90	1.60	1.90	2.00
25 ----	2.90	3.10	3.80	5.30	9.65	3.20	4.10	2.20	1.90	1.60	1.90	2.00
26 ----	3.00	6.60	3.70	4.70	4.80	3.35	3.85	2.20	1.80	1.90	1.90	2.00
27 ----	3.00	6.00	3.50	4.45	4.40	3.20	3.65	2.10	1.80	2.00	1.90	2.00
28 ----	3.00	4.50	3.50	4.25	4.00	3.05	3.45	2.10	1.80	2.00	1.90	2.10
29 ----	3.00	-----	3.40	4.35	4.00	3.00	3.15	2.00	1.70	2.00	1.90	2.10
30 ----	3.00	-----	3.70	3.80	3.70	2.85	3.10	2.00	1.70	2.00	1.90	2.10
31 ----	2.90	-----	4.10	-----	3.45	-----	3.85	2.00	-----	2.00	-----	2.10

NEOSHO RIVER AT IOLA, KANSAS.

This river drains a long, narrow strip in southeastern Kansas, extending into Indian Territory. The upper part of the basin has a general east-west direction, draining the area immediately south of Kansas River and north of the headwaters of Verdigris River. The general direction of the river bends gradually southward between Emporia and Iola, and that direction is maintained for the rest of its course. Neosho River in Indian Territory is known as Grand River. During the last season two gaging stations were maintained in the basin—one at Iola, the other at Fort Gibson, near the mouth. The former station was established in July, 1895, and is located at the highway bridge 1 mile west of the city of Iola, Kansas. The gage is fastened to the head gates of the flume about 90 feet above the bridge. The bench mark is the heads of three large nails driven into the cross-piece of the flume, and is 13.30 feet above the datum of the gage. Results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 238; 1897, Nineteenth Annual Report, Part IV, page 362; 1898, Twentieth Annual Report, Part IV, page 346. The following discharge measurements were made by E. C. Murphy and W. G. Russell during 1899:

- May 18, gage height, 2.70 feet; discharge, 242 second-feet.
- June 9, gage height, 18 feet; discharge, 27,959 second-feet.
- July 5, gage height, 8.20 feet; discharge, 6,313 second-feet.
- July 8, gage height, 16.70 feet; discharge, 25,849 second-feet.
- October 11, gage height, 2.30 feet; discharge, 316 second-feet.

*Daily gage height, in feet, of Neosho River at Iola, Kansas, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.00	2.70	3.60	3.85	3.10	4.50	2.80	2.80	2.70	2.30	2.00	2.00
2	2.90	2.60	3.55	3.70	3.10	5.20	2.80	2.70	2.70	2.30	2.00	2.00
3	2.90	2.60	3.60	3.70	3.00	4.45	3.00	2.70	2.60	2.30	2.00	2.00
4	2.80	2.60	3.60	4.20	3.10	4.80	12.50	2.70	2.60	2.30	2.00	2.00
5	2.80	2.60	3.65	4.40	3.10	6.30	8.90	2.60	2.60	2.30	2.00	2.00
6	2.80	2.60	3.70	4.00	3.00	7.95	5.80	2.50	2.50	2.30	2.00	2.00
7	2.80	2.60	3.70	3.85	3.10	6.60	14.00	2.60	2.50	2.30	2.00	2.00
8	2.70	2.60	3.60	3.60	3.10	5.55	16.50	3.05	2.45	2.30	2.00	2.00
9	2.70	2.60	3.50	3.60	3.10	17.03	9.80	2.90	2.40	2.25	2.00	2.00
10	2.80	2.50	3.50	3.50	3.15	15.70	6.60	2.80	2.40	2.20	2.00	2.00
11	2.80	2.50	4.90	3.50	3.30	11.40	4.50	2.70	2.40	2.20	2.00	2.00
12	2.80	2.50	11.05	3.40	3.50	11.50	3.75	2.60	2.40	2.20	2.00	2.10
13	2.90	2.50	6.05	3.40	3.40	9.20	3.25	2.50	2.40	2.20	2.00	2.10
14	2.90	2.60	5.45	3.40	3.40	5.60	3.00	2.50	2.40	2.20	2.00	2.10
15	2.90	2.70	5.00	3.40	3.25	4.75	3.65	2.50	2.40	2.20	2.00	2.10
16	2.90	2.80	4.50	3.30	3.00	4.40	4.65	2.55	2.40	2.20	2.00	2.10
17	2.90	2.90	4.85	3.20	2.90	4.20	4.80	3.30	2.40	2.10	2.00	2.20
18	2.90	2.95	7.55	3.20	2.85	4.10	4.10	3.00	2.40	2.10	2.00	2.20
19	2.80	3.10	5.85	3.10	2.85	4.05	3.60	2.80	2.40	2.10	2.00	2.20
20	2.80	3.15	5.40	4.50	2.90	3.85	3.95	2.80	2.40	2.10	2.00	2.20
21	2.80	3.20	5.15	4.05	2.90	3.70	5.35	2.60	2.40	2.10	2.00	2.20
22	2.80	3.30	4.65	3.80	2.90	3.60	6.40	2.60	2.40	2.10	2.00	2.20
23	2.80	3.40	4.10	3.75	4.65	3.50	3.50	2.60	2.40	2.10	2.00	2.10
24	2.80	3.60	3.85	3.60	6.60	3.25	3.35	2.50	2.40	2.10	2.00	2.10
25	2.80	3.95	3.65	3.50	4.90	3.15	3.05	2.50	2.40	2.00	2.00	2.10
26	2.80	5.95	3.55	3.40	6.95	3.10	3.00	2.60	2.40	2.00	2.00	2.10
27	2.80	4.70	3.70	3.30	6.55	3.05	2.85	2.60	2.40	2.00	2.00	2.10
28	2.70	3.90	3.90	3.20	4.45	3.00	2.80	2.60	2.40	2.00	2.00	2.10
29	2.70	4.20	3.10	3.10	3.85	2.90	2.70	2.85	2.40	2.00	2.00	2.10
30	2.70	4.20	3.10	3.10	3.70	2.80	2.70	2.85	2.40	2.00	2.00	2.10
31	2.70	3.95	3.95	3.25	3.25	2.70	2.75	2.75	2.40	2.00	2.00	2.10

## GRAND RIVER AT FORT GIBSON, INDIAN TERRITORY.

In its lower course through Indian Territory Neosho River is known as Grand River. The station was established by W. G. Russell, May 16, 1899, at the railroad bridge one-half mile north of the station at Fort Gibson and 3 miles above the mouth of the river. The rod is spiked to the ties of the bridge. The initial point for soundings is the left end of the bridge. The channel is straight for some distance both above and below the station. The right bank is liable to overflow, while the left is not, being high and rocky. The bed of the stream is sandy and shifting at the right side and toward the center. W. Blackwell, railroad pump man, is the observer. Two measurements of discharge were made here by W. G. Russell during 1899. The first one was on May 16, at a gage height of 15.00 feet, and showed a discharge of 19,823 second-feet; the second measurement was on October 12, with a gage height of 9.20 feet, and gave a discharge of 1,070 second-feet.

*Daily gage height, in feet, of Grand River at Fort Gibson, Indian Territory, for 1899.*

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		13.80	12.80	15.20	10.90	10.00	10.00	11.90
2		13.80	13.00	15.00	10.90	10.00	10.00	11.80
3		13.80	13.00	14.80	10.40	10.00	10.00	11.60
4		14.70	13.20	14.90	10.20	10.00	10.00	11.40
5		13.60	13.70	14.40	10.20	10.00	10.00	11.10
6		13.00	14.00	14.20	10.10	10.00	10.00	11.00
7		12.90	14.60	14.00	10.00	10.00	10.00	10.80
8		16.20	14.70	13.90	10.00	9.90	10.00	10.50
9		16.00	14.80	13.70	10.00	9.90	10.00	10.40
10		16.30	14.90	13.30	10.00	9.80	10.00	10.40
11		15.20	15.00	13.20	10.00	9.70	10.00	10.20
12		17.20	15.40	13.00	10.00	9.20	10.00	10.00
13		19.00	15.90	13.00	10.00	9.20	10.00	10.00
14		19.80	16.00	12.90	10.00	9.10	10.00	10.00
15		19.60	16.80	12.90	10.00	9.10	10.00	10.00
16	15.00	17.60	17.00	12.80	10.00	9.10	10.00	10.00
17	15.00	16.60	17.60	12.70	9.90	9.00	10.00	10.00
18	13.60	15.60	17.90	12.60	9.80	9.00	10.00	10.00
19	13.50	14.50	17.90	12.60	9.70	9.00	10.20	10.00
20	13.40	14.00	17.60	12.40	9.70	9.00	10.40	10.00
21	13.30	14.00	17.40	12.20	9.70	9.00	10.60	10.00
22	14.30	14.00	17.40	12.10	9.60	9.10	11.00	10.00
23	14.70	13.80	17.00	12.00	9.60	9.10	11.20	10.00
24	15.60	13.80	17.00	12.00	9.70	9.10	11.50	10.00
25	15.10	13.10	16.80	11.90	9.80	9.20	11.80	10.10
26	14.80	13.00	16.60	11.80	9.80	9.20	12.00	10.20
27	14.80	13.00	16.00	11.80	9.80	9.50	12.00	10.30
28	14.80	13.00	16.00	11.60	9.90	9.50	12.00	10.40
29	14.80	13.00	15.80	11.40	9.90	9.60	12.00	10.40
30	13.80	13.00	15.60	11.20	9.90	9.70	11.90	10.50
31	13.80		15.40	11.00		9.80		10.60

## NORTH FORK OF CANADIAN RIVER AT OKLAHOMA, OKLAHOMA.

This stream rises in the extreme northeast corner of the panhandle of Texas. Its general course across Oklahoma and Indian Territory is southeasterly, emptying into the main Canadian River 45 miles above its mouth. The basin is a long, narrow area located between Cimarron River on the north and the main Canadian River on the

south. Two gaging stations are maintained on the river, one at Oklahoma, Oklahoma, and the other at Eufaula, Indian Territory. The former station was established by W. G. Russell May 19, 1899, and is located at the highway bridge, east of the Atchison, Topeka and Santa Fe Railroad bridge, one-half mile south of the town. The right bank is high, but the left is low and liable to overflow. H. E. Smith, a farmer living near by, is the observer. Two measurements of discharge were made by W. G. Russell during 1899, as follows: The first, on May 19, at a gage height of 5.50 feet, gave a discharge of 395 second-feet; the second, on October 15, at a gage height of 2.80 feet, showed a discharge of 22 second-feet.

*Daily gage height, in feet, of North Fork of Canadian River at Oklahoma, Oklahoma, for 1899.*

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		6.10	5.10	9.30	3.30	3.10	3.40	5.50
2		5.90	5.00	8.60	3.20	3.10	3.30	5.50
3		5.70	4.90	8.00	3.30	3.00	3.10	5.40
4		5.60	4.80	7.60	3.20	3.00	3.10	5.30
5		6.20	4.70	7.10	3.20	2.90	3.30	5.20
6		6.50	4.60	6.90	3.20	2.90	3.50	5.10
7		6.20	4.50	6.20	3.20	2.90	3.60	5.00
8		6.90	4.50	5.90	3.20	2.90	3.60	4.10
9		6.20	4.30	5.60	3.10	2.90	3.70	5.20
10		5.90	4.30	5.40	3.30	2.90	3.70	5.10
11		6.50	4.50	5.30	3.20	2.90	3.70	4.90
12		8.00	5.00	5.20	3.10	2.80	3.80	4.80
13		9.30	5.20	5.00	3.10	2.80	3.90	4.70
14		7.80	5.10	4.90	3.00	2.80	4.00	4.60
15		8.00	4.60	4.80	3.00	2.80	4.20	4.50
16		11.10	4.50	4.70	3.00	2.80	4.60	4.40
17		11.00	4.40	4.60	3.00	2.80	5.00	4.40
18		9.40	6.00	4.40	3.10	2.80	5.20	4.40
19	5.50	8.80	4.50	4.30	3.00	2.70	6.00	4.30
20	5.40	8.00	4.30	4.30	3.00	2.70	12.10	4.30
21	5.30	7.80	4.30	4.20	3.00	2.70	13.60	4.60
22	5.20	7.20	5.00	4.10	3.00	2.70	13.50	4.60
23	5.20	7.00	4.80	4.00	3.00	2.60	12.60	4.50
24	5.10	6.80	6.00	3.11	3.60	2.60	7.90	4.40
25	5.60	6.50	6.30	3.10	3.60	2.90	6.00	4.30
26	5.70	6.10	7.50	3.90	3.50	3.00	5.90	4.30
27	6.40	5.90	7.60	3.80	3.40	3.50	5.80	4.20
28	6.40	5.70	8.50	3.70	3.30	4.00	5.70	4.20
29	6.20	5.50	9.60	3.60	3.30	3.00	5.60	4.10
30	5.80	5.30	10.20	3.50	3.30	4.00	5.60	4.10
31	6.20		10.30	3.40		3.70		4.20

NORTH FORK OF CANADIAN RIVER AT EUFAULA, INDIAN TERRITORY.

This station was established by W. G. Russell May 17, 1899, and is located at the railroad bridge of the Missouri, Kansas and Texas Railroad, 5 miles above the mouth of the river and 2 miles north of the town of Eufaula. The channel is straight for some distance both above and below the station. The right bank is high, but the left bank is low and liable to overflow. The bed of the stream is sandy and shifting. H. Erwin, railroad pump man, is the observer. Two measurements of discharge were made during 1899 by W. G. Russell: The first, on May 17, with a gage height of 24.00 feet, gave a discharge of 19,072 second-feet; the second, on October 13, with a gage height of 9.50 feet, gave a discharge of 154 second-feet.

*Daily gage height, in feet, of North Fork of Canadian River at Eufaula, Indian Territory, for 1899.*

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		12.00	11.60	12.00	10.50	10.00	10.00	11.50
2		12.00	11.60	11.60	10.50	9.80	9.80	11.50
3		11.60	11.50	11.60	10.50	9.80	9.70	11.50
4		11.60	11.00	11.50	10.50	9.60	9.50	11.50
5		11.60	11.00	12.00	10.30	9.50	9.50	11.50
6		10.00	10.60	12.00	10.40	9.50	9.50	11.50
7		10.50	13.50	12.00	10.40	9.50	9.50	11.50
8		11.50	10.60	12.00	10.30	9.50	9.40	11.50
9		11.60	10.60	11.60	10.00	9.50	9.40	11.50
10		12.00	10.60	11.60	10.00	9.50	9.40	11.50
11		14.00	11.00	11.50	10.00	9.50	9.30	11.50
12		14.00	11.60	11.50	10.00	9.50	9.40	11.50
13		13.00	12.00	11.50	10.00	9.50	9.40	11.40
14		11.00	12.50	11.50	10.00	9.50	9.40	11.40
15		12.00	12.50	11.50	10.00	9.50	9.30	10.40
16		13.00	11.50	11.40	10.00	9.40	9.20	10.40
17	24.00	14.00	11.00	11.00	10.00	9.40	9.20	10.30
18	23.60	15.00	10.60	11.00	10.00	9.50	9.20	10.50
19	23.00	17.00	11.00	11.00	10.00	9.50	9.20	11.00
20	22.50	20.00	12.60	11.00	10.00	9.40	9.20	11.00
21	21.30	20.00	13.00	11.00	10.00	9.40	9.50	11.00
22	20.50	19.00	13.00	11.00	10.00	9.30	9.60	11.40
23	19.90	16.00	14.00	10.80	10.00	9.20	10.50	11.50
24	20.50	13.00	16.00	10.80	10.00	9.20	10.70	11.50
25	19.60	12.50	18.00	10.80	10.00	9.30	12.00	11.50
26	18.60	12.00	11.50	10.80	10.00	9.30	12.50	11.50
27	18.00	11.50	11.00	10.80	10.00	9.60	12.50	11.30
28	17.60	11.50	11.00	10.70	10.00	10.20	12.50	11.00
29	15.00	11.00	12.00	10.70	10.00	10.00	12.30	10.00
30	12.50	11.50	12.00	10.60	10.00	10.00	12.30	10.00
31	12.00		12.00	10.60		10.00		9.60

WASHITA RIVER AT PAULS VALLEY, INDIAN TERRITORY.

This river rises in the eastern edge of the Texas Panhandle, immediately south of Canadian River. Its general direction is southeasterly through Oklahoma Territory, and then into Indian Territory, emptying into Red River about 11 miles above the crossing of the Missouri, Kansas and Texas Railroad. The gaging station was established by W. G. Russell on May 20, 1899, and is located at the high-way bridge, 2 miles east of the town of Pauls Valley, Indian Territory. The channel is straight for some distance above and below the station; the right bank is low and liable to overflow, but the left bank is high. The bed of the stream is sandy and shifting. Two measurements of discharge were made at this point by W. G. Russell in 1899: The first, on May 20, with a gage height of 8.50 feet, gave a discharge of 684 second-feet; the second, made on October 15, at a gage height of 4.60 feet, gave a discharge of 96 second-feet.

*Daily gage height, in feet, of Washita River at Pauls Valley, Indian Territory, for 1899.*

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		7.60	7.30	12.80	5.40	5.10	6.00	8.50
2		6.80	7.20	9.90	5.40	5.00	5.80	8.00
3		6.50	7.00	8.90	5.30	4.90	5.50	7.80
4		6.50	7.00	8.20	5.10	4.80	5.40	7.60
5		6.20	7.00	7.80	5.00	4.80	5.30	7.50
6		6.40	6.90	7.70	5.00	4.70	5.20	7.40
7		7.30	6.80	7.70	5.00	4.70	5.10	7.00
8		8.80	8.30	7.60	4.90	4.70	5.00	6.80
9		7.70	9.50	7.20	5.90	4.70	4.90	7.00
10		7.50	8.50	7.00	4.90	4.70	4.80	7.40
11		9.40	7.70	7.80	4.90	4.70	4.80	7.40
12		8.80	7.00	6.80	4.90	4.70	4.80	7.50
13		9.00	6.90	6.70	4.90	4.60	4.80	7.50
14		9.50	9.00	6.60	4.90	4.50	4.80	7.50
15		10.70	9.10	6.50	4.90	4.60	4.70	8.60
16		11.50	8.50	6.30	4.90	4.60	4.70	8.00
17		12.70	8.00	6.10	5.00	4.60	4.80	7.40
18		16.20	7.50	6.00	5.20	4.60	7.00	7.50
19		15.70	8.90	6.00	5.70	4.50	14.55	7.20
20	8.50	13.70	8.00	5.90	5.50	4.50	20.70	7.00
21	7.90	12.20	7.50	5.80	5.40	4.50	20.70	6.80
22	7.80	11.40	8.90	5.70	5.20	4.50	19.80	6.50
23	7.40	10.50	9.00	5.70	5.20	4.50	19.05	6.60
24	7.40	9.10	9.50	5.80	5.00	4.50	15.75	6.50
25	7.20	8.20	9.30	5.70	6.00	4.70	14.25	6.40
26	7.00	8.00	9.40	5.70	5.70	5.00	15.60	6.30
27	6.90	7.80	8.30	5.50	5.50	6.00	16.50	6.60
28	6.80	7.30	7.80	5.50	5.30	7.50	13.90	6.50
29	6.80	7.50	9.30	5.50	5.30	6.50	11.30	6.50
30	7.00	7.80	12.70	5.40	5.20	6.40	9.00	6.40
31	7.70		14.00	5.40		6.30		6.00

TRINITY RIVER AT DALLAS, TEXAS.

This river rises in Montague and Cooke counties, in northern Texas, the headwater streams draining the area within a few miles of Red River on the north. The general course of Trinity River is southeasterly, and it empties into the Gulf of Mexico at Galveston. The entire basin is located in Texas. The station, established October 1, 1898, is located at Turtle Creek pump house, 3 miles north of the court-house in Dallas. The height of the water is indicated by a pointer which slides up and down in the well of the pump house. This well is connected with the river by a pipe. Measurements of discharge are made by wading. The channel is practically straight above and below the point of measurement. The right bank is high, the left bank low and liable to overflow. The bed of the stream is of gravel and shifting. There was no discharge of the river from June 22 to October 30. Three discharge measurements were made during 1899 by Thomas U. Taylor, as follows: The first one, on June 20, at a gage height of 57 feet, gave a discharge of 269 second-feet; June 22, a gage height of 53.30 feet gave a discharge of 0 second-feet; the third measurement was on December 29, at a gage height of 56.60 feet, and gave a discharge of 336 second-feet.

*Daily gage height, in feet, of Trinity River at Dallas, Texas, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	55.50	55.25	55.50	54.20	57.45	55.50	64.60	56.20	52.65	50.35	60.25	59.75
2	55.40	54.90	55.85	54.20	56.85	55.40	63.25	55.75	52.25	50.35	60.45	56.70
3	55.40	54.55	55.80	54.20	56.60	55.30	58.60	55.45	51.80	50.00	60.55	56.45
4	55.40	54.40	55.45	54.20	56.30	55.20	59.05	55.20	51.40	50.25	58.80	56.25
5	55.30	54.60	55.45	54.30	55.85	55.20	63.20	55.20	51.05	49.95	57.30	56.05
6	55.25	54.95	55.00	54.80	55.70	55.15	73.35	54.95	50.25	50.20	56.05	56.00
7	55.15	54.85	54.40	54.65	57.10	55.00	69.60	54.80	51.15	50.20	55.70	56.00
8	55.30	54.65	54.65	54.50	57.50	55.00	59.45	54.80	51.05	50.25	55.55	56.00
9	55.65	54.65	54.45	54.50	58.75	54.95	57.25	54.75	50.80	50.25	55.40	56.05
10	55.55	54.80	53.95	54.50	61.10	55.60	56.75	54.65	49.80	50.30	55.30	56.20
11	55.75	54.40	53.90	54.70	59.00	56.45	56.55	54.55	51.05	50.35	55.15	56.35
12	55.65	54.25	53.90	54.95	59.75	61.70	56.30	54.75	51.20	50.30	54.95	57.75
13	56.30	54.45	54.10	55.00	58.05	62.55	56.20	54.60	51.15	49.75	54.95	59.80
14	59.10	54.55	54.55	54.65	57.55	58.75	56.45	54.50	51.00	50.25	54.95	61.20
15	58.15	54.95	54.35	54.95	57.70	57.95	56.05	54.40	51.15	50.30	54.95	61.80
16	57.50	54.45	54.10	55.80	57.70	57.65	55.70	54.35	50.95	50.30	55.00	60.60
17	56.85	54.80	54.00	56.70	57.75	59.65	55.40	54.35	51.35	50.05	54.60	58.85
18	56.45	54.55	54.65	57.10	58.00	61.10	55.30	54.40	51.40	50.00	54.25	57.55
19	56.05	54.90	54.40	56.60	57.80	58.25	55.45	54.20	50.35	50.00	54.05	56.85
20	55.70	54.45	54.00	56.30	56.95	57.20	55.80	53.75	50.65	50.00	58.20	56.50
21	55.55	54.30	53.95	55.90	56.80	58.20	55.30	53.40	51.30	49.90	67.30	56.50
22	55.45	54.75	54.25	55.65	56.80	58.40	58.25	53.05	51.30	49.80	71.05	57.30
23	55.50	54.40	54.10	55.50	56.80	58.55	57.50	52.75	51.40	49.80	65.45	57.70
24	55.55	54.05	54.05	55.55	57.00	58.60	57.30	52.40	51.10	49.80	62.75	58.40
25	55.40	54.50	54.15	55.60	57.95	57.90	56.65	52.00	50.38	49.80	64.20	57.35
26	55.15	54.40	54.20	57.30	58.00	56.95	56.20	51.55	49.80	49.80	68.10	57.15
27	55.00	54.20	54.25	58.30	58.00	56.40	55.80	51.85	50.25	49.80	71.90	57.25
28	55.20	54.05	54.45	58.55	57.60	56.00	57.10	52.00	50.15	49.95	74.55	56.80
29	55.30	-----	-----	58.55	56.85	55.90	56.45	52.15	50.00	50.15	76.00	56.55
30	55.25	-----	54.25	58.00	55.85	59.20	55.85	52.35	50.10	53.10	74.45	56.40
31	55.30	-----	54.20	-----	55.65	-----	56.10	52.50	-----	59.30	-----	-----

BRAZOS RIVER AT WACO, TEXAS.

This river has its source in the Staked Plains region of western Texas, and has a general southeasterly course, emptying into the Gulf of Mexico south of the mouth of Trinity River. Its drainage basin is entirely within the State of Texas. The gaging station, established by T. U. Taylor September 14, 1898, is located at the Austin street bridge, northwest of Waco. The gage is inclined, the channel straight, and the banks high. The bed of the stream is of shifting sand. Measurements of discharge have been made under the suspension bridge above the railroad bridge. Under the former, at low water, is a sand bar, which does not, however, affect the reliability of the measurements, as there are then two distinct channels. Three measurements of discharge were made in 1899 by Thomas U. Taylor: The first, on June 19, at a gage height of 18.50 feet, showed a discharge of 58,700 second-feet; the measurement of June 26, at a gage height of 6.90 feet, gave a discharge of 4,430 second-feet; while the third measurement, on December 30, at a gage height of 4.90 feet, showed a discharge of 2,085 second-feet.

Daily gage height, in feet, of Brazos River at Waco, Texas, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.70	2.30	2.20	1.80	2.10	6.00	α15.00	5.30	2.45	1.10	7.10	5.30
2	2.65	2.35	2.25	1.90	2.05	5.45	17.00	5.00	2.40	1.10	6.65	4.90
3	2.60	2.40	2.20	1.90	2.00	4.75	12.45	4.90	2.30	1.10	6.10	4.45
4	2.50	2.40	2.20	1.90	2.40	4.25	11.25	4.70	2.40	2.00	5.65	4.20
5	2.50	2.40	2.15	1.90	2.70	4.00	14.85	4.20	2.30	2.00	5.30	4.05
6	2.50	2.35	2.10	2.20	2.70	3.70	12.60	3.95	2.30	2.00	5.00	3.95
7	2.60	2.40	2.10	2.10	2.60	3.85	12.20	3.75	2.30	2.00	4.75	3.85
8	2.50	2.25	2.00	2.10	2.60	7.40	10.10	3.60	2.30	1.90	4.35	3.85
9	2.50	2.25	2.20	2.10	2.55	10.30	9.00	3.60	2.20	1.90	4.10	3.95
10	2.50	2.40	2.05	2.10	3.15	9.45	8.40	3.50	2.20	1.95	3.85	4.25
11	2.50	2.40	2.00	2.05	5.10	7.95	8.35	3.40	2.15	1.95	3.70	6.45
12	2.50	2.30	1.95	1.95	5.25	7.40	7.50	3.30	2.10	1.90	3.60	9.75
13	2.50	2.30	1.90	1.80	5.75	7.10	6.95	3.20	2.10	1.90	3.50	8.60
14	2.50	2.30	2.00	1.90	4.70	6.60	6.50	3.15	2.10	1.90	3.40	7.55
15	2.60	2.30	2.00	5.90	4.05	6.30	6.25	3.10	2.10	1.90	3.30	6.70
16	2.45	2.30	2.00	2.75	4.20	6.60	5.90	3.00	2.05	1.90	3.20	6.00
17	2.40	2.40	2.00	2.55	4.30	10.00	5.70	3.00	2.10	1.90	3.15	5.80
18	2.40	2.40	2.00	2.60	6.20	6.55	5.65	2.95	2.15	1.90	3.10	5.70
19	2.45	2.40	2.10	2.45	5.55	18.50	5.40	2.90	2.10	1.90	3.30	5.15
20	2.50	2.35	1.95	2.40	4.80	20.70	5.20	2.80	2.10	1.90	5.90	4.95
21	2.50	2.30	1.90	2.35	4.20	18.05	5.15	2.80	2.30	1.90	19.85	5.85
22	2.55	2.30	1.90	2.30	4.10	10.25	5.00	2.70	2.65	1.90	21.85	9.40
23	2.40	2.30	1.80	2.30	3.75	9.10	5.30	2.70	2.45	1.90	11.85	6.55
24	2.50	2.30	1.90	2.20	4.50	8.20	9.95	2.70	2.40	1.90	8.90	6.20
25	2.50	2.30	1.80	2.20	6.40	7.35	9.00	2.60	2.30	1.95	8.40	6.10
26	2.40	2.30	1.90	2.15	5.85	6.85	8.30	2.55	2.40	2.25	7.25	5.75
27	2.40	2.30	1.90	2.20	5.45	6.30	7.25	2.50	2.40	2.55	6.70	5.50
28	2.40	2.20	1.90	2.20	5.05	6.10	6.60	2.50	2.35	2.50	6.20	5.05
29	2.35	-----	1.85	2.10	5.00	α9.00	6.10	2.50	2.20	9.15	5.60	4.95
30	2.40	-----	1.80	2.05	7.25	α12.00	5.90	2.50	-----	11.00	5.45	4.85
31	2.30	-----	1.80	-----	6.50	-----	5.70	2.50	-----	8.30	-----	4.70

α Estimated.

BRAZOS RIVER AT LEWIS, TEXAS.

This station, established by Thomas U. Taylor February 22, 1898, is at the International and Great Northern Railroad bridge about 1¼ miles southwest of the town of Lewis, Texas, and about 75 miles below the station at Waco. After the establishment of the Waco station the one at Lewis was not of much importance, and was discontinued February 25, 1899. No measurements of discharge were made here during 1899.

Daily gage height, in feet, of Brazos River at Lewis, Texas, for 1899.

Day.	Jan.	Feb.									
1	4.40	4.30	9	4.50	4.20	17	4.60	4.20	25	4.30	4.20
2	4.40	4.25	10	4.60	4.20	18	4.45	4.20	26	4.25	-----
3	4.35	4.20	11	4.80	4.20	19	4.40	4.20	27	4.20	-----
4	4.30	4.20	12	5.15	4.20	20	4.40	4.20	28	4.15	-----
5	4.40	4.20	13	5.45	4.20	21	4.40	4.20	29	4.05	-----
6	4.70	4.10	14	6.25	4.20	22	4.35	4.20	30	4.15	-----
7	4.55	4.15	15	5.10	4.20	23	4.25	4.20	31	4.20	-----
8	4.50	4.20	16	4.85	4.20	24	4.20	4.20			

Station discontinued February 25.

## COLORADO RIVER AT AUSTIN, TEXAS.

This river drains a large area in central Texas. It rises in the extreme western portion of the State, within a few miles of the western boundary of New Mexico, and flows in a general southeasterly direction, emptying into the Gulf of Mexico in Matagorda County. Its head-water tributaries drain the country immediately south of the Brazos River. Llano Creek is a tributary of Colorado River and empties into it 85 miles above Austin. On March 14, 1899, this stream was measured one-half mile west of the station at Llano, Texas, and showed a discharge of 76 second-feet; a second measurement was made below on this creek, 200 yards above its junction with the Colorado River at Kingsland, on the same date, which also showed a discharge of 76 second-feet. On March 13 the main Colorado River, at a short distance below the wagon bridge near Marble Falls, Texas, showed a discharge of 197 second-feet. The river was also measured four times at the head of Lake McDonald, about 20 miles above Austin. On January 31 it showed a discharge of 210 second-feet; on October 3 the discharge was 134 second-feet; on October 4 the discharge was also 134 second-feet; and on the same date, at another section near by, the discharge was 136 second-feet. On March 15 two measurements were made at the power house at the Austin dam. The first measurement was in the fore bay, and showed a discharge of 206 second-feet; immediately afterwards the tailrace was measured and showed a discharge of 233 second-feet. The station maintained during 1899 is located at the Congress avenue bridge, south of the city of Austin. The gage rod is a vertical timber attached to a bath house near by. The bench mark is on the first flange above the crib-work of the north pier of the highway bridge, and is 4.78 feet above the zero of the gage. The following measurements of discharge were made by Thomas U. Taylor during 1899:

- March 17, gage height, 1.70 feet; discharge, 267 second-feet.
- March 31, gage height, 1.50 feet; discharge, 170 second-feet.
- November 10, gage height, 1.71 feet; discharge, 476 second-feet.
- November 16, gage height, 1.50 feet; discharge, 386 second-feet.
- November 28, gage height, 2.36 feet; discharge, 1,156 second-feet.
- December 5, gage height, 2.02 feet; discharge, 686 second-feet.

*Daily gage height, in feet, of Colorado River at Austin, Texas, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.90	2.00	1.85	1.45	2.05	3.60	3.85	3.10	1.45	1.05	2.80	2.65
2	1.85	1.95	1.85	1.45	2.05	3.20	3.35	2.45	1.45	1.05	2.35	2.50
3	1.85	1.90	1.75	1.45	2.00	2.95	3.55	2.30	1.45	.90	2.10	2.50
4	1.95	2.05	1.85	1.45	2.10	3.55	3.50	1.95	1.45	.85	2.10	2.20
5	1.95	1.95	1.85	1.55	2.00	3.15	3.65	1.80	1.45	.90	1.95	2.05
6	1.95	1.90	1.85	1.50	2.05	2.85	3.45	1.70	1.40	.90	1.95	2.05
7	1.85	1.90	1.90	1.50	1.95	11.35	3.15	1.75	1.40	.85	2.00	2.05
8	1.95	1.85	1.80	1.45	1.85	21.05	2.95	1.75	1.40	.80	1.90	2.40
9	1.95	1.90	1.85	1.45	1.95	17.60	3.60	1.65	1.40	.85	1.80	2.75
10	1.95	1.90	1.80	1.45	2.00	14.75	3.25	1.65	1.35	.90	1.75	3.45
11	1.95	1.90	1.75	1.45	2.00	9.00	3.00	1.65	1.35	.90	1.70	6.40
12	2.05	2.10	1.75	1.45	4.10	5.30	2.80	1.55	1.35	.90	1.65	5.35
13	1.95	1.95	1.75	1.50	7.95	4.45	2.65	1.55	1.35	.90	1.60	4.30
14	1.90	1.80	1.75	1.55	7.10	4.10	2.50	1.55	1.35	.90	1.65	3.70
15	1.85	1.75	1.80	1.50	5.30	3.60	2.30	1.55	1.35	.90	1.60	3.35
16	1.90	1.80	1.80	1.50	4.55	3.75	2.15	1.55	1.35	.90	1.55	3.05
17	1.90	1.85	1.75	1.55	3.85	4.40	2.05	1.55	1.35	.85	1.50	2.85
18	1.95	1.80	1.75	1.65	3.40	5.90	2.00	1.55	1.35	.95	1.45	2.70
19	1.95	1.75	1.75	1.80	3.20	6.60	2.00	1.55	1.30	1.45	1.75	2.60
20	1.90	1.75	1.70	1.90	3.00	6.15	2.00	1.65	1.30	.95	2.00	2.65
21	1.90	1.75	1.65	3.95	2.75	4.90	1.90	1.55	1.25	.90	5.35	2.75
22	1.90	1.75	1.65	3.80	2.45	6.00	1.85	1.55	1.25	.90	6.35	2.90
23	1.90	1.85	1.60	3.45	4.20	5.15	1.80	1.55	1.15	.90	4.55	4.05
24	1.90	1.90	1.60	3.05	4.05	4.15	1.80	1.55	1.15	1.40	5.65	3.90
25	1.95	1.85	1.60	2.85	4.75	3.75	1.75	1.55	1.10	1.35	3.00	3.40
26	1.90	1.85	1.60	2.65	4.50	3.45	2.35	1.55	1.15	1.45	2.65	3.05
27	1.90	1.85	1.60	2.55	5.05	3.15	2.45	1.55	1.15	1.55	2.55	2.85
28	1.90	1.75	1.60	2.45	4.85	2.95	2.20	1.55	1.15	2.30	2.35	2.75
29	1.90	-----	1.55	2.35	4.10	2.85	3.30	1.55	1.15	3.35	2.35	2.70
30	1.90	-----	1.45	2.25	3.70	2.75	4.25	1.55	1.05	2.90	2.95	2.55
31	1.95	-----	1.50	-----	3.35	-----	3.60	1.55	-----	3.10	-----	-----

## GUADALUPE RIVER AT NEW BRAUNFELS, TEXAS.

This river drains a small area in central Texas. Its source is in Kerr County, and it has a general southeasterly direction, emptying into the Gulf of Mexico in Calhoun County. At New Braunfels it receives Comal River, which is the principal source of supply for the upper Guadalupe. Comal River is simply the outlet of a series of large springs near New Braunfels and is only about 3 miles long. These springs maintain a very constant flow throughout the entire year. Comal River is described in Bulletin 140, page 84. The gaging station at New Braunfels is about 1 mile east of the town, near the highway bridge, and below the International and Great Northern Railroad bridge, and was established March 13, 1898. It is located below the mouth of Comal River, and hence includes the flood waters of the main Guadalupe besides the very equable discharge of Comal River. Two measurements of discharge were made by Thomas U. Taylor during 1899: The first, on March 16, with a gage height of 1.80, showed a total discharge of the two channels of 358 second-feet; the second one, on December 23, with a gage height of 2.70 feet, gave a discharge of 797 second-feet.

*Daily gage height, in feet, of Guadalupe River at New Braunfels, Texas, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1 ----	1.80	1.80	1.80	1.80	1.80	1.90	3.65	2.00	1.80	1.70	2.40	2.00
2 ----	1.80	1.80	1.80	1.80	1.80	1.90	2.65	2.00	1.80	1.70	2.30	2.00
3 ----	1.80	1.80	1.80	1.80	1.80	1.85	2.45	1.90	1.80	1.70	2.05	2.00
4 ----	1.80	1.80	1.80	1.80	2.15	1.80	2.35	1.90	1.80	1.70	2.00	1.90
5 ----	1.80	1.80	1.80	1.85	2.05	1.80	2.60	1.90	1.80	1.70	2.00	1.90
6 ----	1.80	1.80	1.80	1.90	1.85	3.85	2.60	1.90	1.80	1.70	2.00	1.90
7 ----	1.80	1.80	1.80	1.80	1.80	3.25	2.50	1.90	1.80	1.70	1.90	1.95
8 ----	1.80	1.80	1.80	1.80	1.80	16.00	2.45	1.90	1.80	1.70	1.90	2.65
9 ----	1.80	1.80	1.80	1.80	1.80	8.00	2.30	1.85	1.80	1.70	1.90	2.60
10 ----	1.80	1.80	1.80	1.80	1.80	4.20	2.30	1.80	1.80	1.70	1.90	2.30
11 ----	1.80	1.80	1.80	1.80	2.65	3.55	2.25	1.80	1.80	1.70	1.90	2.20
12 ----	1.80	1.80	1.80	1.80	2.10	3.10	2.20	1.80	1.80	1.70	1.90	2.20
13 ----	1.80	1.80	1.80	1.80	1.95	3.45	2.10	1.80	1.80	1.70	1.60	2.10
14 ----	1.80	1.80	1.80	1.80	1.90	3.00	2.10	1.80	1.80	1.70	1.90	2.10
15 ----	1.80	1.80	1.83	1.85	1.90	2.75	2.10	1.80	1.80	1.70	1.90	2.00
16 ----	1.80	1.80	1.80	1.85	1.90	2.55	2.10	1.80	1.80	1.70	1.90	2.00
17 ----	1.80	1.80	1.80	1.80	1.90	4.45	2.00	1.80	1.80	1.70	1.80	2.00
18 ----	1.80	1.80	1.80	1.80	1.90	3.05	2.00	1.80	1.80	1.70	1.80	2.10
19 ----	1.80	1.80	1.80	1.80	1.80	3.15	2.00	1.80	1.80	1.70	1.90	2.25
20 ----	1.80	1.80	1.80	1.95	1.80	2.85	1.90	1.80	1.80	1.70	2.15	2.40
21 ----	1.80	1.80	1.80	2.45	1.80	2.60	1.90	1.80	1.80	1.90	2.10	2.65
22 ----	1.80	1.80	1.80	2.20	1.80	2.50	1.90	1.80	1.80	2.00	2.10	2.80
23 ----	1.80	1.80	1.80	2.00	4.20	2.45	1.90	1.80	1.80	2.00	2.30	2.70
24 ----	1.80	1.80	1.80	2.00	2.90	2.40	1.90	1.80	1.80	2.00	2.30	2.55
25 ----	1.80	1.80	1.80	2.00	2.50	2.40	2.00	1.80	1.80	2.00	2.30	2.40
26 ----	1.80	1.80	1.80	2.00	2.30	2.30	2.00	1.80	1.75	2.00	2.10	2.30
27 ----	1.80	1.80	1.80	1.90	2.05	2.20	2.00	1.80	1.70	2.15	2.10	2.30
28 ----	1.80	1.80	1.80	1.80	2.00	2.20	4.50	1.80	1.70	6.15	2.00	2.20
29 ----	1.80	-----	1.80	1.80	2.00	2.15	3.35	1.80	1.70	3.30	2.00	2.20
30 ----	1.80	-----	1.80	1.80	2.00	2.10	2.20	1.80	1.70	2.70	2.00	2.20
31 ----	1.80	-----	1.80	-----	1.90	-----	2.00	1.80	-----	2.45	-----	-----

#### LEONA RIVER AT UVALDE, TEXAS.

In former years there was located in the southern suburbs of Uvalde a large spring with constant flow, known as "Leona spring." This spring was dry but once between 1870 and 1893, viz, in 1885. It soon revived, however, and continued flowing up to 1893, when the discharge stopped, and no water has issued from it since that date. The water in the wells in the vicinity in 1884 was 25 feet below the surface of the ground, but in 1899 the level was about 50 feet below the surface. A pumping station was located on the banks of Leona River, near Leona spring, in 1893, but after one or two years the river failed to such an extent that the entire pumping plant was moved to within 150 yards of the court-house at Uvalde. At the new station a 15 by 15 foot pit was excavated 24 feet deep, and the pumps were placed at the bottom of this pit, and then a well 4 by 7 feet square was sunk from this level to a depth of 16 feet, out of which the water was pumped into a standpipe. The water at first rose in this well to within 35 feet of the ground surface. In December, 1897, it was noticed that the supply was failing, and this continued until May, 1898, when a second pit, 10 by 10 feet, and 9 feet deep, was excavated on the southwest side of the first pit, and the well was also lowered until its bottom was 63 feet below the ground surface; when the pumps were finally lowered, their new position was 33 feet below the surface. In January, 1899, it was found necessary to sink three small drill wells in the bottom of the main pump well to a depth of

30 to 35 feet, reaching a total depth of 98 feet from the surface of the ground.

Leona River, in 1895, was found by Mr. Cyrus C. Babb to be dry under the railroad bridge, but at the crossing  $1\frac{1}{2}$  miles south of the town a discharge of 11 second-feet was found. The river ceased flowing at this crossing in January, 1898. About June 15, 1899, heavy rains fell over Uvalde and Kinney counties, raising the Leona River to a flowing depth of 6 to 8 feet. Notwithstanding this, on June 28, 1899, when visited by Thomas U. Taylor, the river was dry at the crossing above referred to. The bed of the stream was followed to the head of the upper irrigation ditch about 4 miles below the town of Uvalde, but no flowing water was found. The only irrigation along Leona River in 1899 was done through the agency of a steam pump 10 or 12 miles below Uvalde.

#### LAS MORAS SPRING, NEAR BRACKETTVILLE, TEXAS.

This spring is located at Fort Clark, near Brackettville, 10 miles distant from Spofford, on the Southern Pacific Railroad. The discharge from this spring was measured by Prof. Thomas U. Taylor on June 30, 1899, when 60 second-feet was found. A measurement on December 24, 1895, near the same point, by Cyrus C. Babb, showed a discharge of 21 second-feet.

#### SAN FELIPE SPRINGS, NEAR DEL RIO, TEXAS.

San Felipe Creek has its source in four large springs, the upper one being 2 miles above the railroad bridge near Del Rio, the others being within about 200 yards of the bridge. On June 29, 1899, the creek was measured by Prof. Thomas U. Taylor, at a point about 200 yards below the railroad bridge, and a discharge of 84 second-feet was found. Madre ditch diverts water from one of these springs above the point of measurement, and on June 29 its discharge was found to be 29 second-feet. Previous measurements at this locality will be found in Bulletin 140, page 85.

#### RIO GRANDE AT DEL NORTE, COLORADO.

This river has its source in the Continental Divide in southern Colorado. Its general course is easterly through its mountainous collecting area until San Luis Park is reached, when it gradually takes a southeasterly course, and then just before crossing the State line into New Mexico it bends southward and continues this general course throughout New Mexico. The station is located about 2 miles above the town of Del Norte, Colorado, well above most of the irrigation ditches which divert water from this river. The gage consists of an inclined 2 by 6 inch plank fastened to a post driven into the right bank of the river. Bench mark No. 1 is a large nail in the root of a tree 15 feet northeast of the end of the cable on the left bank of the

river and is 7.54 feet above gage datum. Bench mark No. 2 is a large nail in the root of a tree 25 feet northwest of the end of the inclined gage, and is also 7.54 feet above gage datum. While the banks are not high, the river has never been known to overflow. The current is swift; the bed is composed of small stone, and has not materially changed during the last year. Discharge measurements are made from a box suspended from a five-eighths inch wire cable fastened to trees on each side of the river. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 247; 1897, Nineteenth Annual Report, Part IV, page 383; 1898, Twentieth Annual Report, Part IV, page 360. The following discharge measurements were made by A. L. Fellows during 1899:

April 25, gage height, 2.42 feet; discharge, 1,004 second-feet.

May 24, gage height, 2.92 feet; discharge, 1,480 second-feet.

June 29, gage height, 2.10 feet; discharge, 734 second-feet.

August 21, gage height, 1.58 feet; discharge, 387 second-feet.

*Daily gage height, in feet, of Rio Grande at Del Norte, Colorado, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				1.62	1.90	2.94	2.00	2.24	1.46			
2												1.96
3				1.48	1.82	2.62	2.12	2.20	1.50			
4		2.64	2.82								1.64	
5				1.40	1.86	2.44	1.98	2.64	1.48			
6												
7	2.76			1.40	1.96	2.50	2.12	2.42	1.40	1.50		
8												
9				1.52	2.16	2.68	1.94	2.12	1.40			2.00
10												
11		2.60	2.66	1.70	3.62	2.82	1.90	2.00	1.40		1.60	
12												
13				1.84	3.54	2.90	1.80	1.84	1.38			
14	2.74									1.90		
15				1.92	3.20	2.62	1.86	1.76	2.12			
16												2.30
17				2.04	3.18	2.50	1.86	1.82	1.86			
18		2.46	2.04								1.62	
19				2.10	3.14	2.38	2.74	1.70	1.64			
20												
21	2.68			2.14	3.02	2.32	2.14	1.60	1.58	1.80		
22												
23				2.30	2.84	2.20	2.02	1.60	1.52			2.04
24												
25		2.48	1.96	2.46	3.04	2.10	1.84	1.54	1.48		2.04	
26												
27				2.28	2.96	2.48	1.84	1.50	1.44			
28	2.84									1.72		
29				2.24	2.84	2.10	2.00	1.48	1.42			
30									1.42			2.12
31			1.64		2.90		2.24	1.42				

CONEJOS RIVER AT LOS MOGOTES, COLORADO.

This stream rises on the eastern slope of the mountain range which forms the western line of Conejos County, in southern Colorado. It flows southeasterly, and then bending at the town of Conejos flows in a general northeasterly direction, entering the Rio Grande below the mouth of Trinchera Creek. The gage rod, established by A. L. Fellows August 25, 1899, was at first located at a wagon bridge 10 miles above the town of Conejos, but owing to the fact that it was destroyed

at this point, it was later moved to a point about 500 yards below. It is here attached to the pier projecting into the river near the house occupied by Gustav Timm, a ranchman who has acted as observer. The channel is fairly good, being of gravel and not particularly liable to either change or overflow. Owing to the removal of the gage it will not be possible to make a rating table for 1899. Two measurements of discharge were made at this point in 1899 by A. L. Fellows: The first, on August 25, at a gage height of 1.00 foot, showed a discharge of 76 second-feet; the second measurement, on November 28, at a gage height of 2.20 feet, showed a discharge of 70 second-feet.

*Daily gage height, in feet, of Conejos River at Los Mogotes, Colorado, for 1899.*

Day.	Sept.	Oct.	Nov.	Day.	Sept.	Oct.	Nov.	Day.	Sept.	Oct.	Nov.
1....	.95	1.02	1.15	12....	.98	1.20	1.57	23....	1.18	1.30	1.50
2....	.92	1.05	1.12	13....	.95	1.38	1.57	24....	1.15	1.28	1.48
3....	.92	1.10	1.12	14....	.98	1.32	1.57	25....	1.10	1.25	1.40
4....	.92	1.12	1.10	15....	2.00	1.25	1.57	26....	1.05	1.25	1.55
5....	.90	1.10	<i>a</i> 1.55	16....	1.75	1.22	1.65	27....	1.05	1.15	1.90
6....	.90	1.07	1.57	17....	1.65	1.25	1.70	28....	1.05	1.20	2.20
7....	.87	1.07	1.57	18....	1.50	1.28	1.70	29....	1.05	1.18	2.10
8....	.87	1.05	1.57	19....	1.30	1.25	1.70	30....	1.05	1.15	1.60
9....	1.02	1.05	1.57	20....	1.22	1.20	1.60	31....	-----	1.15	-----
10....	1.05	1.02	1.57	21....	1.22	1.30	1.58				
11....	1.00	1.00	1.57	22....	1.20	1.32	1.55				

*a* Gage moved to a point near house of Gustav Timm.

RIO GRANDE AT CENICERO, COLORADO.

The Rio Grande for a number of years has been dry during the summer after passing through San Luis Park, due to the diversion of water above. On August 20 the river 6 miles below Alamosa, Colorado, was carrying 17 second-feet, and on the 23d of the same month, at a point one-half mile above Alamosa, the discharge was found to be 10 second-feet. Just before it crosses the State line into New Mexico it enters the canyon, and in order to obtain the amount of water passing out of the State, a station was located on June 28, 1899, by A. L. Fellows, at the State bridge across the Rio Grande, at a point about 4 miles west of Eastdale, Colorado. The station is favorably located for the purpose, the cross section being fairly uniform, the channel regular and not liable to overflow. The gage consists of two rods, one for low stages, fastened to a rock near the shore; the upper section is fastened to the lower side of the middle pier of the bridge. The observer is Roman Mondragon. The following measurements of discharge were made by A. L. Fellows in 1899:

June 28, gage height, 0.90 foot; discharge, 20 second-feet.

August 24, gage height, 1 foot; discharge, 31 second-feet.

November 28, gage height, 1.30 feet; discharge, 297 second-feet.

*Daily gage height, in feet, of Rio Grande at Cenicero, Colorado, for 1899.*

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		0.78	1.00	1.00	1.30	1.50	1.80
2		.90	1.00	1.00	1.30	1.50	1.80
3		.88	.90	1.00	1.20	1.60	1.80
4		.90	.90	1.00	1.40	1.60	1.70
5		1.00	1.40	1.00	1.30	1.60	1.60
6		.90	1.40	1.00	1.20	1.60	1.50
7		.90	1.30	1.00	1.20	1.60	1.60
8		.90	1.40	1.00	1.20	1.70	1.60
9		.90	1.40	1.00	1.30	1.70	1.70
10		.85	1.30	1.00	1.30	1.80	1.60
11		.80	1.30	1.00	1.40	1.70	1.60
12		.80	1.30	1.00	1.30	1.70	1.70
13		.85	1.30	1.10	1.30	1.70	1.70
14		.90	1.20	1.10	1.20	1.80	1.80
15		1.00	1.10	1.60	1.30	1.80	1.90
16		1.00	1.00	2.10	1.30	1.70	2.00
17		1.00	1.00	2.00	1.40	1.70	2.00
18		.98	1.00	1.40	1.40	1.70	2.00
19		1.00	1.00	1.50	1.40	1.70	2.00
20		1.00	.90	1.50	1.40	1.70	2.00
21		1.02	.90	1.50	1.40	1.70	2.00
22		1.08	1.00	1.40	1.40	1.80	2.00
23		1.50	1.00	1.40	1.40	1.80	2.00
24		1.50	1.00	1.40	1.40	1.80	2.00
25		1.35	.95	1.30	1.50	1.80	2.00
26		1.30	.90	1.30	1.50	1.80	2.00
27		1.20	.90	1.30	1.50	1.80	2.00
28	0.90	1.10	1.00	1.30	1.50	1.80	2.00
29	.90	1.10	1.00	1.30	1.50	1.80	2.00
30	.80	1.10	1.00	1.30	1.50	1.80	2.00
31		1.00	1.00		1.50		2.00

## RIO GRANDE AT EMBUDO, NEW MEXICO.

Rio Grande enters the canyon some distance above where it crosses the New Mexico and Colorado line, and continues southward for some distance below Embudo. It receives a number of important tributaries from either side through this section of its course, which contribute to its discharge; and although in recent years the river is dry in the vicinity of Alamosa, Colorado, there is a constant flow at Embudo, New Mexico. The station at this point, established in 1889, is located about 300 feet east of the railroad station at Embudo. The gage is inclined, and consists of a timber fastened to posts driven into the bank of the river. Bench mark No. 1 is a rock near the end of the cable, left bank, marked "B. M." with white paint, and is 20.66 feet above gage datum. Bench mark No. 2 is a rock 100 feet above the cable, left bank, similarly marked, and is 18.79 feet above gage datum. Bench mark No. 3 is a notch cut in the southeastern corner of the station, 2 feet above the platform, and is 30.48 feet above gage datum. The left bank is steep, and the right has a gentle slope. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 251; 1897, Nineteenth Annual Report, Part IV, page 385; 1889 to 1898, Twentieth Annual Report, Part IV, page 366. The following measurements of discharge were made by P. E. Harroun during 1899:

- April 7, gage height, 8.20 feet; discharge, 710 second-feet.
- April 20, gage height, 9.50 feet; discharge, 1,627 second-feet.
- May 4, gage height, 8.60 feet; discharge, 967 second-feet.
- May 30, gage height, 8.10 feet; discharge, 745 second-feet.
- September 4, gage height, 7 feet; discharge, 183 second-feet.
- October 27, gage height, 7.58 feet; discharge, 412 second-feet.

Daily gage height, in feet, of Rio Grande at Embudo, New Mexico, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.50	7.60	7.70	8.40	9.20	7.90	7.20	7.20	7.00	7.30	7.60	7.85
2	7.60	7.60	7.70	8.30	9.00	7.85	7.20	7.25	7.00	7.30	7.60	7.85
3	7.60	7.60	7.80	8.30	8.80	7.80	7.15	7.20	7.00	7.35	7.60	7.80
4	7.60	7.70	7.80	8.30	8.60	7.80	7.10	7.20	7.00	7.40	7.60	7.80
5	7.60	7.70	7.85	8.20	8.45	7.80	7.10	7.30	7.00	7.40	7.65	8.00
6	7.70	7.70	7.90	8.20	8.25	7.60	7.10	7.25	7.00	7.40	7.70	7.85
7	7.85	7.70	8.00	8.20	8.20	7.35	7.10	7.20	7.00	7.40	7.75	7.70
8	7.90	7.80	8.05	8.10	8.20	7.00	7.10	7.20	7.10	7.40	7.80	7.70
9	7.90	7.80	8.15	8.10	8.20	6.90	7.10	7.20	7.10	7.40	7.80	7.80
10	7.90	7.85	8.20	8.10	8.20	6.85	7.10	7.30	7.10	7.40	7.80	8.00
11	7.90	7.90	8.20	8.10	8.20	6.70	7.05	7.25	7.10	7.40	7.80	7.60
12	7.90	7.80	8.25	8.20	8.30	6.60	7.00	7.20	7.10	7.40	7.80	7.60
13	7.90	7.90	8.30	8.50	8.65	6.70	7.00	7.20	7.15	7.40	7.80	7.60
14	7.80	7.80	8.35	8.65	8.80	6.95	7.10	7.20	7.20	7.40	7.80	7.70
15	7.80	7.80	8.50	8.80	9.00	7.00	7.25	7.25	<sup>a</sup> 7.30	7.50	7.85	7.60
16	7.70	7.80	8.65	8.80	9.10	7.00	7.40	7.30	8.15	7.50	7.90	7.60
17	7.70	7.80	8.70	8.85	9.20	7.00	7.60	7.30	7.90	7.50	7.90	7.70
18	7.70	7.70	8.70	9.05	9.20	7.00	7.60	7.15	7.85	7.50	7.90	7.70
19	7.70	7.70	8.70	9.35	9.15	7.00	8.10	7.10	7.85	7.50	7.90	7.70
20	7.70	7.70	8.65	9.35	9.00	7.00	7.90	7.10	7.65	7.50	7.90	7.70
21	7.70	7.70	8.60	9.30	9.00	7.00	7.60	7.10	7.60	7.50	7.95	7.70
22	7.70	7.70	8.45	9.25	8.80	7.00	7.60	7.10	7.50	7.50	8.00	7.70
23	7.70	7.70	8.40	9.20	8.75	7.00	7.55	7.00	7.50	7.50	8.00	7.70
24	7.70	7.70	8.30	9.20	8.50	7.10	7.50	7.00	7.50	7.50	8.00	7.70
25	7.60	7.70	8.30	9.30	8.20	7.10	7.45	7.00	7.40	7.50	8.10	7.70
26	7.60	7.70	8.30	9.40	8.20	7.10	7.35	7.00	7.40	7.50	8.10	7.70
27	7.60	7.70	8.30	9.40	8.10	7.00	7.20	7.00	7.30	7.50	8.00	7.70
28	7.60	7.70	8.35	9.30	8.10	7.15	7.15	7.00	7.30	7.50	8.00	7.70
29	7.60	-----	8.40	9.20	8.10	7.20	7.10	7.00	7.30	7.60	7.90	7.70
30	7.60	-----	8.35	9.20	8.00	7.20	7.10	7.00	7.30	7.60	7.90	7.70
31	7.60	-----	8.40	-----	8.00	-----	7.20	7.00	-----	7.60	-----	7.70

<sup>a</sup> Began to rise at 4.30 p. m.; maximum, 8.3 feet, at 6 p. m.

RIO GRANDE AT RIO GRANDE, NEW MEXICO.

Three miles below Embudo the river emerges into Espanola Valley, through which it continues for a few miles and then enters White Rock Canyon, flowing through that canyon for 30 miles. At the lower end of this canyon the river emerges into Albuquerque Valley, and so continues down to about Socorro. This valley averages from 1 to 3 miles in width, and has been irrigated for a great many years by the Mexican settlers. Their primitive methods of irrigation are very wasteful of the waters, so that the duty of water in this section, about 17 acres per second-foot, is not as high as it might be. During the last few years, however, a number of important and modern irrigation systems have been planned and built in the vicinity of Albuquerque. The gaging station, established February 3, 1895, is located about one-fourth of a mile above the railroad station of Rio Grande, New Mexico, and at the head of White Rock Canyon. The gage is inclined, and consists of timbers fastened to piles and wired to a solid rock. The bench mark is the top of the boulder to which the upper portion of the gage is fastened, and is 17.815 feet above gage datum. Measurements are made from a car suspended from a cable above the rod. The bed of the stream is rocky and is confined between high banks. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 254; 1897, Nineteenth Annual Report, Part IV, page 386; 1898,

Twentieth Annual Report, Part IV, page 370. Three measurements of discharge were made at this point by P. E. Harroun during 1899: The first one, on April 6, at a gage height of 5.90 feet, gave a discharge of 978 second-feet; the second, on September 2, at a gage height of 3.70 feet, gave a discharge of 110 second-feet; the third measurement, October 24, at a gage height of 5.15 feet, gave a discharge of 482 second-feet.

*Daily gage height, in feet, of Rio Grande at Rio Grande, New Mexico, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.65	5.40	5.65	6.20	7.15	5.60	4.20	5.00	3.60	4.70	5.30	5.65
2	4.65	5.35	6.00	6.20	7.15	5.55	4.20	4.80	3.60	4.70	5.25	5.60
3	4.65	5.35	5.90	6.05	6.95	5.45	4.30	4.70	3.60	4.70	5.30	5.60
4	4.75	5.15	5.80	6.15	6.75	5.45	4.30	6.75	3.65	4.85	5.40	5.60
5	4.85	5.30	5.80	6.10	6.60	5.45	4.10	5.50	3.60	5.10	5.40	5.35
6	4.75	5.20	5.85	5.90	6.50	5.35	4.00	5.00	3.60	5.05	5.45	5.00
7	4.85	5.30	5.85	5.85	6.45	5.25	4.00	6.35	3.55	5.05	5.50	5.25
8	4.95	5.30	5.90	6.05	6.35	5.20	3.90	5.45	4.00	5.00	5.55	5.40
9	5.10	5.45	6.15	5.95	6.35	5.05	4.40	5.45	4.25	4.95	5.55	5.65
10	5.00	5.45	6.05	6.05	6.30	5.40	4.20	4.80	4.75	4.90	5.55	5.45
11	4.95	5.45	6.25	6.30	6.30	5.10	4.20	4.75	4.95	4.85	5.60	5.25
12	5.00	5.35	6.25	6.45	6.45	5.05	4.20	4.65	4.35	4.85	5.55	5.15
13	4.95	5.20	6.20	6.65	6.40	5.00	4.00	4.60	4.30	4.85	5.55	5.40
14	5.00	5.75	6.20	6.95	6.65	4.90	4.40	4.55	4.30	4.80	5.55	5.40
15	5.05	5.50	6.25	7.30	7.15	4.85	4.55	4.40	α 9.30	4.80	5.90	5.15
16	5.05	5.40	6.55	7.20	7.35	4.60	5.00	4.35	9.40	5.00	5.70	4.85
17	5.00	5.50	6.15	7.65	7.40	4.65	5.05	4.30	6.55	5.00	5.75	5.10
18	5.00	5.45	6.40	8.15	7.15	4.50	7.80	4.15	5.85	5.05	5.75	5.40
19	5.00	5.50	6.30	8.30	6.90	4.45	6.80	4.20	5.45	4.95	5.70	5.65
20	5.05	5.45	6.35	8.30	6.75	4.40	6.30	4.15	5.25	5.05	5.70	5.55
21	5.05	5.50	6.30	7.95	6.75	4.30	5.70	4.10	5.15	5.10	5.70	5.40
22	5.00	5.50	6.25	7.70	6.75	4.20	5.30	4.00	5.25	5.15	5.70	5.30
23	5.00	5.50	6.20	7.75	6.40	4.20	5.30	3.90	5.00	5.15	5.80	5.45
24	5.00	5.55	6.15	7.85	6.25	4.30	5.15	3.75	5.05	5.15	5.90	5.50
25	5.05	5.80	6.20	7.90	6.10	4.40	5.25	3.85	4.95	5.20	5.80	5.45
26	5.10	5.50	6.45	8.05	6.10	4.65	5.20	3.80	4.85	5.20	5.75	5.45
27	5.20	5.50	6.65	7.95	5.95	4.50	5.30	3.70	4.85	5.30	5.75	5.40
28	5.25	5.65	6.60	7.75	6.00	4.40	5.35	3.75	4.75	5.30	5.75	5.40
29	5.25	-----	6.55	7.50	5.85	4.20	5.00	3.70	4.75	5.30	5.70	5.45
30	5.35	-----	6.45	7.15	5.80	4.35	5.05	3.60	4.65	5.25	5.70	5.50
31	5.40	-----	6.40	-----	5.70	-----	6.05	3.60	-----	5.25	-----	5.65

α 10 at 7 a. m.

RIO GRANDE AT SAN MARCIAL, NEW MEXICO.

The fifth gaging station on the main stream, continuing downward, is at San Marcial. It was established January 29, 1895, and is located at the railroad bridge one-half mile south of the town. The wire gage is attached to the guard rail of the bridge, south span, lower side. Bench mark No. 1 is the top of the capstone on which the bridge truss rests, and is at an elevation of 15 feet above gage datum; bench mark No. 2 is the top of the extension of the pier to which the old vertical gage was fastened, and is at an elevation of 13 feet above gage datum. The channel is sandy and shifting. A number of bridge piers interfere with the current to a certain extent, but not with the observed gage heights or discharge measurements. Results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 257; 1897, Nineteenth Annual Report, Part IV, page 387; 1898, Twentieth Annual Report, Part IV, page 371. The following discharge measurements were made by P. E. Harroun during 1899:

*Measurements of Rio Grande at San Marcial, New Mexico.*

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1899.	<i>Feet.</i>	<i>Sec. feet.</i>	1899.	<i>Feet.</i>	<i>Sec. feet.</i>
Apr. 3.....	7.30	715	May 17.....	6.50	199
Apr. 19.....	7.30	660	Sept. 22.....	5.30	112
Apr. 25.....	7.70	1,609	Oct. 12.....	4.40	6
May 2.....	7.60	1,403	Dec. 17.....	6.20	263

*Daily gage height, in feet, of Rio Grande at San Marcial, New Mexico, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.95	6.90	6.70	7.00	7.70	6.00	-----	6.00	-----	-----	5.00	6.50
2	6.75	6.65	6.70	7.15	7.65	5.80	-----	5.80	-----	-----	5.00	6.50
3	6.50	6.70	6.60	7.30	7.50	5.70	-----	5.60	-----	-----	5.10	6.50
4	6.60	6.70	6.50	7.10	7.40	5.60	-----	5.40	-----	-----	5.10	6.55
5	6.55	6.60	6.50	7.00	7.40	5.40	-----	5.65	-----	-----	5.20	6.55
6	6.60	6.50	6.70	6.90	7.30	5.25	-----	6.80	-----	-----	5.20	6.55
7	6.60	5.10	6.70	7.20	7.20	5.00	-----	7.15	-----	-----	5.30	6.55
8	6.75	4.50	6.50	7.00	7.20	-----	-----	7.55	-----	-----	5.30	6.60
9	6.55	4.50	6.80	6.90	7.20	-----	-----	6.95	5.35	-----	5.40	6.60
10	6.50	6.95	6.50	6.80	7.10	-----	-----	6.40	5.65	-----	5.40	6.45
11	6.60	6.60	6.50	6.70	7.00	-----	-----	6.10	5.00	-----	5.50	6.60
12	7.00	6.70	6.50	6.50	6.80	-----	-----	5.70	5.15	-----	5.50	6.55
13	6.70	5.90	6.60	6.40	6.70	-----	-----	5.30	5.50	4.50	5.60	6.55
14	7.00	7.20	7.00	6.90	6.60	-----	-----	-----	5.05	4.50	5.60	6.55
15	6.90	6.70	7.10	6.15	6.50	3.60	-----	-----	-----	4.50	5.70	6.60
16	6.85	6.70	7.00	6.00	6.40	3.60	-----	-----	-----	4.50	5.70	6.60
17	6.70	6.95	6.90	6.05	6.50	3.60	-----	-----	-----	4.50	5.80	6.05
18	6.55	6.80	6.90	6.90	6.60	3.60	-----	-----	-----	4.50	5.80	6.40
19	6.55	6.80	6.80	7.35	6.70	-----	9.05	-----	7.25	4.50	5.90	6.50
20	6.55	6.80	6.50	7.80	7.45	-----	9.25	-----	6.05	4.50	6.00	6.45
21	6.60	6.80	6.40	7.95	7.40	-----	7.60	-----	5.50	4.50	6.00	6.55
22	6.50	6.80	6.40	7.95	7.30	-----	6.75	-----	5.15	4.50	6.10	6.55
23	6.60	6.80	6.40	7.80	7.30	-----	6.25	-----	5.00	4.50	6.20	6.60
24	6.70	6.70	6.40	7.70	7.20	-----	6.15	-----	5.00	4.60	6.20	6.65
25	6.70	6.80	6.40	7.70	7.00	-----	7.60	-----	-----	4.60	6.30	6.70
26	6.60	6.80	6.30	7.70	6.95	-----	7.50	-----	-----	4.70	6.30	6.65
27	6.60	6.80	6.30	7.70	6.80	-----	6.55	-----	-----	4.70	6.40	6.65
28	6.60	6.80	6.50	7.70	6.65	-----	6.70	-----	-----	4.80	6.40	6.65
29	6.60	-----	6.70	7.80	6.55	-----	6.20	-----	-----	4.80	6.50	6.75
30	6.60	-----	6.85	7.70	6.30	-----	6.25	-----	-----	4.90	6.50	6.75
31	6.65	-----	7.00	-----	6.20	-----	6.20	-----	-----	4.90	-----	6.80

June 8 to July 14, inclusive, no flow in river.

August 14 to September 8, inclusive, no flow in river.

September 15 to 18, inclusive, September 25 to October 22, inclusive, no flow in river.

## RIO GRANDE AT EL PASO, TEXAS.

This is an important station, and measurements have been made here for a long period. During the last three years the work has been carried on under the direction of W. W. Follett, consulting engineer International (Water) Boundary Commission. This commission has had charge of the investigation looking toward the building of an international dam at El Paso. The present station is located at Courchesne's limekiln, 4 miles north of El Paso, Texas. The river heights are measured at the masonry pump foundation pier, 150 feet above the kiln. The top of the downstream chisel draft is assumed to be at a gage height of 15 feet, and the distance to the water surface below is measured with a carefully graduated rod. The left bank of the river is formed by the loose rock fill of the Atchison, Topeka and Santa Fe Railroad embankments, and will not overflow; the right

bank, however, is made ground and is liable to overflow at high stages. Owing to the shifting character of the bed of the stream, it has been necessary to make a large number of discharge measurements at this point in order to obtain an accurate idea of the discharge. Results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 259; 1897, Nineteenth Annual Report, Part IV, page 390; 1898, Twentieth Annual Report, Part IV, page 312. There were 32 discharge measurements made by T. M. Courchesne during 1899, as follows:

*Measurements of Rio Grande at El Paso, Texas.*

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
1899.	<i>Feet.</i>	<i>Second-ft.</i>	1899.	<i>Feet.</i>	<i>Second-ft.</i>
Jan. 4.....	6.40	290	Mar. 16.....	5.70	86
Jan. 9.....	6.10	226	Mar. 18.....	5.60	69
Jan. 12.....	6.00	173	Mar. 20.....	5.70	78
Jan. 14.....	5.90	126	Mar. 22.....	5.80	93
Jan. 16.....	5.90	126	Mar. 25.....	5.60	66
Jan. 18.....	6.40	244	Apr. 11.....	5.50	48
Jan. 21.....	6.30	249	Apr. 14.....	5.20	31
Jan. 23.....	6.10	181	May 8.....	6.90	336
Jan. 26.....	6.40	261	Dec. 14.....	5.40	94
Jan. 28.....	6.20	187	Dec. 16.....	5.30	70
Jan. 31.....	6.10	188	Dec. 18.....	5.10	48
Feb. 2.....	6.10	167	Dec. 20.....	5.10	47
Feb. 4.....	6.00	147	Dec. 23.....	5.20	56
Mar. 8.....	6.30	216	Dec. 26.....	5.30	72
Mar. 11.....	6.60	144	Dec. 28.....	5.50	101
Mar. 13.....	5.80	112	Dec. 30.....	5.40	104

*Daily gage height, in feet, of Rio Grande at El Paso, Texas, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Dec.
1.....	6.15	6.10	6.25	6.05	7.45	(a)	(a)	5.70	(a)
2.....	6.20	6.10	6.15	5.50	7.60	(a)	(a)	5.00	(a)
3.....	6.40	6.00	6.20	5.05	7.50	(a)	(a)	5.00	(a)
4.....	6.40	6.00	6.15	5.05	7.40	(a)	(a)	4.90	(a)
5.....	6.25	5.90	6.20	5.05	7.30	(a)	(a)	4.85	4.30
6.....	6.15	6.25	6.20	5.00	7.10	(a)	(a)	4.65	4.40
7.....	6.10	6.50	6.25	4.95	6.85	(a)	(a)	4.45	4.50
8.....	6.10	6.30	6.30	5.10	6.85	(a)	(a)	4.15	4.50
9.....	6.10	6.40	6.20	5.25	6.55	(a)	(a)	-----	4.50
10.....	6.10	6.40	6.10	5.40	6.30	(a)	(a)	-----	4.50
11.....	6.00	6.40	6.00	5.50	6.00	(a)	(a)	-----	4.50
12.....	6.00	6.30	5.90	5.40	5.85	(a)	(a)	-----	4.75
13.....	5.90	5.90	5.80	5.25	5.65	(a)	(a)	-----	5.10
14.....	5.90	6.20	5.80	5.20	5.70	(a)	(a)	-----	5.40
15.....	5.90	6.00	5.75	5.10	5.55	(a)	(a)	-----	5.40
16.....	5.90	6.00	5.70	5.10	5.40	(a)	(a)	-----	5.30
17.....	6.20	6.00	5.65	5.10	5.50	(a)	(a)	-----	5.20
18.....	6.40	6.05	5.60	4.90	5.15	(a)	4.45	-----	5.10
19.....	6.40	6.20	5.60	4.90	4.95	(a)	5.35	-----	5.10
20.....	6.40	6.10	5.70	4.90	4.85	(a)	6.60	-----	5.10
21.....	6.30	6.20	5.80	4.95	4.80	(a)	7.90	-----	5.10
22.....	6.30	6.50	5.80	5.00	4.70	(a)	9.05	-----	5.15
23.....	6.10	6.55	5.65	5.35	4.60	(a)	9.05	-----	5.20
24.....	6.20	6.35	5.60	7.45	4.60	(a)	8.40	-----	5.20
25.....	6.25	6.30	5.60	7.60	4.60	(a)	8.20	-----	5.20
26.....	6.35	6.30	5.45	7.50	4.60	(a)	7.85	-----	5.30
27.....	6.30	6.25	5.45	7.30	4.60	(a)	7.55	-----	5.25
28.....	6.20	6.20	5.50	7.20	4.60	(a)	6.90	-----	5.40
29.....	6.20	-----	5.40	7.30	4.60	(a)	6.70	-----	5.50
30.....	6.10	-----	5.40	7.30	4.55	(a)	6.65	-----	5.40
31.....	6.10	-----	5.75	-----	4.50	(a)	6.35	-----	5.40

*a* Not flowing from June 1 to July 17 and from August 9 to November 30.

## PECOS RIVER AT PECOS, TEXAS.

This stream rises on the eastern slope of the Santa Fe Range in northern New Mexico. Its course is first southerly, through a typical mountainous and canyon country, until it reaches Fort Sumner, when the character of the topography changes. The river then takes a more southerly course and the country then changes from a rolling to an almost flat area. A number of large irrigation enterprises have been completed within the last few years and now irrigate large areas in the vicinity of Roswell and Eddy, New Mexico, and even extend down into Texas. The summer flow of the river is largely dependent upon numerous springs, which occur in the limestone country in the vicinity of Roswell and below. Owing to the numerous diversions for irrigating purposes, however, the river would be dry in the summer where it crosses into Texas were it not for the waters which are gradually returning to the river through seepage. This water, unfortunately, is impregnated to a considerable extent with alkali, which renders it undesirable for irrigating purposes. The station on this river was established January 1, 1898, and is located at a point 6 miles above the town of Pecos, Texas, at the flume of the Margueretta canal. This canal diverts water from the river 3 miles above this point on the west side, and then the water is carried over to the east side by means of a flume, where it is used below. The bench mark of the gage is the top of north pier at west side of flume, and its elevation is 20.7 feet above gage datum. The channel at this point is nearly straight, the water sluggish, the banks high, and the bottom sandy and shifting. One measurement of the discharge in the flume was made on June 22, when it was found to be 85 second-feet. Two measurements were made on the main river by Prof. Thomas U. Taylor in 1899, as follows: June 22, at a gage height of 0.70 foot, the discharge was 21 second-feet; the second measurement, on December 28, at a gage height of 2.90 feet, gave a discharge of 345 second-feet.

In the vicinity of Fort Stockton, Pecos County, Texas, occur a series of springs which contribute to the discharge of Comanche Creek, a tributary of Pecos River. On June 23, 1899, their discharge was measured by Prof. Thomas U. Taylor at the ford one-half mile east of the court-house, and the discharge was found to be 66 second-feet.

*Daily gage height, in feet, of Pecos River at Pecos, Texas, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.80	3.00	2.80	1.00	1.00	0.45	0.75	5.35	1.30	1.25	1.30	3.00
2	2.80	3.00	2.70	1.00	1.00	.45	.90	4.80	1.30	1.20	1.30	3.00
3	2.60	3.00	2.60	1.00	1.00	.40	.70	3.75	1.30	1.20	1.30	2.95
4	2.60	2.95	2.50	1.00	1.00	.40	.80	3.65	1.25	1.85	1.30	2.90
5	2.60	2.80	2.50	1.00	1.00	.40	.80	3.45	1.20	1.60	1.35	2.90
6	2.55	2.65	2.75	1.00	1.00	.40	.80	2.65	1.20	1.50	1.40	2.90
7	2.50	2.45	2.65	1.00	1.00	.40	.80	2.15	1.20	1.50	1.40	3.00
8	2.50	2.40	2.55	1.00	1.00	.40	1.50	2.05	1.20	1.45	1.40	3.05
9	2.50	2.70	2.35	1.00	1.55	.40	3.75	1.90	1.30	1.35	1.45	3.00
10	2.50	3.00	2.10	1.00	1.50	.40	2.20	1.75	1.50	1.30	1.45	3.10
11	3.10	3.00	1.80	.95	1.00	1.75	1.60	1.70	2.40	1.30	1.50	3.00
12	3.10	2.90	1.45	.90	1.00	1.00	1.35	1.80	1.85	1.20	1.40	2.90
13	3.10	2.85	1.35	.90	1.00	.60	1.15	2.20	3.00	1.20	1.40	3.00
14	3.00	3.00	1.30	.90	1.00	.60	1.00	2.15	2.40	1.20	1.40	3.00
15	3.00	3.00	1.20	1.10	.95	.60	.85	2.05	1.80	1.20	1.40	3.00
16	3.00	3.00	1.20	3.50	.90	1.60	1.15	2.00	1.65	1.35	1.40	3.00
17	3.00	2.90	1.10	2.75	.70	2.30	.80	2.00	1.35	1.10	1.30	3.00
18	3.00	2.80	1.10	1.95	.50	1.15	4.35	1.95	1.30	1.10	1.30	3.10
19	3.00	2.70	1.10	1.60	.50	.85	1.95	1.50	1.30	1.10	2.65	3.10
20	3.00	2.70	1.10	1.45	.50	.70	3.00	1.40	1.40	1.00	4.40	3.10
21	3.00	2.70	1.20	1.35	.50	.70	3.00	1.30	1.60	1.00	3.30	3.20
22	3.00	2.70	1.15	1.30	.50	.70	2.65	1.40	2.60	1.00	2.60	3.30
23	3.00	2.70	1.10	1.30	.50	.70	3.05	1.40	2.65	1.10	2.25	3.05
24	2.95	2.60	1.10	1.15	.50	.70	4.25	1.40	2.45	1.10	2.05	3.25
25	2.90	2.50	1.10	1.10	.50	.70	5.00	1.40	2.00	1.10	2.00	3.80
26	3.05	2.75	1.30	1.10	.50	.70	5.55	1.40	1.80	1.10	2.00	3.15
27	3.00	2.70	1.10	1.10	.50	.70	5.60	1.40	1.50	1.20	2.00	3.05
28	3.00	2.70	1.00	1.10	.50	.70	5.50	1.30	1.45	1.20	2.55	3.00
29	3.05	-----	1.00	1.00	.50	.70	5.50	1.30	1.40	1.20	2.50	2.90
30	3.00	-----	1.00	1.00	.50	.70	5.50	1.30	1.35	1.20	2.45	2.90
31	3.00	-----	1.00	-----	.50	-----	5.50	1.30	-----	1.30	-----	2.95

GREEN RIVER AT GREENRIVER, WYOMING.

This river has its source in the Wind River and Gros Ventre mountains in western Wyoming; it flows southerly, receiving a number of important tributaries from either side, and after crossing the State line flows through Utah. In this State its principal tributaries are Yampa and White rivers from the east and Duchesne River from the west. Sixty miles below the crossing of the Rio Grande Western Railway in Utah, Green River joins the Grand River to form the Colorado. Two gaging stations have been maintained on the main river, one at Greenriver, Wyoming, at the crossing of the Union Pacific Railroad, and the other at Blake, Utah, at the crossing of the Rio Grande Western Railway. The former station, established May 2, 1895, is located at the pump house of the Union Pacific Railroad Company. The rod is fastened to a pile near the east end of the bridge. The bench mark consists of a cross on the third step from the bottom on the south end of the east abutment, and is 12.48 feet above gage datum. The rod was last verified with the bench mark August 30, 1899. As the section under the railroad bridge is poor, discharge measurements are made from the iron highway bridge about one-half mile below. The average annual discharge of Green River at this point having been determined for the last five years, and as the water supply is far greater than the demand by irrigators, observations will be discontinued in the spring and attention given to the

more important tributaries of the river. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 275; 1897, Nineteenth Annual Report, Part IV, page 395; 1898, Twentieth Annual Report, Part IV, page 380. The following discharge measurements were made by A. J. Parshall during 1889:

- April 19, gage height, 1.35 feet; discharge, 1,595 second-feet.
- May 13, gage height, 2.20 feet; discharge, 2,661 second-feet.
- May 25, gage height, 2.55 feet; discharge, 3,422 second-feet.
- June 7, gage height, 3.80 feet; discharge, 8,234 second-feet.
- June 20, gage height, 5.30 feet; discharge, 15,305 second-feet.
- July 5, gage height, 6.25 feet; discharge, 18,372 second-feet.
- August 30, gage height, 2.10 feet; discharge, 1,632 second-feet.

Daily gage height, in feet, of Green River at Greenriver, Wyoming, for 1899.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....		1.80	1.90	1.00	1.78	3.20	6.38	3.88	2.05	1.45	1.60	1.20
2.....				.70	1.58	3.25	6.43	3.78	2.05	1.45		
3.....	1.50			.95	1.50	3.35	6.50	3.70	1.95	1.45	1.60	1.20
4.....				1.10	1.43	3.48	6.43	3.68	1.90	1.40		
5.....				.90	1.33	3.55	6.13	3.65	1.90	1.40	1.60	1.40
6.....				.80	1.30	4.00	5.85	3.65	1.90	1.40		
7.....				.90	1.33	3.95	5.75	3.58	1.90	1.40	1.55	1.45
8.....		1.80	1.70	.85	1.50	3.70	5.73	3.53	1.85	1.45		
9.....	1.60			.95	1.50	3.45	5.65	3.50	1.85	1.45	1.55	1.45
10.....				.90	1.63	3.38	5.60	3.45	1.80	1.45		
11.....				1.30	1.95	3.43	5.53	3.40	1.78	1.48	1.50	1.45
12.....				1.35	2.15	3.73	5.45	3.40	1.73	1.50		
13.....	1.60			1.50	2.28	4.13	5.45	3.35	1.78	1.55	1.50	1.45
14.....				1.50	2.55	4.68	5.48	3.23	1.85	1.58		
15.....		1.90	1.30	1.60	2.58	4.73	5.53	3.13	1.80	1.60	1.50	1.45
16.....				1.50	2.80	4.35	5.45	3.00	1.75	1.60		
17.....				1.40	2.78	4.30	5.38	2.95	1.75	1.60	1.50	1.40
18.....				1.40	2.65	4.50	5.23	2.93	1.75	1.60		
19.....	1.60			1.35	2.63	4.93	4.95	2.83	1.73	1.63	1.45	1.40
20.....				1.35	2.50	5.40	4.73	2.68	1.70	1.65		
21.....				1.30	2.80	5.80	4.68	2.60	1.65	1.68	1.40	1.45
22.....		1.90	1.30	1.25	2.78	6.18	4.50	2.55	1.65	1.70		
23.....				1.35	2.73	6.50	4.45	2.53	1.60	1.70	1.30	1.45
24.....				1.45	2.58	6.63	4.40	2.50	1.60	1.70		
25.....	1.70			1.65	2.55	6.30	4.33	2.45	1.60	1.65	1.25	1.50
26.....				2.00	2.78	6.05	4.18	2.40	1.55	1.65		
27.....	1.70			1.95	3.08	5.98	4.03	2.38	1.55	1.63	1.25	1.55
28.....		1.90		1.90	3.18	6.03	3.98	2.30	1.50	1.60		
29.....			1.70	1.90	3.20	6.10	3.95	2.23	1.50	1.60	1.25	1.55
30.....	1.55			1.83	3.25	6.28	3.95	2.10	1.45	1.60		1.60
31.....					3.20		3.95	2.05		1.60		

BLACK FORK AT GRANGER, WYOMING.

This tributary of Green River rises in the extreme southwestern corner of Wyoming, and flows in a general northwesterly direction until after its junction with Hams Fork, when it turns southeasterly and joins Green River 20 miles below Greenriver station, Wyoming. Considerable irrigation is practiced on its head-water streams, almost wholly for forage crops, as the elevation is too high for diversified farming. The general industry of the country is stock raising, the herds being ranged on the hillside during the summer, and during the winter fed the hay raised by irrigation. The station on this river was established April 28, 1897, and is located below the mouth of Hams Fork and about a quarter of a mile below Granger. The rod consists of a horizontal timber fastened to two upright posts set firmly in the bank of the river. One end of the timber to which the wire gage is

fastened projects out over the water. The bench mark is a rail spike in an old tie 25 feet west of inside post of gage, marked "B. M." in black paint, and is at an elevation of 8.74 feet above gage datum. The rod was last verified with the bench mark August 30, 1899. The results of measurements may be found as follows: 1897, Nineteenth Annual Report, Part IV, page 393; 1898, Twentieth Annual Report, Part IV, page 382. The following discharge measurements were made by A. J. Parshall during 1899:

- April 19, gage height, 1.85 feet; discharge, 769 second-feet.
- May 13, gage height, 3.30 feet; discharge, 2,229 second-feet.
- May 25, gage height, 3.60 feet; discharge, 2,535 second-feet.
- June 7, gage height, 5.10 feet; discharge, 4,776 second-feet.
- June 20, gage height, 5.70 feet; discharge, 5,567 second-feet.
- July 5, gage height, 3.90 feet; discharge, 2,674 second-feet.
- August 30, gage height, 0.20 foot; discharge, 101 second-feet.

*Daily gage height, in feet, of Black Fork at Granger, Wyoming, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....			2.20	.....	1.80	3.90	4.40	1.50	0.80	0.30	.....	.....
2.....	1.80	.....	.....	2.90	2.20	3.90	4.50	1.40	.80	.30	.....	1.30
3.....	.....	.....	.....	2.90	2.65	3.90	4.60	1.40	.80	.30	.....	.....
4.....	.....	2.10	.....	2.90	1.60	4.20	4.30	1.40	.70	.30	0.80	.....
5.....	.....	.....	.....	2.95	1.70	4.30	3.90	1.40	.65	.35	.....	.....
6.....	.....	.....	.....	3.20	1.60	4.50	3.80	1.40	.60	.40	.....	.....
7.....	.....	.....	.....	3.25	1.70	5.05	3.60	1.40	.60	.50	.....	.....
8.....	.....	.....	2.30	1.80	1.90	5.40	3.50	1.60	.60	.50	.....	.....
9.....	1.60	.....	.....	1.80	2.00	5.20	3.30	1.50	.60	.50	.....	1.00
10.....	.....	.....	.....	1.60	2.20	4.90	3.10	1.50	.60	.50	.....	.....
11.....	.....	2.10	.....	1.40	2.65	4.85	3.10	1.50	.50	.50	.80	.....
12.....	.....	.....	.....	1.60	2.75	5.10	3.00	1.50	.50	.60	.....	.....
13.....	.....	.....	.....	1.65	3.35	5.50	3.20	1.25	.50	.60	.....	.....
14.....	.....	.....	.....	1.60	3.80	6.05	3.20	1.20	.50	.70	.....	.....
15.....	.....	.....	2.50	1.70	4.20	6.05	3.20	1.20	.50	.70	.....	.....
16.....	1.70	.....	.....	1.80	4.50	5.60	3.10	1.20	.50	.70	.....	1.00
17.....	.....	.....	.....	1.75	4.50	5.50	3.20	1.10	.40	.70	.....	.....
18.....	.....	2.20	.....	1.60	4.10	5.40	2.90	1.10	.40	.70	.90	.....
19.....	.....	.....	.....	1.85	3.80	5.50	2.55	1.00	.45	.70	.....	.....
20.....	.....	.....	.....	2.10	3.90	5.70	2.30	1.00	.50	.80	.....	.....
21.....	.....	.....	.....	1.50	4.00	5.90	2.20	.95	.50	.70	.....	.....
22.....	1.90	.....	2.70	1.50	3.80	6.25	2.05	.90	.50	.70	.....	.....
23.....	.....	.....	.....	1.60	3.80	6.00	2.00	.90	.50	.80	.....	1.50
24.....	.....	.....	.....	1.85	3.30	5.50	1.90	.80	.50	.80	.....	.....
25.....	.....	2.30	.....	1.80	3.60	5.30	1.90	.70	.40	.80	.90	.....
26.....	.....	.....	.....	2.00	4.10	5.00	1.80	.70	.40	.80	.....	.....
27.....	.....	.....	.....	2.20	4.20	4.70	1.80	.70	.30	.80	.....	.....
28.....	1.90	.....	.....	2.00	4.30	4.60	1.80	.70	.30	.70	.....	.....
29.....	.....	.....	3.80	1.80	4.30	4.40	1.80	.70	.30	.70	.....	.....
30.....	.....	.....	.....	1.80	3.90	4.30	1.70	.70	.30	.75	.....	1.30
31.....	.....	.....	.....	.....	3.90	.....	1.50	.70	.....	.80	.....	.....

UINTA RIVER NEAR WHITEROCKS, UTAH.

Uinta River has its source on the southern slope of the Uinta Mountains in northeastern Utah, and flows in a general southeasterly direction, emptying into Duchesne River about 15 miles above its mouth. Its drainage area is included within the Uinta Indian Reservation. During the fall of 1899 an investigation of the water supply of the Uinta Indian Reservation was begun by Cyrus C. Babb, and in this connection a number of gaging stations were established. Uinta River emerges from its canyon about 10 miles northwest of the Indian agency at Whiterocks, and at this point a gaging station was estab-

lished September 16, 1899. The gage rod is a 2 by 4 inch timber, 12 feet long, bolted to two trees on the left bank of the stream. The bench mark is a nail in an aspen tree 125 feet north of the rod, and its elevation is 8.93 feet above gage datum. Discharge measurements are made by car and cable. The bed of the stream is very rocky and strewn with large bowlders, and the station is not altogether satisfactory, on account of the roughness of the channel. During high water the velocity undoubtedly will be great, owing to the rapid fall of the water. A few hundred yards above the station an important tributary comes in from the east. At the present location a second channel has to be measured, but it will never carry a large volume of water. Farther down the stream a number of larger channels are formed, so that it is difficult to obtain a satisfactory station. Daily records of gage heights were not maintained at this point, but frequent measurements of discharge were made by Cyrus C. Babb and C. T. Prall during 1899, as follows:

*Measurements of Uinta River near Whiterocks, Utah.*

1899.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Second-feet.</i>		<i>Feet.</i>	<i>Second-feet.</i>
September 16.....	1.15	191	November 25.....	1.00	119
September 28.....	1.00	142	December 4.....	1.00	136
October 6.....	1.00	159	December 11.....	.97	136
October 18.....	1.10	165	December 18.....	1.00	124
November 2.....	1.00	141	December 28.....	(a)	86

a Ice.

WHITEROCKS RIVER NEAR WHITEROCKS, UTAH.

This stream drains the country immediately east of the head waters of Uinta River. It has its source in the peaks of the Uinta Mountains, which attain elevations of over 13,000 feet. The general course of the river is southerly, and it joins the main Uinta through numerous channels between Whiterocks and Fort Duchesne. A gaging station was established in the canyon of this river about 10 miles above the United States Indian agency at Whiterocks on September 15, 1899, by Cyrus C. Babb, in connection with the investigation of a water supply for the Uinta Indian Reservation. The gage rod consists of a 2 by 4 inch by 12 foot timber bolted to the triple trunk of a tree on the left bank of the stream. The bench mark is a nail in a burnt tree 50 feet east of the rod, and is at an elevation of 10.12 feet above gage datum. Discharge measurements are made from a car and cable 200 feet above the gage rod. The bed of this river is very rocky, is strewn with large bowlders, and although permanent in character is not altogether satisfactory because of the fact that it is impossible to obtain accurate soundings. Daily gage heights were not read at this point, owing to its distance

from any reliable observer. The following discharge measurements were made by C. C. Babb and C. T. Prall during 1899:

*Measurements of Whiterocks River near Whiterocks, Utah.*

1899.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Second-feet.</i>		<i>Feet.</i>	<i>Second-feet.</i>
September 15 .....		93	November 27 .....	1.05	66
September 29 .....	1.00	58	December 5 .....	1.10	71
October 7 .....	1.00	75	December 12 .....	.95	59
October 17 .....	1.10	85	December 19 .....	.95	56
November 1 .....	1.00	65	December 29 .....	(a)	66

a Ice.

UINTA RIVER AT FORT DUCHESNE, UTAH.

This river, on its emergence from its canyon, spreads out in numerous channels over its flood plain until a short distance above Fort Duchesne, where its waters are collected in one channel. Whiterocks River enters some distance above this point. A number of canals for the use of the Indians divert water between Fort Duchesne and the agency. On the east side are a number of small ditches, which in the aggregate take considerable water; but the amount is difficult to estimate. On the east side are two principal ditches, known as Canal No. 1 and Bench ditch. The former was measured on October 14, 1899, and was then carrying 16 second-feet; its maximum capacity is about double this quantity. Bench ditch, near its head, on the same day, was discharging 49 second-feet; its maximum capacity is somewhere in the neighborhood of 75 second-feet. This station was established September 14, 1899, in connection with the investigation of the water supply for the Uinta Indian Reservation, and is located at the highway bridge at the fort. The permanent rod was established November 8, 1899, and is nailed to the southern end of the east crib of the new bridge. The bench mark is a nail in the southeast crib in the first header above the bottom, and is at an elevation of 4,910.13 feet. The elevation of the zero of the rod is 4,907.20 feet. Daily gage readings were not obtained at this place. The following measurements of discharge were made by Cyrus C. Babb and C. T. Prall during 1899:

*Measurements of Uinta River at Fort Duchesne, Utah.*

1899.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Second-feet.</i>		<i>Feet.</i>	<i>Second-feet.</i>
September 14 .....		85	December 1 .....	2.55	120
September 26 .....	2.30	71	December 8 .....	2.43	112
October 27 .....	2.40	83	December 13 .....	2.40	107
November 3 .....	2.50	102	December 21 .....	2.35	102
November 18 .....	2.57	120	December 27 .....	2.59	131

UINTA RIVER AT OURAY SCHOOL.

This river, after leaving Fort Duchesne, receives as its principal tributary Dry Gulch Creek, which enters from the west. The natural flow of this tributary occurs only during flood stages, but for several years there has been a constant stream in it, being the waste water from the Indians' ditches above, principally from Canal No. 1 and Bench ditch. The station was established November 8, 1899, and is located at the highway bridge over the river near the Ouray School. The rod is nailed to the east end of the south crib of the wagon bridge. Bench mark No. 1 is the head of a nail in the extreme northeast corner of the bridge floor, and is at an elevation of 4,745.97 feet above sea; bench mark No. 2 is a nail in the flagstaff of the school, with an elevation of 4,760 feet. The elevation of the zero of the rod is 4,737.36 feet. During low water measurements are made, by wading, at a section 200 feet below the bridge, and at high stages they are made from the bridge itself. The section is a good one, although the center pier of the bridge will interfere somewhat with the accuracy of the results when measurements are taken there. The following measurements of discharge were made by Cyrus C. Babb and C. T. Prall during 1899:

- November 15, gage height, 0.53 foot; discharge, 124 second-feet.
- November 20, gage height, 0.56 foot; discharge, 124 second-feet.
- December 2, gage height, 0.49 foot; discharge, 120 second-feet.
- December 9, gage height, 0.50 foot; discharge, 115 second-feet.
- December 16, gage height, 0.45 foot; discharge, 103 second-feet.

*Daily gage height, in feet, of Uinta River at Ouray School, Utah, for 1899.*

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1....		0.51	9....		.52	17...	0.68		25...	0.46	
2....		.50	10....			18...	.64		26...	.51	
3....		.30	11....			19...	.60		27...	.46	
4....		.18	12....	0.57		20...	.58		28...	.61	
5....		.40	13....	.55		21...	.55		29...	.58	
6....		.40	14....	.58		22...	.50		30...	.50	
7....			15....	.57		23...	.59		31...		
8....		.60	16....	.99		24...	.52				

DUCHESNE RIVER AT PRICE ROAD BRIDGE, UTAH.

This stream has its source in the high peaks of the Uinta and Wasatch mountains, and flows in a general easterly direction, emptying into Green River 3 miles above the mouth of White River. Practically the entire drainage basin is included within the Uinta Indian Reservation. Strawberry Creek is an important tributary of the Duchesne and includes within its basin a tract of very fine grazing land, known as Strawberry Valley. The area is of a rolling character in contrast to the basin of the upper Duchesne, which is distinctly mountainous. A number of measurements were made of the tributaries of Duchesne

River in the fall of 1899, in connection with the water-supply investigations for the Uinta Indian Reservation. In Strawberry Valley a number of small tributaries, averaging about one second-foot each, contribute to the supply of the river. In September, 1899, Currant Creek was discharging 20 second-feet at the crossing of the Provo and Fort Duchesne road. Red Creek, farther to the east, was at the same date carrying 8 second-feet. Strawberry Creek 4 miles above its mouth was measured on September 10 and found to be carrying 134 second-feet. Duchesne River immediately above Strawberry Creek was carrying on the same day 302 second-feet. Lake Creek is an important tributary of Duchesne River from the north. At the bridge near its mouth it was found to be carrying 128 second-feet on September 11. The station on Duchesne River was established October 26, 1899, and is located 3 miles below the mouth of Lake Creek at the highway bridge on the stage road from Price to Fort Duchesne. The permanent gage rod was placed November 16, 1899, and is nailed to the east side of the center pier. Bench mark No. 1 is a wire nail in a log close to the rod, and is opposite the 7-foot mark. Bench mark No. 2 is a wire nail on the west side of the crib, with an elevation of 5.48 feet above gage datum. The section at this point is very good, with a moderate velocity of water. There is one pier in the center of the stream which does not materially affect the accuracy of the results at low water, but presumably will to a certain extent during the flood season. The following measurements of discharge were made by Cyrus C. Babb and C. T. Prall during 1899:

- October 26, gage height, 5.48 feet; discharge, 403 second-feet.
- November 16, gage height, 5.50 feet; discharge, 436 second-feet.
- November 29, gage height, 5.38 feet; discharge, 360 second-feet.
- December 7, gage height, 5.50 feet; discharge, 386 second feet.
- December 14, gage height, 5.10 feet; discharge, 309 second-feet.

*Daily gage height, in feet, of Duchesne River at Price road bridge, Utah, for 1899.*

Day.	Dec.	Day.	Dec.	Day.	Dec.	Day.	Dec.	Day.	Dec.
1.....	.....	8.....	5.52	14.....	5.00	20.....	5.40	26.....	5.94
2.....	.....	9.....	5.52	15.....	5.05	21.....	5.35	27.....	5.98
3.....	5.32	10.....	5.04	16.....	5.06	22.....	5.45	28.....	6.00
4.....	5.32	11.....	5.04	17.....	5.15	23.....	5.65	29.....	6.00
5.....	5.36	12.....	5.00	18.....	5.40	24.....	5.75	30.....	6.00
6.....	5.20	13.....	5.00	19.....	5.40	25.....	5.92	31.....	.....
7.....	5.52								

**GREEN RIVER AT BLAKE, UTAH.**

This river, in the lower portion of its course, drains a rough and broken country in eastern Utah not susceptible of irrigation and hardly adapted to grazing purposes. It is in canyon most of its way below the Rio Grande Western Railway and is very inaccessible. About 60

miles below the railroad crossing it receives the waters of Grand River, and the two streams form Colorado River. The station located at Blake, Utah, was established October 21, 1894. The rod of the wire gage is nailed to the guard rail on the lower side of the railroad bridge. The elevation of the top of the pier, to which the old vertical rod is attached, is 22 feet above gage datum. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 278; 1897, Nineteenth Annual Report, Part IV, page 398; 1898, Twentieth Annual Report, Part IV, page 387. One measurement of discharge was made during 1899 by J. S. Baker, on June 28, when, at a gage height of 10.19 feet, a discharge of 52,378 second-feet was found.

*Daily gage height, in feet, of Green River at Blake, Utah, for 1899.*

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1.....	1.80	2.10	2.00	3.55	5.85	7.15	9.55	5.40	3.25	2.50
2.....	1.80	2.10	2.00	3.50	5.65	7.25	9.35	5.15	3.20	2.40
3.....	1.80	2.20	2.10	3.50	5.55	7.35	9.15	5.20	3.20	2.40
4.....	1.80	2.20	2.10	3.50	5.25	7.45	8.95	6.60	3.20	2.40
5.....	1.80	2.10	2.20	3.40	5.05	7.55	8.75	6.55	3.20	2.40
6.....	1.80	2.10	2.20	3.40	4.85	7.65	8.55	6.40	3.10	2.40
7.....	1.80	2.10	2.20	3.40	4.95	7.75	8.40	6.30	3.10	2.40
8.....	1.80	2.10	2.20	3.30	5.15	7.85	8.30	6.15	3.10	2.40
9.....	1.80	2.10	2.20	3.30	5.50	8.05	8.20	6.00	3.10	2.40
10.....	1.80	2.10	2.30	3.20	5.90	8.20	8.10	5.85	3.00	2.40
11.....	1.80	2.10	2.30	3.20	6.15	8.30	8.00	5.65	3.00	2.40
12.....	1.80	2.10	2.30	3.30	6.35	8.40	7.90	5.45	3.00	2.40
13.....	1.90	2.10	2.30	3.30	6.55	8.50	7.80	5.25	2.90	2.40
14.....	1.90	2.00	2.30	3.30	6.65	8.50	7.70	5.20	2.85	2.40
15.....	1.90	2.00	2.35	3.40	6.95	8.65	7.60	5.10	2.80	.....
16.....	1.90	2.00	2.40	3.50	7.30	8.90	7.50	5.00	2.80	.....
17.....	1.90	2.00	2.40	3.60	7.55	9.20	7.40	4.95	2.80	.....
18.....	1.90	2.10	2.40	3.75	7.75	9.15	7.30	4.85	2.70	.....
19.....	2.00	2.10	2.50	3.95	7.75	9.10	7.15	4.75	2.70	.....
20.....	2.00	2.10	2.60	4.15	7.65	9.40	7.00	4.65	2.65	.....
21.....	2.00	2.00	2.70	4.35	7.60	9.50	6.85	4.55	2.60	.....
22.....	2.00	2.00	2.85	4.55	7.60	9.75	6.65	4.45	2.60	.....
23.....	2.00	2.00	3.05	4.75	7.50	9.90	6.45	4.25	2.55	.....
24.....	2.00	2.00	3.25	4.95	7.50	10.00	6.25	4.05	2.50	.....
25.....	2.10	2.00	3.45	5.05	7.40	10.05	6.05	3.85	2.50	.....
26.....	2.10	2.00	3.65	5.25	7.25	10.25	5.90	3.65	2.50	.....
27.....	2.20	2.00	3.85	5.45	7.05	10.30	5.75	3.50	2.50	.....
28.....	2.20	2.00	4.05	5.65	6.90	10.15	5.60	3.50	2.50	.....
29.....	2.20	.....	4.25	5.85	6.95	9.95	5.50	3.45	2.50	.....
30.....	2.20	.....	4.10	6.00	7.05	9.75	5.50	3.40	2.50	.....
31.....	2.20	.....	3.75	.....	7.10	.....	5.45	3.30	.....	.....

Station discontinued November 15.

GRAND RIVER AT GLENWOOD SPRINGS, COLORADO.

This river has its source on the western slope of the Continental Divide in north-central Colorado, near the head waters of North Platte, South Platte, and Arkansas rivers. It flows in a general southwesterly direction, passing out of the State into Utah, where it joins the Green River to form the Colorado. Little irrigation is practiced along the main stream, owing to the comparatively small area of land that can be utilized for that purpose. Two stations were maintained on this river during 1899, one at Glenwood Springs and the other at Grand Junction, Colorado. The former station was established by A. L. Fellows May 12, 1899, at the request of the Denver and Rio Grande

Railroad Company, and is located at the railroad bridge one-fourth of a mile west of the railroad station, and above the mouth of Roaring Fork. A wire gage is here used. Discharge measurements are made at the wagon bridge opposite Colorado Hotel in the town. The channel is good, composed of gravel and rock, and not liable to great changes. The banks are not subject to overflow. Gage readings were taken only during the high-water season, having been discontinued July 17, but the station will probably be resumed in 1900, when continuous measurements will be made. Roaring Fork was measured twice during the year, the first time on June 17, when, during the flood stage, the discharge was found to be 11,258 second-feet; the second time on November 17, when a discharge of 457 second-feet was found. Three measurements at the gaging station were made by A. L. Fellows in 1899. The first, on May 12, at a gage height of 6.05 feet, showed a discharge of 17,577 second-feet; the second, on June 17, at a gage height of 10.22 feet, showed a discharge of 29,187 second-feet; the third, on November 17, at a gage height of 2.75 feet, gave a discharge of 1,084 second-feet.

*Daily gage height, in feet, of Grand River at Glenwood Springs, Colorado, for 1899.*

Day.	May.	June.	July.	Day.	May.	June.	July.	Day.	May.	June.	July.
1.....		7.50	6.90	12....	6.05	9.35	5.90	23....	6.20	9.70	.....
2.....		7.40	7.10	13....	6.80	10.05	5.60	24....	6.30	9.30	.....
3.....		7.35	7.00	14....	7.50	10.40	5.30	25....	6.65	8.80	.....
4.....		7.20	7.00	15....	7.85	10.30	5.00	26....	7.15	8.50	.....
5.....		6.65	6.80	16....	8.15	10.10	4.90	27....	7.65	8.40	.....
6.....		6.45	6.70	17....	7.75	10.10	4.70	28....	7.70	8.20	.....
7.....		6.40	6.50	18....	7.65	10.20	.....	29....	7.45	7.20	.....
8.....		6.60	6.40	19....	7.80	10.60	.....	30....	7.50	7.00	.....
9.....		7.60	6.40	20....	8.00	10.65	.....	31....	7.60	.....	.....
10....		7.85	6.20	21....	7.50	10.60	.....				
11....		8.25	6.10	22....	6.75	10.40	.....				

Station discontinued July 18.

#### GRAND RIVER AT GRAND JUNCTION, COLORADO.

The station at this point, established October 18, 1894, is located at the wagon bridge across Grand River, near the pump house of the city waterworks at Grand Junction and a short distance above the mouth of Gunnison River. The river at this point discharges through two channels, and a separate record of each is maintained, with separate discharge measurements. The water in the right-hand channel does not run during the entire year, and in 1899 there was a discharge in it extending only from May 10 to July 15, inclusive. Gage rod No. 1, in the right-hand channel, consists of a 4 by 6 inch timber bolted to the bridge abutment on the right-hand side of the right channel. The bench mark is the top of the bridge abutment and is 12 feet above gage datum. The horizontal wire gage No. 2 is fastened to the upper side

of the bridge over the left channel. The bench mark is a cross on iron post of bridge at 592-foot mark on right abutment, and is 31 feet above gage datum. The results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 261; 1897, Nineteenth Annual Report, Part IV, page 401; 1898, Twentieth Annual Report, Part IV, page 389. Only two measurements of discharge were made during the year on the right channel, and these by A. L. Fellows. The first, on May 13, with a gage height of 3.15 feet, gave a discharge of 2,758 second-feet; the second, on June 18, with a gage height of 5.55 feet, showed a discharge of 8,954 second-feet. During 1899 the following measurements of discharge on the left channel were made by A. L. Fellows:

- April 15, gage height, 4.70 feet; discharge, 2,946 second-feet.
- May 13, gage height, 10 feet; discharge, 20,395 second-feet.
- June 18, gage height, 11.55 feet; discharge, 30,000 second-feet.
- September 19, gage height, 4.20 feet; discharge, 1,989 second-feet.
- November 18, gage height, 3.90 feet; discharge, 1,916 second-feet.

*Daily gage height, in feet, of Grand River at Grand Junction, Colorado, for 1899.*

[Rod No. 1.]

Day.	May.	June.	July.	Day.	May.	June.	July.	Day.	May.	June.	July.
1...	.....	3.90	3.90	12....	1.95	4.85	0.90	23....	2.70	5.80	.....
2...	.....	3.95	4.00	13....	3.05	5.45	.95	24....	2.60	5.20	.....
3...	.....	3.80	4.10	14....	3.55	5.80	.80	25....	2.95	4.85	.....
4...	.....	3.40	3.90	15....	4.00	5.90	.20	26....	3.35	4.70	.....
5...	.....	3.05	3.40	16....	4.30	5.85	.....	27....	3.85	4.50	.....
6...	.....	2.95	2.90	17....	4.45	5.75	.....	28....	4.10	4.10	.....
7...	.....	2.95	2.65	18....	4.10	5.70	.....	29....	3.85	4.00	.....
8...	.....	3.25	2.25	19....	4.20	5.90	.....	30....	3.80	3.95	.....
9...	.....	3.45	1.90	20....	4.20	6.10	.....	31....	3.95	.....	.....
10...	0.40	3.90	1.50	21....	4.15	6.45	.....				
11...	.90	4.35	1.20	22....	3.50	6.10	.....				

Water was running in this channel only during the time when records are given.

*Daily gage height, in feet, of Grand River at Grand Junction, Colorado, for 1899.*

[Rod No. 2.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....		3.80	3.40	6.75	10.50	10.30	6.50	4.45	.....	.....	.....
2.....		3.80	3.45	6.45	10.55	10.50	6.50	4.65	.....	.....	.....
3.....		3.80	3.55	6.30	10.45	10.50	6.40	4.60	3.80	.....	.....
4.....		3.40	3.60	6.05	10.00	10.35	7.35	4.45	.....	.....	.....
5.....			3.60	5.80	9.50	9.90	7.00	4.35	.....	.....	.....
6.....			3.60	5.75	9.35	9.70	6.85	4.30	.....	.....	.....
7.....			3.60	6.00	9.30	9.55	6.65	4.20	.....	.....	.....
8.....		3.60	3.60	6.40	9.55	9.30	6.45	4.20	.....	.....	.....
9.....			3.60	6.95	9.85	9.05	6.20	4.15	.....	.....	.....
10.....			3.70	7.50	10.30	8.85	5.90	4.10	3.90	3.90	.....
11.....		3.60	3.75	8.15	10.45	8.70	5.75	4.10	.....	.....	.....
12.....			3.85	8.95	10.70	8.55	5.65	4.10	.....	.....	3.70 <sup>a</sup>
13.....			4.05	9.75	11.20	8.65	5.55	4.05	.....	.....	.....
14.....			4.40	10.25	11.60	8.55	5.45	3.95	.....	.....	.....
15.....		3.40	4.60	10.65	11.70	8.40	5.40	4.10	.....	3.90	.....
16.....			4.65	10.85	11.65	8.35	5.35	4.35	.....	.....	.....
17.....			4.90	10.80	11.65	8.15	5.25	4.30	.....	.....	.....
18.....		3.50	5.20	10.70	11.60	7.85	5.20	4.30	.....	.....	.....
19.....			5.45	10.80	11.80	7.65	5.15	4.20	4.40	.....	.....
20.....			5.55	10.80	11.90	7.45	4.95	4.15	.....	.....	.....
21.....			5.35	10.60	11.95	7.35	4.85	4.10	.....	.....	.....
22.....	4.10	3.80	5.15	10.05	11.80	7.25	4.75	4.05	.....	3.90	.....
23.....	4.10		5.35	9.50	11.55	7.15	4.65	3.95	.....	.....	.....
24.....	4.10		5.95	9.55	11.15	7.05	4.55	3.90	.....	.....	.....
25.....	4.00	4.10	6.55	9.95	10.90	6.95	4.50	3.90	.....	.....	.....
26.....			7.00	10.45	10.80	6.85	4.45	3.90	.....	.....	.....
27.....			7.55	10.75	10.65	6.65	4.40	3.95	4.00	.....	.....
28.....			7.70	10.70	10.45	6.60	4.30	3.90	.....	.....	.....
29.....		3.70	7.25	10.45	10.40	6.55	4.30	3.90	.....	3.90	.....
30.....			7.10	10.40	10.35	6.50	4.30	3.90	.....	.....	.....
31.....			.....	10.60	.....	6.50	4.30	.....	.....	.....	.....

<sup>a</sup> River frozen.

#### UNCOMPAHGRE RIVER AT FORT CRAWFORD, COLORADO.

This river has its source in Ouray County, in the high peaks in southwestern Colorado, and flows in a general northwesterly direction, entering Gunnison River at Delta. The upper portion of its drainage basin is mountainous, but proceeding downstream the character changes to a more rolling country, and irrigation is possible along the valleys and adjacent mesas. In the vicinity of Montrose a number of canals divert nearly all of the low water flow, and recourse must be had to storage for the further irrigation of the country. The station established June 25, 1895, is located about one-half mile east of the depot at Fort Crawford, at a wagon bridge, and is about 8 miles above Montrose. The gage consists of an inclined timber bolted to the bridge trestle on the right-hand side of the stream. The bench mark is a spike driven into the base of a cottonwood post near by, and is 9.18 feet above gage datum. The channel has been changing a great deal, and a new location for the station will probably be found during the next season. On September 20 a measurement of this river was made at Montrose, at a gage height of 0.40 foot, which gave a discharge of 15 second-feet. On November 20, at a gage height of 0.45 foot, at the same point, the discharge was 15 second-feet. A measurement of Montrose canal at its head gate was made September 21, at a gage height of 0.67 foot, and showed a discharge of 30

second-feet. Results of measurements may be found as follows: 1896, Eighteenth Annual Report, Part IV, page 266; 1897, Nineteenth Annual Report, Part IV, page 402; 1898, Twentieth Annual Report, Part IV, page 391. The following measurements of discharge were made by A. L. Fellows during 1899:

- April 16, gage height, 4.50 feet; discharge, 328 second-feet.
- May 15, gage height, 5.22 feet; discharge, 747 second-feet.
- June 19, gage height, 5.18 feet; discharge, 773 second-feet.
- September 21, gage height, 3.65 feet; discharge, 69 second-feet.
- November 20, gage height, 3.70 feet; discharge, 79 second-feet.

*Daily gage height, in feet, of Uncompahgre River at Fort Crawford, Colorado, for 1899.*

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1....	.....	4.35	5.05	4.70	4.00	3.00	17.....	4.55	5.35	5.35	4.35	3.85	3.70
2....	3.80	4.45	5.05	4.70	4.15	3.00	18.....	4.60	5.45	5.35	4.45	3.85	3.60
3....	3.85	4.35	4.80	4.55	4.80	2.95	19.....	4.55	5.30	5.30	4.45	3.80	3.70
4....	3.80	4.35	4.40	4.25	4.65	2.95	20.....	4.45	4.95	5.25	4.35	3.80	3.75
5....	3.88	4.30	4.35	4.35	4.55	2.80	21.....	4.35	4.90	5.10	4.35	3.75	3.75
6....	3.82	4.40	5.05	4.25	4.30	2.80	22.....	4.40	4.80	5.05	4.25	3.70	3.60
7....	3.80	4.35	5.05	4.20	3.90	2.80	23.....	4.60	4.80	4.95	4.05	3.70	3.50
8....	3.85	4.30	5.00	4.10	3.95	2.80	24.....	4.58	4.65	4.80	4.10	3.35	3.50
9....	3.95	4.35	5.15	4.25	3.80	2.80	25.....	4.75	4.95	4.80	4.10	3.85	3.55
10....	4.25	4.40	5.45	4.20	3.90	2.75	26.....	4.70	5.00	5.00	4.20	3.85	3.55
11....	4.15	4.70	5.40	4.35	4.00	2.80	27.....	4.68	5.10	4.90	4.35	3.60	3.50
12....	4.25	4.65	5.45	4.45	4.00	2.85	28.....	4.55	5.10	4.85	4.00	3.45	3.50
13....	4.30	4.90	5.85	4.50	3.95	2.90	29.....	4.45	5.10	4.85	4.10	3.40	3.45
14....	4.35	5.10	5.75	4.50	3.95	3.85	30.....	4.30	5.35	4.70	4.15	3.30	3.45
15....	4.40	5.15	5.85	4.35	3.95	3.95	31.....	.....	5.35	.....	4.05	3.20	.....
16....	4.55	5.25	5.55	4.40	3.85	3.70							

Closed for the winter September 30.

GUNNISON RIVER AT GRAND JUNCTION, COLORADO.

This river, the principal tributary of Grand River, has its source on the western slope of the Continental Divide in south-central Colorado, and flows in a general westerly direction into Grand River at Grand Junction. There were two gaging stations maintained within its basin during the last season, one at Fort Crawford, on the Uncompahgre, and the other at Grand Junction, at the mouth of Gunnison River. This latter station was established in May, 1897, and is located at the iron highway bridge one and one-half miles from the town of Grand Junction. The gage is vertical and consists of a timber bolted to the stone pier of the bridge. The bench mark is the top of the capstone of the bridge pier, and is 17.60 feet above gage datum. The measurements here are not satisfactory, owing to the fact that at high stages of Grand River the water backs up the mouth of the Gunnison considerably above the point where the gage rod upon the latter is located, thus affecting the gage readings so seriously that no satisfactory rating table can be made for this point. The station will not be resumed the coming year. Results of measurements may be found as follows: 1897, Nineteenth Annual Report, Part IV, page

405; 1898, Twentieth Annual Report, Part IV, page 390. The following measurements of discharge were made by A. L. Fellows during 1899:

April 15, gage height, 3.50 feet; discharge, 3,002 second-feet.

May 13, gage height, 7 feet; discharge, 14,280 second-feet.

June 18, gage height, 7.15 feet; discharge, 12,769 second-feet.

September 19, gage height, 2.20 feet; discharge, 1,061 second-feet.

November 18, gage height, 2 feet; discharge, 968 second-feet.

*Daily gage height, in feet, of Gunnison River at Grand Junction, Colorado, for 1899.*

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1....	2.00	4.60	6.60	5.60	3.00	1.80	17.....	3.90	7.30	7.20	3.80	2.70	1.80
2....	2.10	4.50	6.50	5.40	4.30	1.90	18.....	4.20	7.00	7.10	3.80	2.60	1.90
3....	2.00	4.40	6.40	5.60	3.10	1.80	19.....	4.30	7.10	7.20	3.70	2.60	2.10
4....	2.00	4.00	6.00	5.60	3.80	1.90	20.....	4.50	7.30	7.30	3.90	2.50	2.00
5....	2.00	4.00	5.60	5.40	4.00	1.90	21.....	4.20	7.00	7.20	3.80	2.40	1.80
6....	2.00	4.00	5.50	5.00	3.60	1.90	22.....	3.90	6.50	7.10	3.70	2.40	1.60
7....	2.10	4.10	5.50	4.90	3.40	2.00	23.....	4.20	5.80	6.80	3.60	2.20	1.60
8....	2.10	4.30	5.80	4.20	3.30	1.90	24.....	4.70	5.90	6.50	3.50	2.10	1.60
9....	2.20	4.80	5.90	4.20	3.20	1.60	25.....	5.00	6.20	6.40	3.30	2.00	1.60
10....	2.30	5.20	6.00	4.10	3.20	1.50	26.....	5.40	6.40	6.40	3.20	1.80	1.50
11....	2.60	5.80	6.50	4.00	3.00	1.50	27.....	5.70	6.50	6.50	3.00	1.80	1.40
12....	2.80	6.30	6.90	3.90	2.70	1.40	28.....	5.60	6.70	6.10	3.30	1.80	1.40
13....	3.00	6.60	7.30	3.90	2.70	1.40	29.....	5.40	6.50	5.80	3.60	1.80	1.40
14....	3.40	7.20	7.50	4.00	2.70	1.60	30.....	5.00	6.40	5.70	3.30	1.80	1.30
15....	3.60	7.40	7.50	4.00	2.70	1.80	31.....	.....	6.60	.....	3.20	2.10	.....
16....	3.70	7.50	7.40	3.90	2.70	1.80							

Station discontinued September 30.

[Continued in Water-Supply and Irrigation Paper No. 38.]

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