

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 340—F

STREAM-GAGING STATIONS
AND
PUBLICATIONS RELATING TO WATER RESOURCES
1885-1913

PART VI. MISSOURI RIVER BASIN

COMPILED BY B. D. WOOD

Part of Water-Supply Paper 340



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STREAM-GAGING STATIONS AND PUBLICATIONS RELATING TO WATER RESOURCES, 1885-1913.

Compiled by B. D. Wood.

INTRODUCTION.

Investigation of water resources by the United States Geological Survey has consisted in large part of measurements of the volume of flow of streams and studies of the conditions affecting that flow, but it has comprised also investigation of such closely allied subjects as irrigation, water storage, water powers, underground waters, and quality of waters. Most of the results of these investigations have been published in the series of water-supply papers, but some have appeared in the monographs, bulletins, professional papers, and annual reports.

The results of stream-flow measurements are now published annually in twelve parts, each part covering an area whose boundaries coincide with natural drainage features as indicated below:

- Part I. North Atlantic basins.
- II. South Atlantic and eastern Gulf of Mexico basins.
- III. Ohio River basin.
- IV. St. Lawrence River basin.
- V. Upper Mississippi River and Hudson Bay basins.
- VI. Missouri River basin.
- VII. Lower Mississippi River basin.
- VIII. Western Gulf of Mexico basins.
- IX. Colorado River basin.
- X. Great Basin.
- XI. Pacific basins in California.
- XII. North Pacific basins.

HOW GOVERNMENT REPORTS MAY BE OBTAINED OR CONSULTED.

Water-supply papers and other publications of the United States Geological Survey containing data in regard to the water resources of the United States may be obtained or consulted as indicated below.

1. Copies may be obtained free of charge by applying to the Director of the Geological Survey, Washington, D. C. The edition printed for free distribution is, however, small and is soon exhausted.

2. Copies may be purchased at nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C., who will on application furnish lists giving prices.

3. Sets of the reports may be consulted in the libraries of the principal cities in the United States.

4. Complete sets are available for consultation in the local offices of the water-resources branch of the Geological Survey, as follows:

Albany, N. Y., Room 18, Federal Building.
 Atlanta, Ga., Post Office Building.
 St. Paul, Minn., Old Capitol Building.
 Helena, Mont., Montana National Bank Building.
 Denver, Colo., 302 Chamber of Commerce Building.
 Salt Lake City, Utah, Federal Building.
 Boise, Idaho, 615 Idaho Building.
 Phoenix, Ariz., 417 Fleming Building.
 Portland, Oreg., 416 Couch Building.
 Tacoma, Wash., Federal Building.
 San Francisco, Cal., 328 Customhouse.
 Los Angeles, Cal., Federal Building.
 Santa Fe, N. Mex., Capitol Building.
 Honolulu, Hawaii, Kapiolani Building.

A list of the Geological Survey's publications will be sent on application to the Director of the United States Geological Survey, Washington, D. C.

STREAM-FLOW REPORTS.

Stream-flow records have been obtained at more than 1,550 points in the United States, and the data obtained have been published in the reports tabulated below:

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

[A=Annual Report; B=Bulletin; WS=Water-Supply Paper.]

Report.	Character of data.	Year.
10th A, pt. 2.....	Descriptive information only.....	
11th A, pt. 2.....	Monthly discharge and descriptive information.....	1884 to Sept., 1890.
12th A, pt. 2.....	do.....	1884 to June 30, 1891.
13th A, pt. 3.....	Mean discharge in second-feet.....	1884 to Dec. 31, 1892.
14th A, pt. 2.....	Monthly discharge (long-time records, 1871 to 1893).....	1888 to Dec. 31, 1893.
B 131.....	Descriptions, measurements, gage heights, and ratings.....	1893 and 1894.
16th A, pt. 2.....	Descriptive information only.....	
B 140.....	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).....	1895.
WS 11.....	Gage heights (also gage heights for earlier years).....	1896.
18th A, pt. 4.....	Descriptions, measurements, ratings, and monthly discharge (also similar data for some earlier years).....	1895 and 1896.
WS 15.....	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.....	1897.
WS 16.....	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.....	1897.
19th A, pt. 4.....	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).....	1897.
WS 27.....	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.....	1898.
WS 28.....	Measurements, ratings, and gage heights, Arkansas River and western United States.....	1898.
20th A, pt. 4.....	Monthly discharge (also for many earlier years).....	1898.
WS 35 to 39.....	Descriptions, measurements, gage heights, and ratings.....	1899.
21st A, pt. 4.....	Monthly discharge.....	1899.
WS 47 to 52.....	Descriptions, measurements, gage heights, and ratings.....	1900.
22d A, pt. 4.....	Monthly discharge.....	1900.
WS 65, 66.....	Descriptions, measurements, gage heights, and ratings.....	1901.

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

Report.	Character of data.	Year.
WS 75.....	Monthly discharge.....	1901.
WS 82 to 85.....	Complete data.....	1902.
WS 97 to 100.....	do.....	1903.
WS 124 to 135.....	do.....	1904.
WS 165 to 178.....	do.....	1905.
WS 201 to 214.....	do.....	1906.
WS 241 to 252.....	do.....	1907-8.
WS 261 to 272.....	do.....	1909.
WS 281 to 292.....	do.....	1910.
WS 301 to 312.....	do.....	1911.
WS 321 to 332 ^a	do.....	1912.
WS 351 to 362 ^a	do.....	1913.

^a In preparation.

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

The records at most of the stations discussed in these reports extend over a series of years, and miscellaneous measurements at many points other than regular gaging stations have been made each year. An index of the reports containing records obtained prior to 1904 has been published in Water-Supply Paper 119.

The following table gives, by years and drainage basins, the numbers of the papers on surface-water supply published from 1899 to 1913. The data for any particular station will be found in the reports covering the years during which the station was maintained. For example, data for Machias River at Whitneyville, Me., 1903 to 1913, are published in Water-Supply Papers 97, 124, 165, 201, 241, 261, 281, 301, 321, and 351, which contain records for the New England streams from 1903 to 1913. Results of miscellaneous measurements are published by drainage basins.

Numbers of water-supply papers containing results of stream measurements, 1899-1913.

	1899 ^a	1900 ^b	1901	1902	1903	1904	1905	1906	1907-8	1909	1910	1911	1912	1913
North Atlantic	35	47, ^c 48	65, 75	82	97	^d 124, ^e 125 ^f 126	^d 165, ^e 166 ^f 167	^d 201, ^e 202 ^f 203	241	261	281	301	321	351
South Atlantic and eastern Gulf of Mexico	^g 35, 36	48	65, 75	^g 82, 83	^g 97, 98	^f 126, 127	^f 167, 168	^f 203, 204	242	262	282	302	322	352
Ohio River basin.....	36	48, ^h 49	65, 75	83	98	128	169	205	243	263	283	303	323	353
St. Lawrence River and Great Lakes.....	36	49	65, 75	ⁱ 82, 83	97	129	170	206	244	264	284	304	324	354
Hudson Bay and Upper Mississippi River.....	36	49	^j 65, 66, 75	^j 83, 85	^j 98, 99, ^k 100	^j 128, 130	171	207	245	265	285	305	325	355
Missouri River.....	^l 36, 37	49, ^m 50	66, 75	84	99	130, ⁿ 131	172	208	246	266	286	306	326	356
Lower Mississippi River....	37	50	^j 65, 66, 75	^j 83, 84	^j 98, 99	^j 128, 131	^j 169, 173	^j 205, 209	247	267	287	307	327	357
Western Gulf of Mexico....	37	50	66, 75	84	99	132	174	210	248	268	288	308	328	358
Colorado River.....	^o 37, 38	50	66, 75	85	100	133	175, ^p 177	211	249	269	289	309	329	359
Great Basin.....	38, ^q 39	51	66, 75	85	100	133, ^r 134	176, ^r 177	212, ^r 213	250, ^r 251	270, ^r 271	290, ^r 291	310	330	360
California.....	38, ^s 39	51	66, 75	85	100	134	177	213	251	271	291	311	331	361
North Pacific	38	51	66, 75	85	100	135	^t 177, 178	214	252	272	292	312	^u 332	^u 362

^a Rating tables and index to Water-Supply Papers 35-39 contained in Water-Supply Paper 39.

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

^c Wissahickon and Schuylkill rivers to James River.

^d New England rivers only.

^e Hudson River to Delaware River, inclusive.

^f Susquehanna River to Yadkin River, inclusive.

^g James River only.

^h Scioto River.

ⁱ Lake Ontario and tributaries to St. Lawrence River proper.

^j Tributaries of Mississippi from east.

^k Hudson Bay only.

^l Gallatin River.

^m Loup and Platte rivers near Columbus, Nebr., and all tributaries below junction with Platte.

ⁿ Platte and Kansas rivers.

^o Green and Gunnison rivers and Grand River above junction with Gunnison.

^p Below junction with Gila.

^q Mohave River only.

^r Great Basin in California, excepting Truckee and Carson drainage basins.

^s Kings and Kern rivers only.

^t Rogue, Umpqua, and Siletz rivers only.

^u Published in three parts: A, Pacific drainage in Washington and upper Columbia River; B, Snake River basin; C, Lower Columbia River and Pacific drainage in Oregon.

In these papers and in the following lists the stations are arranged in downstream order. The main stem of any river is determined by measuring or estimating its drainage area—that is, the headwater stream having the largest drainage area is considered the continuation of the main stream, and local changes in name and lake surface are disregarded. All stations from the source to the mouth of the main stem of the river are presented first, and the tributaries in regular order from source to mouth follow, the streams in each tributary basin being listed before those of the next basin below.

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

PART VI. MISSOURI RIVER BASIN.

PRINCIPAL STREAMS.

The principal streams in the Missouri River basin are Red Rock, Beaverhead, and Jefferson rivers, which may be considered a continuous river forming the head of the Missouri; and, below the mouth of the Jefferson, Madison, Gallatin, Prickly Pear, Little Prickly Pear, Dearborn, Sun, Marias, Judith, Musselshell, Milk, Yellowstone, Little Muddy, Little Missouri, Cheyenne, Niobrara, Platte (including North Platte and South Platte), Kansas, Osage (Marais des Cygnes), and Gasconade rivers. These streams drain wholly or in part the States of Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

In addition to the annotated list of publications relating specifically to the section, these pages contain a similar list of reports that are of general interest in many sections and cover a wide range of hydrologic subjects, and also brief references to reports published by State and other organizations. (See pp. 80-81.)

GAGING STATIONS.

NOTE.—Dash after a date indicates that station was being maintained June 30, 1913; period after a date indicates discontinuance.

Red Rock River (head of Missouri) above Red Rock reservoir, near Monida, Mont., 1911.

Red Rock River below Red Rock reservoir, near Monida, Mont., 1911-

Red Rock River at Lima, Mont., 1907-1911.

Red Rock River at Red Rock, Mont., 1890.

Beaverhead River (continuation of Red Rock River) at Barratts, Mont., 1907-

Beaverhead River at Dillon, Mont., 1907.

Jefferson River (continuation of Red Rock-Beaverhead River) near Sappington, Mont., 1894-95.

Jefferson River near Silverstar, Mont., 1910-

Missouri River near Townsend, Mont., 1891-1904.

Missouri River at Canyon Ferry, Mont., 1889.

Missouri River near Craig, Mont., 1890-1892.

Missouri River at Toston, Mont., 1890; 1910-

Missouri River at Cascade, Mont., 1902-

Missouri River at Great Falls, Mont., 1897-1905.

Missouri River at Fort Benton, Mont., 1910-

Missouri River near Williston, N. Dak., 1905-1907.

Missouri River at Mannhaven, N. Dak., 1904-1905.

Missouri River at Washburn, N. Dak., 1904; 1905.

Missouri River at Bismarck, N. Dak., 1904-5.

Missouri River near Nesson, N. Dak., 1904-5.

Missouri River at Kansas City, Mo., 1905-6.

Passamari River [Ruby River] near Alder, Mont., 1911-

Bighole River near Dewey, Mont., 1910-

Pipestone Creek near Whitehall, Mont., 1910-11.

Whitetail Creek near Whitehall, Mont., 1910-11.

Little Whitetail Creek near Whitehall, Mont., 1911.

Boulder Creek:

Muskrat Creek near Boulder, Mont., 1912-

Gibbon River (head of Madison River) near Yellowstone, Mont., 1913-

Madison River near Yellowstone, Mont., 1913-

Madison River near Red Bluff, Mont., 1890-1894.

Madison River near Norris, Mont., 1897-1905; 1910.

Madison River near Three Forks, Mont., 1893-1897.

West Gallatin River (head of Gallatin River) near Salesville, Mont., 1895-1905; 1910-

West Gallatin River near Bozeman, Mont., 1889-1894.

Gallatin River at Logan, Mont., 1893-1905.

Middle Creek near Bozeman, Mont., 1895-96; 1898-1900; 1902-3.

Crow Creek near Radersburg, Mont., 1901.

Crow Creek near Townsend, Mont., 1912-

Deep Creek near Townsend, Mont., 1910-

Prickly Pear Creek near Clancy, Mont., 1908-

Prickly Pear Creek at East Helena, Mont., 1908-

Lump Gulch Creek near Clancy, Mont., 1908-

Tenmile Creek near Helena, Mont., 1908-

Sevenmile Creek at Birdseye, Mont., 1908-

Little Prickly Pear Creek near Marysville, Mont., 1909-

Little Prickly Pear Creek near Canyon Creek, Mont., 1909-1912; 1913-

Deadman Creek near Marysville, Mont., 1909-1911.

Lost Horse Creek near Marysville, Mont., 1909-1911.

Marsh Creek near Marysville, Mont., 1909-1911.

Dearborn River near Clemons, Mont., 1908-1911.

Falls Creek near Clemons, Mont., 1908-1911.

Smith River at Truly, Mont., 1905-1907.

Sun River, North Fork of North Fork (head of Sun River), near Augusta, Mont., 1911-12.

Sun River, North Fork, near Augusta, Mont., 1889-90; 1903-

Sun River at Fort Shaw, Mont., 1912-

Sun River at Sun River, Mont., 1905-1912.

Sun River near Great Falls, Mont., 1897.

South Fork of North Fork of Sun River near Augusta, Mont., 1911-12.

Willow Creek near Augusta, Mont., 1905-1911; 1912-

South Fork of Sun River at Augusta, Mont., 1904-

Ford Creek near Augusta, Mont., 1906-1912.

Smith Creek near Augusta, Mont., 1906-1912.

Sun River canals:

Floweree Big canal near Fort Shaw, Mont., 1912.

Crown Butte canal at Riebling, Mont., 1912.

Crown Butte canal near Simms, Mont., 1912.

Sun River canal near Sun River, Mont., 1912.

Sun River canal at Vaughan, Mont., 1912.

Belt Creek near Belt, Mont., 1905-6.

Highwood Creek near Highwood, Mont., 1905-6.

Marias River near Shelby, Mont., 1902-1906; 1911-

Two Medicine River near Midvale, Mont., 1902-3.

Missouri River tributaries—Continued.

Marias River tributaries—Continued.

- Two Medicine River at Family, Mont., 1907–
- Badger Creek near Family, Mont., 1907–
- Cut Bank Creek at Cut Bank, Mont., 1905–
- Birch Creek at Swift dam, near Dupuyer, Mont., 1913–
- Birch Creek near Dupuyer, Mont., 1907–
- Birch Creek at Hall's ranch, near Dupuyer, Mont., 1913–
- Dupuyer Creek at Dupuyer, Mont., 1908–12.
- Dupuyer Creek near Valier, Mont., 1912–
- Dry Fork of Marias River near Valier, Mont., 1911–
- Teton River at Strabane [near Belleview], Mont., 1904–6; 1908–
- Teton River at Chouteau, Mont., 1904–1906; 1913–
- Deep Creek at Frazier's ranch, Mont., 1912.
- Deep Creek near Chouteau, Mont., 1911–
- Willow Creek near Chouteau, Mont., 1912–
- Spring Creek near Strabane, Mont., 1913–
- Muddy Creek near Bynum, Mont., 1912–
- Blackleaf Creek near Bynum, Mont., 1912–
- Judith River near Lewistown, Mont., 1910–11.
- Musselshell River, North Fork (head of Musselshell River), near Delpine, Mont., 1909–10.
- Musselshell River, North Fork, near Martinsdale, Mont., 1907–
- Musselshell River at Harlowton, Mont., 1907–
- Musselshell River at Shawmut, Mont., 1902–1907.
- Musselshell River at Lavina, Mont., 1906.
- Checkerboard Creek near Delpine, Mont., 1909–1912; 1913–
- South Fork of Musselshell River near Martinsdale, Mont., 1907–
- American Fork near Harlowton, Mont., 1907–1911; 1913–
- Lebo Creek near Harlowton, Mont., 1907–1911; 1913–
- Flatwillow Creek near Flatwillow, Mont., 1911–
- Milk River, South Fork (head of Milk River), near Browning, Mont., 1905–
- Milk River at international boundary, 1913–
- Milk River at Havre, Mont., 1908–
- Milk River at Chinook, Mont., 1897.
- Milk River at Malta, Mont., 1902–
- Milk River at Hinsdale, Mont., 1908–
- West Fork of Milk River at Chinook, Mont., 1906–1909.
- North Fork of Milk River near Kimball, Alberta, 1913–
- North Fork of Milk River near Browning, Mont., 1911–12.
- North Fork of Milk River near Chinook, Mont., 1905–
- Beaver Creek near Saco (Ashfield), Mont., 1903–1906; 1908–1912.
- Beaver Creek overflow near Bowdoin, Mont., 1903–1906; 1908–1912.
- Rock Creek near Hinsdale, Mont., 1905–1907; 1912–
- Porcupine Creek at Nashua, Mont., 1908–
- Canals in Milk River basin:
 - Paradise Valley canal near Chinook, Mont., 1903–
 - Cook canal near Chinook, Mont., 1905–
 - Matheson canal near Chinook, Mont., 1905–
 - Reser ditch near Chinook, Mont., 1905–6.
 - West Fork ditch near Chinook, Mont., 1905–6.
 - Fort Belknap canal near Chinook, Mont., 1903–
 - Harlem canal near Zurich, Mont., 1903–
 - Agency ditch near Harlem, Mont., 1905–
 - Winter-Anderson canal near Chinook, Mont., 1906; 1908.
 - Rock Creek canal near Hinsdale, Mont., 1905–1907.

Missouri River tributaries—Continued.

- Little Porcupine Creek near Frazer, Mont., 1908-
- Wolf Creek near Wolf Point, Mont., 1908-
- Wolf Point ditch at Wolf Point, Mont., 1909.
- Poplar River near Poplar, Mont., 1908-
- Big Muddy Creek near Culbertson, Mont., 1908-
- Yellowstone River at Canyon Hotel, Mont., 1913-
- Yellowstone River at Corwin, Mont., 1910-
- Yellowstone River near Horr, Mont., 1889-1893.
- Yellowstone River at Livingston, Mont., 1897-1905.
- Yellowstone River at Billings, Mont., 1904-5.
- Yellowstone River at Huntley, Mont., 1907-
- Yellowstone River at Junction, Mont., 1906-7.
- Yellowstone River near Glendive, Mont., 1897-
 - Big Timber Creek, North Fork, near Big Timber, Mont., 1907-1911.
 - Big Timber Creek near Big Timber, Mont., 1912-
 - South Fork of Big Timber Creek near Big Timber, Mont., 1907-1911.
 - Boulder River near Contact, Mont., 1910-
 - Boulder River near McLeod, Mont., 1912-
 - East Fork of Boulder River near McLeod, Mont., 1907-1909.
 - West Fork of Boulder River near Bruffeys, Mont., 1907-1910.
 - West Fork of Boulder River at McLeod, Mont., 1907-
 - Sweetgrass Creek above Melville, Mont., 1907-
 - Sweetgrass Creek below Melville, Mont., 1907-
 - Stillwater River near Nye, Mont., 1911-1913.
 - Stillwater River near Absarokee, Mont., 1910-
 - Woodbine Creek near Nye, Mont., 1911-1913.
 - Rosebud River at Absarokee, Mont., 1910-
- Clark Fork at Fromberg, Mont., 1905-
- Pryor Creek near Coburn, Mont., 1911-
- Pryor Creek at Huntley, Mont., 1904-
- Wind River (head of Bighorn) at Dubois, Wyo., 1911-12.
- Wind River near Wind River, Wyo., 1908-9.
- Wind River at Riverton, Wyo., 1906-1908; 1911-12.
- Bighorn River at Thermopolis, Wyo., 1900-1905; 1910-12.
- Bighorn River near Hardin, Mont., 1904-
 - Warm Spring Creek near Dubois, Wyo., 1911-12
 - Horse Creek at Dubois, Wyo., 1911-12.
 - Red Creek near Dubois, Wyo., 1909.
 - Dinwoody Creek near Crowheart, Wyo., 1909.
 - Meadow Creek near J. K. ranch, Wyo., 1909.
 - Willow Creek at J. K. ranch, Wyo., 1909.
 - Bull Lake Creek near J. K. ranch, Wyo., 1909.
 - Dry Creek at Crowheart, Wyo., 1909.
 - Little Wind River at Fort Washakie, Wyo., 1908-9.
 - Little Wind River above Arapahoe, Wyo., 1906-1909; 1911-12.
 - Little Wind River below Arapahoe, Wyo., 1906-1909; 1911-12.
 - South Fork of Little Wind River near Wind River, Wyo., 1909.
 - St. Lawrence Creek near Wind River, Wyo., 1909.
 - Trout Creek at Wind River, Wyo., 1909.
 - Popo Agie River near Lander, Wyo., 1911-12.
 - Little Popo Agie River at Hudson, Wyo., 1907-1909; 1911-1912.
 - Owl Creek near Thermopolis, Wyo., 1910-1912.

Missouri River tributaries—Continued.

Yellowstone River—Continued.

Bighorn River—Continued.

- No Wood River at Bonanza, Wyo., 1910-1912.
- Tensleep Creek near Tensleep, Wyo., 1910-1912.
- Paintrock Creek near Hyattville, Wyo., 1911-12.
- Paintrock Creek near Bonanza, Wyo., 1910-1912.
- Grey Bull River near Meeteetse, Wyo., 1897; 1903; 1910-1912.
- Wood River near Meeteetse, Wyo., 1910-1912.
- Shoshone River at Cody, Wyo., 1902-1910.
- Shoshone River at Corbett dam, Wyo., 1908-
- Shoshone River near Lovell, Wyo., 1897-1899.
- South Fork of Shoshone River, at Marquette, Wyo., 1896; 1903-1908.
- Rottengrass Creek near St. Xavier, Mont., 1911-
- Soap Creek near St. Xavier, Mont., 1911-
- Little Bighorn River in sec. 28, T. 8 S., R. 35 E., near Wyola, Mont., 1911-
- Little Bighorn River at Crow Agency, Mont., 1905-6; 1911-
- Prairie Dog ditch near Story, Wyo., 1903.
- Lodgegrass Creek near Lodgegrass, Mont., 1911-
- Tongue River near Dayton, Wyo., 1903; 1911-12.
- Tongue River at Carneyville, Wyo., 1911-1912.
- Goose Creek at Sheridan, Wyo., 1895-1897; 1911-1912.
- Little Goose Creek at Sheridan, Wyo., 1896-7; 1911-1912.
- Powder River:
 - South Fork of Powder River near Kaycee, Wyo., 1911.
 - Middle Fork of Powder River near Kaycee, Wyo., 1911-1912.
 - North Fork of Powder River near Kaycee, Wyo., 1911.
 - Clear Creek at Buffalo, Wyo., 1896-1900; 1902-1904; 1911-12.
 - Clear Creek near Buffalo, Wyo., 1911-1912.
 - Piney Creek at Kearney, Wyo., 1902-1906; 1911-1912.
 - Cruetz ditch near Story, Wyo., 1903.
- Little Muddy River near Williston, N. Dak., 1904-1909.
- Little Missouri River near Alzada, Mont., 1904-1906; 1911-
- Little Missouri River at Camp Crook, S. Dak., 1903-1906.
- Little Missouri River at Medora, N. Dak., 1903-1908.
- Knife River near Broncho, N. Dak., 1903-
- Painted Woods Creek near Washburn, N. Dak., 1909-10.
- Turtle Creek near Washburn, N. Dak., 1909-10.
- Heart River near Richardton, N. Dak., 1903-
- Apple Creek near Bismarck, N. Dak., 1905.
- Cannonball River near Stevenson, N. Dak., 1903-1908; 1911-
- Grand River, North Branch, at Haley, N. Dak., 1908-
- Grand River near Seim, S. Dak., 1904-1906.
- Grand River near Wakpala, S. Dak., 1911-
- Owl (Moreau) River near Bixby, S. Dak., 1904-1906.
- Cheyenne River at Edgemont, S. Dak., 1903-1906.
- Beaver Creek near Edgemont, S. Dak., 1905-6.
- Hat Creek near Edgemont, S. Dak., 1905-6.
- Battle Creek near Hermosa, S. Dak., 1903.
- Spring Creek near Rapid, S. Dak., 1903-1906.
- Rapid Creek at Rapid, S. Dak., 1903-1906.
- Box Elder Creek at Blackhawk, S. Dak., 1903-1905.
- Corbin Morse ditch at Rapid, S. Dak., 1906.

Missouri River tributaries—Continued.**Cheyenne River—Continued.**

- Elk Creek near Piedmont, S. Dak., 1903.
- Belle Fourche River at Bellefourche, S. Dak., 1903-1906.
- Belle Fourche River near Bellefourche, S. Dak., 1906; 1912-
- Redwater River at Bellefourche, S. Dak., 1903-1906.
- Redwater River near Minnesela, S. Dak., 1903.
- Redwater canal at Minnesela, S. Dak., 1904-1906.
- Spearfish Creek near Spearfish, S. Dak., 1903-1906.
- Crow Creek near Bellefourche, S. Dak., 1904.
- Owl Creek near Bellefourche, S. Dak., 1904.
- Indian Creek near Bellefourche, S. Dak., 1904.

White River at Crawford, Nebr., 1897.

White River near Interior, S. Dak., 1904-1906; 1911-

White River near Westover, S. Dak., 1911-

Little White River near Westover, S. Dak., 1912-

Niobrara River near Valentine (Fort Niobrara), Nebr., 1897; 1899; 1901-1906.

Niobrara River near Spencer, Nebr., 1908.

Niobrara River at Niobrara, Nebr., 1902; 1910-

Red Deer Lake (head of Plum Creek) near Woodlake, Nebr., 1904-5.

James River near Lamoure, N. Dak., 1903.

Big Sioux River near Watertown, S. Dak., 1900-1903.

Big Sioux River near Sioux Falls, S. Dak., 1900-1901.

Rock River at Luverne, Minn., 1911-

Big Grizzly Creek (head of North Platte River) near Hebron, Colo., 1904-5.

North Platte River near Hebron, Colo., 1904-5.

North Platte River near Cowdrey, Colo., 1904-5.

North Platte River near Pinkhampton, Colo., 1904.

North Platte River at Saratoga, Wyo., 1903-1906, 1909; 1911-1912.

North Platte River at Pathfinder, Wyo., 1905-

North Platte River at Alcova, Wyo., 1904-5.

North Platte River near Douglas, Wyo., 1894.

North Platte River near Orin Junction, Wyo., 1895-1900.

North Platte River at Guernsey, Wyo., 1900-1908; 1912.

North Platte River near Fort Laramie, Wyo., 1887-1890.

North Platte River and Interstate canal at Whalen, Wyo., 1909-

North Platte River near Mitchell, Nebr., 1901-1913.

North Platte River at Scottsbluff, Nebr., 1912.

North Platte River near Gering, Nebr., 1897-1900.

North Platte River near Camp Clark, Nebr., 1896-1900.

North Platte River at Bridgeport, Nebr., 1902-1906.

North Platte River near Henry, Nebr., 1912-

North Platte River at North Platte, Nebr., 1895-

Platte River near Lexington, Nebr., 1902-1906.

Platte River near Columbus, Nebr., 1895-

Platte River near Fremont, Nebr., 1913-

Platte River near Leshara, Nebr., 1911-

Platte River near South Bend, Nebr., 1903.

Little Grizzly Creek at Hebron, Colo., 1904-5.

Roaring Fork of North Platte River near Hebron, Colo., 1904-5.

North Fork of North Platte River at Higho, Colo., 1904-5.

Michigan Creek near Walden, Colo., 1904-5.

Michigan Creek near Cowdrey, Colo., 1904-5.

Canadian River at Cowdrey, Colo., 1904-5.

Missouri River tributaries—Continued.

Platte River—Continued.

- Big Creek near Downington, Wyo., 1911-12.
- Mullen Creek near French, Wyo., 1911-12.
- French Creek near French, Wyo., 1911-1912.
- Brush Creek near Saratoga, Wyo., 1911-1912.
- Encampment River near Peryam's ranch, Wyo., 1900.
- Encampment River at Encampment, Wyo., 1911-1912.
- Cow Creek near Saratoga, Wyo., 1911-12.
- Spring Creek near Saratoga, Wyo., 1911-1912.
- Jack Creek at Blydenburg's ranch near Saratoga, Wyo., 1912.
- Jack Creek near Saratoga, Wyo., 1911-12.
- Pass Creek near Walcott, Wyo., 1911.
- Medicine Bow River near Medicine Bow, Wyo., 1901; 1911-1912.
- Rock Creek near Arlington, Wyo., 1911-
- Rock Creek near Rock River, Wyo., 1911-1912.
- Sweetwater River near Splitrock, Wyo., 1902-3.
- Boxelder Creek near Careyhurst, Wyo., 1911.
- Laramie River at Glendevy, Colo., 1904-5; 1910-
- Laramie River near Jelm, Wyo., 1904-5; 1911-
- Laramie River near Woods Landing, Wyo., 1895-1900; 1911.
- Laramie River and Pioneer canal near Woods, Wyo., 1912.
- Laramie River near Uva, Wyo., 1895-1900; 1903.
- Laramie River at Two Rivers, Wyo., 1911-1912.
- Laramie River near Wheatland, Wyo., 1912.
- McIntyre Creek near Gleneyre, Colo., 1904-5.
- Little Laramie River near Filmore, Wyo., 1911-1912.
- Little Laramie River near Hatton, Wyo., 1902-3.
- Little Laramie River near Laramie, Wyo., 1903.
- Little Laramie River at Two Rivers, Wyo., 1911-1912.
- Sybillee Creek near Wheatland, Wyo., 1912.
- North Laramie River, near Wheatland, Wyo., 1912.
- North Laramie River at Uva, Wyo., 1911-1912.
- Chugwater Creek at Chugwater, Wyo., 1911-1912.
- Horse Creek near Little Horse Creek, Wyo., 1911-1912.
- Horse Creek near Lagrange, Wyo., 1911-1912.
- South Platte River, South Fork (head of South Platte), near Cheeseman Lake, Colo., 1899-1901.
- South Platte River, South Fork, at Lake George, Colo., 1910-
- South Platte River, South Fork, at South Platte, Colo., 1905-1912.
- South Platte River at South Platte, Colo., 1902-
- South Platte River near Deansbury (Platte Canyon), Colo., 1887-1892; 1895-1900.
- South Platte River at Denver, Colo., 1895-
- South Platte River near Kersey, Colo., 1901-1903; 1905-
- South Platte River near Orchard, Colo., 1895-1900.
- South Platte River at Julesburg, Colo., 1902-1906; 1908-
- South Platte River near Big Spring, Nebr., 1902-3.
- Tarryall Creek near Jefferson, Colo., 1910-
- Tarryall Creek near Hayman, Colo., 1910-1912.
- Jefferson Creek at Jefferson, Colo., 1910-1912.
- Michigan Creek near Jefferson, Colo., 1910-1912.

Missouri River tributaries—Continued.

Platte River—Continued.

South Platte River—Continued.

Goose Creek near Cheeseman Lake, Colo., 1899.

Middle Fork of South Platte River at Fairplay, Colo., 1910-12.

North Fork of South Platte River at Grant, Colo., 1910-

North Fork of South Platte River at Cassells, Colo., 1908-

North Fork of South Platte River at South Platte, Colo., 1909-10; 1913-

Geneva Creek above Jackwhacker Creek, near Grant, Colo., 1909-1911.

Geneva Creek at Old Geneva smelter, near Grant, Colo., 1909-1911.

Geneva Creek at Sullivan's ranch, near Grant, Colo., 1908-1911.

Geneva Creek at Grant, Colo., 1911-12.

Smelter Creek at Old Geneva smelter, near Grant, Colo., 1909-1911.

Duck Lake Creek near Grant, Colo., 1909-1911.

Scott Gomer Creek at Sullivan's ranch, near Grant, Colo., 1909-

Bear Creek near Morrison, Colo., 1888-1891; 1895-1902.

Clear Creek at Idaho Springs, Colo., 1910-1912.

Clear Creek at Forkscreek, Colo., 1899-1912.

Clear Creek near Golden, Colo., 1908-1909; 1911; 1913-

St. Vrain Creek at Lyons, Colo., 1887-1890; 1895-1903; 1904-

Boulder Creek at Orodell, Colo., 1887-1890; 1907-

Boulder Creek near Boulder, Colo., 1888-1892; 1895-1901; 1907-1909.

South Boulder Creek near Rollinsville, Colo., 1910-

South Boulder Creek at Eldorado Springs (near Marshall), Colo., 1888-1892; 1895-1901; 1909-

Community canal near Marshall, Colo., 1909.

Big Thompson Creek near Arkins, Colo., 1888-1890; 1895-1903; 1904-1911.

Handy ditch near Arkins, Colo., 1899-1900; 1903.

Cache la Poudre River near Elkhorn, Colo., 1909-1911.

Cache la Poudre River near Fort Collins, Colo., 1909-1911.

Cache la Poudre River at mouth of canyon near Fort Collins, Colo., 1884-1901; 1910-

Cache la Poudre River near Greeley, Colo., 1903.

Middle Crow Creek near Hecla, Wyo., 1902-3.

Middle Loup River (head of Loup River) near St. Paul, Nebr., 1895; 1897; 1899; 1903.

Loup River at Columbus, Nebr., 1894-

North Loup River near St. Paul, Nebr., 1895; 1897; 1899; 1903.

Elkhorn River near Norfolk, Nebr., 1896-1903.

Elkhorn River at Arlington, Nebr., 1899-1903; 1913-

Elkhorn River at Waterloo, Nebr., 1911-

South Fork of Elkhorn River, near Norfolk, Nebr., 1896.

Republican River, North Fork (head of Kansas River), near Haigler, Nebr., 1896.

Republican River, North Fork, near Benkleman, Nebr., 1894-95.

Republican River at Benkleman, Nebr., 1903-1906.

Republican River at Culbertson, Nebr., 1913-

Republican River at Bostwick, Nebr., 1904-

Republican River near Superior, Nebr., 1896-1903.

Republican River at Junction, Kans., 1895-1905.

Kansas River near St. George, Kans., 1904.

Kansas River near Topeka, Kans., 1904.

Kansas River near Lecompton, Kans., 1899-1906.

Missouri River tributaries—Continued.

Kansas River near Lawrence, Kans., 1895-1899.

South Fork of Republican River at Benkleman, Nebr., 1895; 1903-1906.

Frenchman River at Culbertson, Nebr., 1913-

Frenchman River near Wauneta, Nebr., 1895-6.

Frenchman River near Palisade, Nebr., 1895-6.

Smoky Hill River at Ellsworth, Kans., 1895-1905.

Smoky Hill River at Solomon, Kans., 1904.

Beaver (Ladder) Creek near Scott City, Kans., 1904-5.

Saline River near Beverly, Kans., 1895-1897.

Saline River near Salina, Kans., 1897-1903.

Solomon River at Beloit, Kans., 1895-1897.

Solomon River near Niles, Kans., 1897-1903.

Big Blue River (head of Blue River) at Beatrice, Nebr., 1910-

Blue River at Manhattan, Kans., 1895-1905.

Little Blue River near Fairbury, Nebr., 1908-

Osage (Marais des Cygnes) River at Ottawa, Kans., 1902-1905.

Gasconade River at Arlington, Mo., 1903-1906.

Piney Fork of Gasconade River, near Houston, Mo., 1908-9.

Piney Fork of Gasconade River, near Hooker, Mo., 1903. (Also called Big Piney Creek.)

Little Piney Creek near Arlington, Mo., 1903.

REPORTS ON WATER RESOURCES OF THE MISSOURI RIVER BASIN.

PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY.

WATER-SUPPLY PAPERS.

Water-supply papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked in this way may, however, be purchased (at price noted) from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Omission of the price indicates that the report is not obtainable from Government sources. Water supply papers are of octavo size.

- *5. Irrigation practice on the Great Plains, by E. B. Cowgill. 1897. 39 pp., 12 pls.

Describes reservoirs for storm and pumped waters, ditching methods of distributing water cultivation and subirrigation, duty of water, and winter irrigation.

- *9. Irrigation near Greeley, Colo., by David Boyd. 1897. 90 pp., 21 pls.

Treats of topography, rainfall, and water supply in the valley of Cache la Poudre River, a tributary of the South Platte; describes the canals and reservoir systems, construction and operation of canals, and agricultural practice; discusses also the legislative and judicial control of the water; speaks of the use of the underground waters, effect of alkali waters on soil, pumping of underground waters, and artesian wells.

- *12. Underground waters of a portion of southeastern Nebraska, by N. H. Darton. 1898. 56 pp., 21 pls.

Discusses physiography, geology, underground waters of moderate depth, and irrigation from underground waters in Lancaster, Seward, northern Saline, York, Fillmore, Hamilton-Clay, Hall, Adams, Buffalo, Kearney, Phelps, northern Gosper, and eastern and central Dawson counties; reviews briefly the prospects for obtaining deeper-seated waters.

29. Wells and windmills in Nebraska, by E. H. Barbour. 1899. 85 pp., 27 pls.

Describes home-made windmills; discusses briefly action of water underground, transmission and storage of windmills, precipitation, surface waters for irrigation, supply for cities and towns, salt water and blowing wells.

34. Geology and water resources of a portion of southeastern South Dakota, by J. E. Todd. 1900. 34 pp., 10 pls.

Describes areas in Turner, Hutchinson, Bonhomme, Yankton, and Clay counties, including typical sections of the valleys of James and Vermilion rivers.

43. Conveyance of water in irrigation canals, flumes, and pipes, by Samuel Fortier. 1901. 86 pp., 15 pls.

Describes the location and construction of various types of canals for irrigation.

70. Geology and water resources of the Patrick and Goshen Hole quadrangles, in eastern Wyoming and western Nebraska, by G. I. Adams. 1902. 50 pp., 11 pls. 15c.

Describes the geologic formations, surface features, water supply (surface and underground), irrigation, and agricultural products of a part of the Great Plains; discusses settlement and occupancy of the lands, and in an appendix gives the text of the "desert-lands" act, the Carey Act, and an act for the construction of reservoirs on public land for the watering of stock.

74. Water resources of the State of Colorado, by A. L. Fellows. 1902. 151 pp., 14 pls. 25c.

Discusses under South Platte, Arkansas, Rio Grande, San Juan, Grand, and Green River irrigation divisions, drainage, and irrigation, and gives records of stream flow.

90. Geology and water resources of part of the lower James River Valley, South Dakota, by J. E. Todd and C. M. Hall. 1904. 47 pp., 23 pls. 35c.

Describes topography, geologic formations, and surface and underground waters of Davison, Hanson, Sanborn, Beagle, and Miner counties, and portions of Kingsbury, Jerauld, Aurora, and McCook counties, S. Dak.

96. Destructive floods in the United States in 1903, by E. C. Murphy. 1904. 81 pp., 13 pls. 15c.

Gives notes on early floods in Mississippi Valley, and describes floods on Kansas River and its tributaries (Blue, Republican, Solomon, Saline, and Smoky Hill rivers); gives an account of the losses and suggests methods of flood prevention; contains also discharge tables and compares flood and ordinary data.

93. Proceedings of first conference of engineers of Reclamation Service, with accompanying papers, compiled by F. H. Newell, Chief Engineer. 1904. 361 pp. [Inquiries concerning this report should be addressed to the Reclamation Service.] Contains:

Irrigation in North Dakota by pumping, by F. A. Wilder. Discusses the use of lignite as a fuel for the operation of farm engines.

South Dakota investigations, by Raymond F. Walter. Mentions surveys of reservoir sites on creeks north of Rapid City and the water supply of the Belle Fourche project.

Work on North Platte River in Wyoming, by John E. Field.

Investigations in Wyoming, by Jeremiah Ahern. Describes the Lake de Smet project and the Shoshone project.

Reclamation and water storage in Nebraska, by O. V. P. Stout. Describes North Platte River and discusses its possible use for irrigation. Gives tables showing monthly discharge of the river from 1895 to 1902 and the volume of storage necessary to insure water to meet possible demands. Describes also Frenchman, Loup, and Niobrara rivers.

102. Contributions to the hydrology of eastern United States, 1903; M. L. Fuller, geologist in charge. 1904. 522 pp. 30c.

Contains brief reports on wells and springs of Minnesota and Missouri. The reports comprise tabulated well records giving information as to location, owner, depth, yield, head, etc., supplemented by notes as to elevation above sea, materials penetrated, temperature, use, and quality; many miscellaneous analyses.

110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains a brief report on the "Spring system of the Decaturville dome, Camden County, Mo., by E. M. Shepard." Some of these springs are of immense size and present many points of interest.

114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.
Contains brief reports as follows:
Missouri, by E. M. Shepard.
Iowa, by W. H. Norton.
Each of these reports describes briefly the topography of the area, the relation of the geology to the water supplies, and gives list of pertinent publications; lists also principal mineral springs.
117. The lignite of North Dakota and its relation to irrigation, by F. A. Wilder. 1905. 59 pp., 8 pls. 10c.
Describes the thickness, extent, variations, and fuel value of the lignite and its use for pumping water, the area, soils and lignite of the river flats, and the status of irrigation in the State.
146. Proceedings of second conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, Chief Engineer. 1905. 267 pp. 15c. [Inquiries concerning this report should be addressed to the Reclamation Service.]
Contains brief account of the organization of the hydrographic (water resources) branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibliography of technical papers by members of the service.
A brief report on "Irrigation development in North Dakota," by H. A. Storrs. Discusses the feasibility of pumping water from the Missouri to irrigate bench lands along its banks.
147. Destructive floods in United States in 1904, by E. C. Murphy. 15c. Contains:
Belle Fourche River flood, South Dakota, from report of R. F. Walter. Describes floods on Belle Fourche River (tributary to the Missouri through Cheyenne River) and on Cache la Poudre River and Crow Creek (tributaries of the South Platte).
162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.
Gives accounts of floods in eastern Missouri and South Dakota, and estimates of flood discharge and frequency on Kansas, Loup, and Platte rivers; contains also index to literature on floods in American streams.
184. The underflow of the South Platte Valley, by C. S. Slichter and H. C. Wolff. 1906. 42 pp. 5c.
Describes investigations of velocity, direction, quantity of underflow and the underflow ditch at Ogalalla, Nebr., gives chemical analyses of the water, and discusses disadvantages of underflow canals; describes also the investigation at North Platte, Nebr., and gives suggestions for construction of small pumping plants.
195. Underground waters of Missouri, their geology and utilization, by E. M. Shepard. 1907. 224 pp., 6 pls. 30c.
Describes the topography and geology of the State, the waters of the various formations, and discusses the water supplies by districts and counties, gives statistics of city water supplies, analyses of waters, and many well records.
215. Geology and water resources of a portion of the Missouri River valley in north-eastern Nebraska, by G. E. Condra. 1908. 208 pp., 3 pls. 40c.
Describes topography, rock formations, mineral resources, streams, springs, shallow and artesian wells, soils, crops, and timber, in Boyd, Knox, Cedar, Dixon, and Dakota counties, and part of Holt County.
216. Geology and water resources of the Republican River valley and adjacent areas, Nebraska, by G. E. Condra. 1907. 71 pp., 4 pls. 15c.
Describes topography, drainage, temperature, rainfall, winds, rock systems, surface and underground waters, water powers, soils, crops, and timbers of Dundy, Hitchcock, Redwillow, Furnas, Harlan, Franklin, Webster, Nuckolls, Thayer, and Jefferson counties.

221. *Geology and water resources of the Great Falls region, Montana*, by C. A. Fisher. 1909. 89 pp., 7 pls. 20c.

Describes the topographic features, geologic formation, streams, lakes, swamps, springs, and artesian wells of a portion of the Great Plains in Cascade, Teton, Fergus, Chouteau, and Lewis and Clark counties; discusses the chemical character of the waters (analyses), water powers, irrigation, temperature, rainfall and culture, and gives details of water supplies by districts.

230. *Surface water supply of Nebraska*, by J. C. Stevens. 1909. 252 pp., 6 pls. 35c.

Discusses relation of rainfall to run-off and evaporation and seepage near Kearney; describes the river basins, and gives results of observations at gaging stations.

236. *The quality of surface waters in the United States: Part I, Analyses of water east of the one hundredth meridian*, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, method of examination, preparation of solutions, accuracy of estimates, and expression of analytical results; gives results of analyses of waters of Missouri, North Platte, and Platte rivers.

258. *Underground water papers, 1910*, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and H. C. Wolff. 1911. 125 pp., 2 pls. 15c.

Contains brief report entitled "The utilization of the underflow near St. Francis, Kans.," by H. C. Wolff; discusses the water-bearing material, velocity, amount, rate of movement, and quality of the waters; arrangement and method of sinking the wells, selection and installation of pumps, engines and cost of pumping, storage reservoirs and loss by evaporation.

273. *Quality of the water supplies of Kansas*, by H. N. Parker, with a preliminary report on stream pollution by mine waters in southeastern Kansas, by E. H. S. Bailey. 1911. 375 pp., 1 pl. 15c.

Describes the topographic and geologic features of the State and the artesian basins; discusses the significance of mineral constituents and classification of waters; gives details concerning quality of underground water by counties and surface water by drainage basins.

274. *Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses*, by Herman Stabler. 1911. 188 pp. 15c.

Describes collection of samples, plan of analytical work, and method of analyses; discusses soap-consuming power of waters, water softening, boiler waters, and water for irrigation; gives results of analyses of samples of water from mills, Yellowstone, Shoshone, Belle Fourche and Redwater rivers.

293. *Underground water resources of Iowa*, by W. H. Norton, W. S. Hendrixson, H. E. Simpson, O. E. Meinzer, and others. 1912. 994 pp., 18 pls. 70c.

Describes the relief, drainage, temperature, and precipitation of the State and the geologic formations; discusses the geologic occurrence of underground waters, artesian phenomena and yield of artesian wells, the chemical composition of underground waters, municipal, domestic, and industrial water supplies, and mineral waters; gives details concerning topography, geology, underground waters, and city and village supplies by districts and counties.

ANNUAL REPORTS.

Each of the papers contained in the annual reports was also issued in separate form.

Annual reports are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers so marked, however, may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

- Tenth Annual Report of the United States Geological Survey, 1888-89*, J. W. Powell, Director. 1890. 2 parts. *Pt. II, *Irrigation*, viii, 123 pp. 35c.

Makes a preliminary report on the organization and prosecution of the survey of the arid lands for purposes of irrigation; includes an account of the methods of topographic and hydraulic work, the segregation work on reservoir sites and irrigable lands, field and office methods, and brief descriptions of the topography of some of the river basins.

Eleventh Annual Report of the United States Geological Survey, 1889-90, J. W. Powell, Director. 1891. 2 parts. Pt. II, Irrigation, pp. xiv, 395, 30 plates and maps. \$1.25. Contains:

*Hydrography, pp. 1-110. Discusses scope of work, methods of stream measurements, rainfall, and evaporation, and describes the more important streams.

*Engineering, pp. 111-200. Defines the scope of the work and gives an account of the surveys in the Sun River basin and in the Arkansas, Rio Grande, California, Lahontan, Utah, and Snake River divisions.

*The arid lands, pp. 201-289. Includes statement of the Director to the House Committee on Irrigation, extracts from the constitutions of States relating to irrigation, and a report on artesian irrigation on the Great Plains, including a discussion of the general considerations affecting artesian water supply, the economic limit to the utilization of artesian water for irrigation, irrigation by artesian wells in various countries, and the geologic conditions and statistics of artesian wells on the Great Plains.

*Topography, pp. 291-343. Comprises reports of the topographic surveys in California, Nevada, Colorado, Idaho, Montana, and New Mexico, and a report on reservoir sites.

*Irrigation literature, pp. 345-388. Gives a list of books and pamphlets on irrigation and allied subjects, mainly contained in the library of the United States Geological Survey.

Twelfth Annual Report of the United States Geological Survey, 1890-91, J. W. Powell, Director. 1891. 2 parts. Pt. II, Irrigation, xviii, 576 pp., 93 pls. \$2.00. Contains:

*Report upon the location and survey of reservoir sites during the fiscal year ended June 30, 1891, by A. H. Thompson, pp. 1-212, Pls. LIV-LVII. Describes reservoir sites in Meagher, Lewis and Clark, Beaverhead, Madison, Chouteau, Cascade, and Fergus counties, Mont., and for each site gives the location, brief description of the drainage basin, height of dam, capacity of reservoir, and the area of segregated land.

*Hydrography of the arid regions, by F. H. Newell, pp. 213-361, Pls. LVIII-CVI. Discusses the available water supply of the arid regions, the duty of water, flood waters, relation of rainfall to river flow; classifies the drainage basins; and describes the rivers of the Missouri, Arkansas, Rio Grande, Colorado, Sacramento, and San Joaquin basins, and the principal streams of the Great Basin in Nevada and Utah and the Snake River drainage.

Thirteenth Annual Report of the United States Geological Survey, 1891-92, J. W. Powell, Director. 1892. (Pts. II and III, 1893.) 3 parts. Pt. III, Irrigation, pp. xi, 486, 77 pls. \$1.85. Contains:

*Water supply for irrigation, by F. H. Newell, pp. 1-99, Pls. CLIII-CX. Discusses areas irrigated and irrigable, fluctuations in rivers and lakes, cost and value of water supply, and describes the location and area, topography, land classification, extent of irrigation, precipitation, and water measurements on the upper Missouri and its tributaries in the Yellowstone basin and in the Platte River basin; for each reservoir site gives the location, height of dam, areas inclosed by contour, approximate contents of reservoir, position of irrigable lands, and areas of segregated lands.

*Engineering results of irrigation survey, by H. N. Wilson, pp. 351-437, Pls. CXLVII-CLXXXII. Describes the reservoirs, canal lines, areas of lands reclaimable, and estimated revenue from irrigation works on the Sun River system, Montana.

***Sixteenth Annual Report of the United States Geological Survey, 1894-95, Charles D. Walcott, Director. 1896. (Pts. II, III, and IV, 1895.) 4 parts. Pt. II. Papers of an economic character, pp. xix, 598, 43 pls. \$1.25. Contains:**

The public lands and their water supply, by F. H. Newell, pp. 457-533, Pls. XXXV-XXXIX. Describes the general character of the public lands, the lands disposed of (railroad, grant, and swamp lands, and private miscellaneous entries), lands reserved (Indian, forest, and military reservations), the vacant lands, and the rate of disposal of vacant lands; discusses the streams, wells, and reservoirs as sources of water supply; gives details for each State.

Water resources of a portion of the Great Plains, by Robert Hay, pp. 535-588, Pls. XL-XLII. Describes an area comprising between 5,000 and 6,000 square miles and including parts of three counties of Kansas, five counties of Nebraska, and six of Colorado, drained to the Missouri through Platte and Kansas rivers; discusses the lakes, streams, and springs of the area, the underflow of the river bottoms, and the water-bearing strata under the higher lands; treats also of the sources of the water supply, rainfall, rate of percolation, volume; valley, upland, and deep wells; waterless wells, artesian flow, and blowing wells; and the temperature of the well waters; describes briefly the topography and geology of the region and the utilization of the water supply.

Seventeenth Annual Report of the United States Geological Survey, 1895-96, Charles D. Walcott, Director. 1896. 3 parts in 4 vols. Pt. II. Economic geology and hydrography, pp. xxv, 864, 113 pls. \$2.35. Contains:

Preliminary report on artesian waters of a portion of the Dakotas, by N. H. Darton, pp. 603-694, Pls. LXIX-CVII. Gives an outline of the geologic relations; describes the water horizons and the extent of the artesian water, and gives details concerning wells and prospects by counties; discusses the origin, amount, pressure, head, and composition of the artesian waters, the use of artesian water for power, and gives details concerning artesian irrigation by counties; contains also remarks on the construction and management of artesian wells.

Eighteenth Annual Report of the United States Geological Survey, 1896-97, Charles D. Walcott, Director. 1897. (Pts. II and III, 1898.) 5 parts in 6 vols. *Pt. IV, Hydrography, pp. x, 756, 102 plates. \$1.75. Contains:

*New developments in well boring and irrigation in eastern South Dakota, by N. H. Darton, pp. 561-616, Pls. XXXVIII-XLVII. Discusses progress in well sinking and irrigation by artesian waters in 1896 in Aurora, Beadle, Bonhomme, Brule, Buffalo, Charles Mix, Davison, Douglas, Hanson, Hutchinson, Jerauld, Sanborn, Spink, and Yankton counties, South Dakota, and in areas west of the Missouri River; treats also of the temperature and volume of flow of the deeper artesian waters and gives chemical analyses of waters from Missouri River and from artesian wells in the Sanborn basin.

*Reservoirs for irrigation, by J. D. Schuyler, pp. 617-740, Pls. XLVII-CII. Describes reservoir sites on Goose Creek, Tarryall Creek, and South Fork Platte River in Colorado; gives tables of reservoir capacity and areas.

Nineteenth Annual Report of the United States Geological Survey, 1897-98, Charles D. Walcott, Director. 1898. (Pts. II, III, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. *Pt. IV, Hydrography, pp. viii, 814, 118 plates. \$1.85. Contains:

*Preliminary report on the geology and water resources of Nebraska, west of the 103d meridian, by N. H. Darton, pp. 710-785, Pls. LXXIV-CXVIII. Describes topography and drainage (to the North Platte) of the area, the general geology of Nebraska, and the geology of the area covered by the report, the water horizons, and deep-seated waters; discusses springs, streams, irrigation, climate, and timber, and gives list of elevations.

——— **Pt. V, Forest Reserves, pp. xvii-400, 110 pls. (16 maps in separate case; paper, 75c.; cloth, \$1.00). \$1.25. Contains:**

*Black Hills Forest Reserve, by H. S. Graves, pp. 67-164, Pls. XIV-XXXVI.

*Bighorn Forest Reserve, by F. E. Town, pp. 165-190, Pls. XXXVII-XLII.

*Yellowstone Park Forest Reserve, southern part, from notes by T. S. Brandegee, pp. 213-216. These reports contain many descriptions of the streams of the forest reserves.

Twentieth Annual Report of the United States Geological Survey, 1898-99, Charles D. Walcott, Director. 1899. (Pts. II, III, IV, V, and VII, 1900.) 7 parts in 8 vols. and separate case for maps with Pt. V. *Pt. V, Forest Reserves, pp. xix, 498, 159 plates, 8 maps in separate case. Contains:

*Pikes Peak, Plum Creek, and South Platte rivers, by J. G. Jack, pp. 39-115, Pls. VIII-XLVII. Describes briefly the drainage of the forest reserves.

Twenty-first Annual Report of the United States Geological Survey, 1899-1900, Charles D. Walcott, Director. 1900. (Pts. III, IV, VI, VI continued, and VII, 1901.) 7 parts in 8 vols. and separate case for maps with Pt. V. Pt. IV, Hydrography, pp. 768, 156 pls. \$1.40. Contains:

*Preliminary description of the geology and water resources of the southern half of the Black Hills and adjoining regions in South Dakota and Wyoming, by N. H. Darton, pp. 489-599, Pls. LVIII-CXII. Describes the topography and geology of an area comprising about 5,500 square miles in southwestern corner of South Dakota, in the adjoining portion of Wyoming, Texas, the geologic formations and their contained waters, the deep borings at Edgemont and other places, the surface waters (Cheyenne and Fall River, Beaver, Lame Johnny, French, Battle Spring, Hat, Cascade, and Stockade Beaver creeks), and irrigation, the soils, mineral resources, climate, and temperature.

Twenty-first Annual Report, etc.—Continued.

*The High Plains and their utilization, by W. D. Johnson, pp. 601-741, Pls. CXIII-CLVI. Describes the area lying in an irregular belt lying about midway across the long eastward slope of the Great Plains and including parts of Wyoming, Colorado, and Nebraska (North and South Platte, Platte, Republican, and Smoky Hill River basins), Colorado, Kansas, New Mexico, Oklahoma, and Texas (Arkansas River basin), and Colorado, New Mexico, and Texas (Rio Grande basin); discusses the origin and structure of the High Plains, the precipitation, temperature and other factors of climate, experiments with irrigation, and the use of mountain streams, local storm-water storage, and artesian waters. Concluded in the Twenty-second Annual Report, Pt. IV, pp. 631-669, Pls. LI-LXV.

— Pt. V, Forest Reserves, 711 pp., 143 pls., 39 maps in separate case. \$2.80. Contains:

*Lewis and Clarke Forest Reserve, Montana, by H. B. Ayres, pp. 27-80, Pls. II-XXXII. Briefly describes the valleys of the streams which drain into Missouri River.

BULLETINS.

An asterisk (*), indicates that the Geological Survey's stock of the paper is exhausted. Many of the papers so marked may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

Discusses the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describes the general methods of work; gives tabulated records of wells in Kansas and Missouri, and detailed records of wells in Greeley County, Kansas, and Randolph County, Missouri. These wells were selected because they give definite stratigraphic information.

- *298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Gives an account of progress in the collection of well records and samples; contains tabulated records of wells in Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming, and detailed records of wells in Geary and Wyandotte County, Kansas; Jackson County, Missouri; Teton County, Montana; and Beadle and Miner counties, South Dakota. The wells of which detailed sections are given were selected because they afford valuable stratigraphic information.

PROFESSIONAL PAPERS.

Professional papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked with an asterisk may, however, be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Professional papers are of quarto size.

- *17. Preliminary report on the geology and water resources of Nebraska west of the one hundred and third meridian, by N. H. Darton. 1903. 69 pp., 42 pls. 25c.

Describes the climate, timber, topography, and general geology of Nebraska, the streams, springs, and deep-seated waters, irrigation in the valley of the North Platte, and gives list of elevations west of the one hundred and third meridian.

- *32. Geology and underground water resources of the central Great Plains, by N. H. Darton. 1905. 433 pp., 72 pls. \$1.80.

Describes altitudes and slopes, climate, drainage, stratigraphic structure, historical geology, and the water horizons; discusses deep wells and prospects (by counties and towns) in South Dakota (see Water-Supply Paper —), Nebraska, central and western Kansas, eastern Colorado, and eastern Wyoming; discusses also the occurrence of coal, petroleum, and natural gas, salt, gypsum, gold, iron ore, and other minerals.

- *53. The geology and water resources of the Bighorn basin, Wyoming, by C. A. Fisher. 1907. 72 pp., 16 pls.

Describes the relief and drainage, climate and culture; the stratigraphic, structural, and historical geology, and the underground waters, coal, oil, and gas, building stone, and other mineral resources; discusses briefly irrigation and mineral waters.

65. Geology and underground waters of the northern portion of the Black Hills and adjoining regions in South Dakota and Wyoming, by N. H. Darton. 1909. 105 pp., 24 pls. 40c.

Describes topographic development, the stratigraphic, structural, and historical geology of the sedimentary rocks, and discusses their mineral resources, including underground water, coal, gypsum, etc.; contains also information concerning the timber, climate, and the surface waters available for irrigation and stock raising.

GEOLOGIC FOLIOS.

Under the plan adopted for the preparation of a geologic map of the United States the entire area is divided into small quadrangles, bounded by certain meridians and parallels, and these quadrangles, which number several thousand, are separately surveyed and mapped.¹ The unit of survey is also the unit of publication, and the maps and description of each quadrangle are issued in the form of a folio. When all the folios are completed they will constitute a Geologic Atlas of the United States.

A folio is designated by the name of the principal town or of a prominent natural feature within the quadrangle. Each folio includes maps showing the topography, geology, underground structure, and mineral deposits of the area mapped and several pages of descriptive text. The text explains the maps and describes the topographic and geologic features of the country and its mineral products. The topographic map shows roads, railroads, waterways, and, by contour lines, the shapes of the hills and valleys, and the height above sea level of all points in the quadrangle. The areal-geology map shows the distribution of the various rocks at the surface. The structural-geology map shows the relations of the rocks to one another underground. The economic-geology map indicates the location of mineral deposits that are commercially valuable. The artesian-water map shows the depth to underground-water horizons. Economic-geology and artesian-water maps are included in folios if the conditions in the areas mapped warrant their publication. The folios are of special interest to students of geography and geology and are valuable as guides in the development and utilization of mineral resources.

The folios numbered from 1 to 163, inclusive, are published in only one form (18 by 22 inches), called the library edition. Some of the folios that bear numbers higher than 163 are published also in an octavo edition (6 by 9 inches). Owing to a fire in the Geological Survey building May 18, 1913, the stock of geologic folios was more or less damaged by fire and water, but 80 or 90 per cent of the folios are usable. They will be sold at the uniform price of 5 cents each, with no reduction for wholesale orders. This rate applies to folios in stock from 1 to 184, inclusive; also to the library edition of folio 186. The library edition of folios 185, 187, and higher numbers sells for 25 cents a copy, except that some folios which contain an unusually large amount of matter sell for 50 cents a copy. The octavo edition of folio 185 and higher numbers sells for 50 cents a copy. If 34 folios selling at 25 cents each (or their equivalent in higher priced folios) are ordered at one time, a discount of 40 per cent is allowed; \$5.10 is the minimum amount accepted at this rate.

All the folios contain descriptions of the drainage of the quadrangles. The folios in the following list contain also brief discussions of the underground waters in connection with the economic resources of the areas and more or less information concerning the utilization of the water resources.

An asterisk (*) indicates that the stock of the folio is exhausted.

24. Three Forks, Montana.

Describes topography and geology and, under "Economic geology," the mineral springs of the district, including Ferris Hot Springs.

¹ Index maps showing areas in the Missouri River basin covered by topographic maps and by geologic folios will be mailed on receipt of request addressed to the Director, U. S. Geological Survey, Washington, D. C.

55. Fort Benton, Montana.

Describes the topographic features and geologic formations of the area and, under "Economic geology," gives a brief paragraph on the artesian waters.

56. Little Belt Mountains, Montana.

Describes the geography and geology of the area and, under "Mineral resources," the hot waters of White Sulphur Springs, of which it gives an analysis.

87. Camp Clark, Nebraska.

Describes the geography and geology of an area lying west of the Scotts Bluff quadrangle gives table of average rainfall in western Nebraska 1886-1897 and, under "Economic geology," discusses underground waters and water for irrigation.

88. Scotts Bluff, Nebraska.

Describes the topography and drainage of the area; gives table of average rainfall from 1886-1897; discusses the geology and, under "Economic resources," the geology, underground waters, and water supply for irrigation.

96. Olivet, South Dakota.

Describes the topography, general geology, and geologic history of an area in the drainage basin of James River, and, under "Economic geology," discusses the surface waters—lakes, springs, and streams—and the underground waters, including the waters from the till and from the older rocks; contains an artesian-water sheet which shows the area of probable flowing wells; discusses artesian pressure, volume of flow, the probabilities of obtaining additional flow, and gives suggestions as to the construction of wells.

97. Parker, South Dakota.

Describes the topography and drainage of the quadrangle, the general geology and the geologic history, and, under "Economic geology," the surface and underground waters; discusses the formations yielding artesian flows, the amount of the flow, the quality of the water, and the causes of apparent decline in pressure; contains an artesian-water map showing areas which will probably yield flowing wells.

99. Mitchell, South Dakota.

Describes the topography and drainage of the quadrangle, the general geology and the geologic history, and, under "Economic geology," the surface and underground waters; discusses the formations yielding artesian flows, the amount of the flow, the quality of the water, and the causes of apparent decline in pressure; contains an artesian water map showing areas which will probably yield flowing wells.

100. Alexandria, South Dakota.

Describes the topography and drainage of the quadrangle, the general geology and the geologic history, and, under "Economic geology," the surface and underground waters; discusses the formations yielding artesian flows, the amount of the flow, the quality of the water, and the causes of apparent decline in pressure; contains an artesian water map showing areas which will probably yield flowing wells.

113. Huron, South Dakota.

Describes an area in the valley of James River; discusses topography, general geology and geologic history, and, under "Economic geology," the water resources, including lakes, springs, and streams, and shallow and deep wells; gives an account of the water horizons of the main artesian supply and the limits of the artesian area, and discusses causes of apparent decline in pressure; contains an artesian-water map showing areas in which wells may be expected to flow.

114. De Smet, South Dakota.

Describes an area which drains in part through James River to the Missouri, and in part into a local system of lakes which sometimes overflow into the basin of the Big Sioux and may thus reach the upper Mississippi; discusses general geology and geologic history, and, under "Economic geology," the water resources, including the lakes, springs, and streams, and shallow and deep wells; gives an account of the water horizons of the main artesian supply, and the limits of the artesian area; and discusses causes of apparent decline in pressure; contains an artesian water map showing areas in which wells may be expected to flow.

127. Sundance, Wyoming-South Dakota.

Describes the general features of the Black Hills in the Red River valley, and the stratigraphic and structural geology and geologic history and, under "Economic geology," discusses the surface and underground waters; gives analyses of water from well at Jerome, South Dakota.

128. Aladdin, Wyoming-South Dakota-Montana.

Describes relief, drainage, stratigraphic, structural, and historical geology and, under "Economic products," discusses surface and underground waters.

*150. Devils Tower, Wyoming.

Describes the topography and geology of an area in Crook County, Wyo., embracing portions of the Belle Fourche and Missouri River valleys; under "Economic geology" discusses the rainfall, the streams, and the geologic formation that furnish underground waters.

156. Elk Point, South Dakota-Nebraska-Iowa.

Describes the relief, drainage, and geology of an area in the Missouri Valley, mainly in Union and Clay counties, S. Dak.; but including also portions in Dixon and Dakota counties, Nebr., and Plymouth and Sioux counties, Iowa; under "Economic geology" describes the springs, lakes, ponds, streams, and water powers, shallow and artesian wells, and the amount of flow, kind of pressure, in the artesian wells; contains an artesian water map to show areas in which flowing wells may probably be obtained.

165. Aberdeen-Redfield¹ (Northville, Aberdeen, Redfield, and Bryan quadrangles), South Dakota.

Describes the relief and drainage and geology of an area in eastern South Dakota comprising nearly all of Spink County, and portions of Falk, Hand, Edmund, and Beadle counties; under "Economic geology" describes the shallow and deep wells, and the artesian wells; discusses the volume of flow, variations in flow, and pressure of artesian wells, and gives a table of pressure in representative wells; gives analyses of artesian water in the quadrangle; contains artesian water map showing areas in which flowing wells can probably be obtained.

168. Jamestown-Tower¹ (Jamestown, Eckelson, and Tower quadrangles), North Dakota.

Describes an area in eastern North Dakota including a portion of Cass, Barnes, Stutsman, Ransom, and Lamoure counties, drained in part by streams that ultimately discharge into Hudson Bay and in part by streams that finally reach the Gulf of Mexico; describes the relief, drainage, and geology of the area, and, under "Economic geology," shallow, deep, and artesian wells; discusses head, pressure, power, volume, and character of the water; and gives a tabulated list of representative wells; contains an artesian water map showing areas in which flowing wells may probably be obtained.

181. Bismarck,¹ North Dakota.

Describes the relief, drainage, and geology of the quadrangle in which Bismarck is situated, under "Economic geology" describes the streams, all of which are tributary to the Missouri, shallow dug wells, tubular wells, and flowing wells.

MISCELLANEOUS REPORTS.

Other Federal bureaus and State and other organizations have from time to time published reports relating to the water resources of the various sections of the country. Notable among those pertaining to the Missouri River basin are the reports of the Chief of Engineers United States Army, of the State geologist of Kansas, the State Drainage Commission of Minnesota, the Commission on Conservation of the State of Montana, the State Board of Irrigation of Nebraska, the superintendent of the Department of Irrigation, Forestry, Fish, and Game of North Dakota, and the State engineer of Wyoming. The following reports deserve special mention:

The Missouri River and its utmost sources, by J. V. Brower. St. Paul, 1897.

Geological report of the exploration of the Yellowstone and Missouri Rivers, by F. V. Hayden. Washington, 1869.

¹ Issued in two editions—library and octavo (see p. 78). Specify edition desired.

Preliminary examination of reservoir sites in Wyoming and Colorado: 55th Cong. 2d session, House Doc. 141.

Report of a commission appointed by his excellency the governor of the State of Colorado to revise the laws of the State of Colorado regulating the appropriation, distribution, and use of water. Denver, 1890.

Special report on well waters of Kansas, by Erasmus Haworth; Kansas Univ. Geol. Survey Bull. 1.

Report of Board of Irrigation Survey and Experiment [Kansas] for 1895-96. Topeka, 1897.

Report of the water-resources investigation of Minnesota by the State Drainage Commission. St. Paul, 1910.

Report of the commission on conservation [State of Montana] on bills relating to public lands, water rights, and the protection and preservation of the forests. Helena, 1911.

Irrigation laws of the State of Wyoming; compiled in the office of the State engineer.

GEOLOGICAL SURVEY HYDROLOGIC REPORTS OF GENERAL INTEREST.

The following list comprises reports not readily classifiable by drainage basins and covering a wide range of hydrologic investigations:

WATER-SUPPLY PAPERS.

- *1. Pumping water for irrigation, by H. M. Wilson. 1896. 57 pp., 9 pls.
Describes pumps and motive powers, windmills, water wheels, and various kinds of engines; also storage reservoirs to retain pumped water until needed for irrigation.
- *3. Sewage irrigation, by G. W. Rafter. 1897. 100 pp., 4 pls. (See Water-Supply Paper 22.)
Discusses methods of sewage disposal by intermittent filtration and by irrigation; describes utilization of sewage in Germany, England, and France, and sewage purification in the United States.
- *8. Windmills for irrigation, by E. C. Murphy. 1897. 49 pp., 8 pls.
Gives results of experimental tests of windmills during the summer of 1896 in the vicinity of Garden, Kansas; describes instruments and methods and draws conclusions.
- *14. New tests of certain pumps and water lifts used in irrigation, by O. P. Hood. 1898. 91 pp., 1 pl.
Discusses efficiency of pumps and water lifts of various types.
- *20. Experiments with windmills, by T. O. Perry. 1899. 97 pp., 12 pls.
Includes tables and descriptions of wind wheels, makes comparisons of wheels of several types, and discusses results.
- *22. Sewage irrigation, Part II, by G. W. Rafter. 1899. 100 pp., 7 pls.
Gives résumé of Water-Supply Paper No. 3; discusses pollution of certain streams, experiments on purification of factory wastes in Massachusetts, value of commercial fertilizers, and describes American sewage-disposal plants by States; contains bibliography of publications relating to sewage utilization and disposal.
- *32. Water resources of Puerto Rico, by H. M. Wilson. 1899. 48 pp., 17 pls. 15c.
Describes briefly topography, climate, rivers, irrigation methods, soils, forestation, water power, and transportation facilities.
- 41. The windmill; its efficiency and economic use, Part I, by E. C. Murphy. 1901. 72 pp., 14 pls. 15c.
- *42. The windmill; its efficiency and economic use, Part II, by E. C. Murphy. 1901. 75 pp., 2 pls. 10c.
Nos. 41 and 42 give details of results of experimental tests with windmills of various types.
- 43. Conveyance of water in irrigation canals, flumes, and pipes, by Samuel Fortier. 1901. 86 pp., 15 pls.
- *44. Profiles of rivers in the United States, by Henry Gannett. 1901. 100 pp., 11 pls. 15c.
Gives elevations and distance along rivers of the United States, also brief descriptions of many of the streams. Arrangement geographic. Many river profiles are scattered through other reports on surface waters in various parts of the United States.
- 56. Methods of stream measurement. 1901. 51 pp., 12 pls. 15c.
Describes the methods used by the Survey in 1901-2. (See also Nos. 64, 94, and 95.)
- 57. Preliminary list of deep borings in the United States, Part I (Alabama-Montana), by N. H. Darton. 1902. 60 pp. (See No. 149.) 5c.

61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp.

Nos. 57 and 61 contain information as to depth, diameter, yield, and head of water in borings more than 400 feet deep; under head "Remarks" gives information concerning temperature, quality of water, purposes of boring, etc. The lists are arranged by States and the States are arranged alphabetically. A second revised edition was published in 1905 as Water-Supply Paper, 149 (q. v.). 5c.

64. Accuracy of stream measurements, by E. C. Murphy. 1902. 99 pp., 4 pls. (See No. 95.) 10c.

Describes methods of measuring velocity of water and of measuring and computing stream flow and compares results obtained with the different instruments and methods; describes also experiments and results at the Cornell University hydraulic laboratory. A second, enlarged edition published as Water-Supply Paper 95.

67. The motions of underground waters, by C. S. Slichter. 1902. 106 pp., 8 pls. 15c.

Discusses origin, depth, and amount of underground waters; permeability of rocks and porosity of soils; causes, rates, and laws of motions of underground water; surface and deep zones of flow, and recovery of waters by open wells and artesian and deep wells; treats of the shape and position of the water table; gives simple methods of measuring yield of flowing well; describes artesian wells at Savannah, Ga.

72. Sewage pollution in the metropolitan area near New York City and its effect on inland water resources, by M. O. Leighton. 1902. 75 pp., 8 pls. 10c.

Defines "normal" and "polluted" waters and discusses the damage resulting from pollution.

77. The water resources of Molokai, Hawaiian Islands, by Waldemar Lindgren. 1903. 62 pp., 4 pls. 10c.

Describes briefly the topography, geology, coral reefs, climate, soils, vegetation, forests, fauna of the island, the springs, running streams, and wells, and discusses the utilization of the surface and underground waters.

- *80. The relation of rainfall to run-off, by G. W. Rafter. 1903. 104 pp. 10c.

Treats of measurements of rainfall and laws and measurements of stream flow; gives rainfall, run-off, and evaporation formulas; discusses effect of forests on rainfall and run-off.

87. Irrigation in India (second edition), by H. M. Wilson. 1903. 238 pp., 27 pls. 25c.

First edition was published in Part II of the Twelfth Annual Report.

93. Proceedings of first conference of engineers of Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1904. 361 pp.

Contains, in addition to an account of the organization of the hydrographic [water resources] branch of the United States Geological Survey, and the reports of the conference, the following papers of more or less general interest:

Limits of an irrigation project, by D. W. Ross.

Relation of Federal and State laws to irrigation, by Morris Bien.

Electrical transmission of power for pumping, by H. A. Storrs.

Correct design and stability of high masonry dams, by George Y. Wisner.

Irrigation surveys and the use of the plane table, by J. B. Lippincott.

The use of alkaline waters for irrigation, by Thomas A. Means.

- *94. Hydrographic manual of the United States Geological Survey, prepared by E. C. Murphy, J. C. Hoyt, and G. B. Hollister. 1904. 76 pp., 3 pls.

Gives instruction for field and office work relating to measurements of stream flow by current meters. (See also No. 95.)

- *95. Accuracy of stream measurements (second, enlarged edition), by E. C. Murphy. 1904. 169 pp., 6 pls.

Describes methods of measuring and computing stream flow and compares results derived from different instruments and methods. (See also No. 94.)

103. A review of the laws forbidding pollution of inland waters in the United States. by E. B. Goodell. 1904. 120 pp. (See No. 152.) 10c.
Explains the legal principles under which antipollution statutes become operative, quotes court decisions to show authority for various deductions, and classifies according to scope the statutes enacted in the different States.
110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.
Contains the following reports of general interest. The scope of each paper is indicated by its title:
Description of underflow meter used in measuring the velocity and direction of underground water, by Charles S. Slichter.
The California or "stovepipe" method of well construction, by Charles S. Slichter.
Approximate methods of measuring the yield of flowing wells, by Charles S. Slichter.
Corrections necessary in accurate determinations of flow from vertical well casings, from notes furnished by A. N. Talbot.
Experiment relating to problems of well contamination at Quitman, Ga., by S. W. McCallie.
Notes on the hydrology of Cuba, by M. L. Fuller.
113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4 pls. 5c.
The first paper discusses the pollution of streams by sewage and by trade wastes, describes the manufacture of strawboard and gives results of various experiments in disposing of the waste. The second paper describes briefly the topography, drainage, and geology of the region about Marion, Ind., the contamination of rock wells and of streams by waste oil and brine.
114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.
Contains report on "Occurrence of underground waters," by M. L. Fuller, discussing sources, amount, and temperature of waters, permeability and storage capacity of rocks, water-bearing formations, recovery of water by springs, wells and pumps, essential conditions of artesian flows, and general conditions affecting underground waters in eastern United States.
115. River surveys and profiles made during 1903, by W. C. Hall and J. C. Hoyt. 1905. 115 pp., 4 pls. 10c.
Contains results of surveys made to determine location of undeveloped power sites.
119. Index to the hydrographic progress reports of the United States Geological Survey, 1888 to 1903, by J. C. Hoyt and B. D. Wood. 1905. 253 pp. 15c.
Scope indicated by title.
120. Bibliographic review and index of papers relating to underground waters published by the United States Geological Survey, 1879-1904, by M. L. Fuller. 1905. 128 pp. 10c.
Scope indicated by title.
122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.
Defines and classifies underground waters, gives common-law rules relating to their use, and cites State legislative acts affecting them.
140. Field measurements of the rate of movement of underground waters, by C. S. Slichter. 1905. 122 pp., 15 pls. 15c.
Discusses the capacity of sand to transmit water, describes measurements of underflow in Rio Hondo, San Gabriel, and Mohave River valleys, Cal., and on Long Island, N. Y.; gives results of tests of wells and pumping plants, and describes stovepipe method of well construction.
143. Experiments on steel-concrete pipes on a working scale, by J. H. Quinton. 1905. 61 pp., 4 pls. 5c.
Scope indicated by title.
144. The normal distribution of chlorine in the natural waters of New York and New England, by D. D. Jackson. 1905. 31 pp., 5 pls., 10c.
Discusses common salt in coast and inland waters, salt as an index to pollution of streams and wells, the solutions and methods used in chlorine determinations, and the use of the normal chlorine map; gives charts and tables for chlorine in the New England States and New York.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains brief reports of general interest as follows:

Drainage of ponds into drilled wells, by Robert E. Horton. Discusses efficiency, cost, and capacity of drainage wells, and gives statistics of such wells in southern Michigan.

Construction of so-called fountain and geyser springs, by Myron L. Fuller.

A convenient gage for determining low artesian heads, by Myron L. Fuller.

146. Proceedings of second conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1905. 267 pp.

Contains brief account of the organization of the hydrographic [water resources] branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibliography of technical papers by members of the service. Of the papers read at the conference those listed below (scope indicated by title) are of more or less general interest:

Proposed State code of water laws, by Morris Bien.

Power engineering applied to irrigation, by O. H. Ensign.

Estimates on tunneling in irrigation projects, by A. L. Fellows.

Collection of stream-gaging data, by N. C. Grover.

Diamond-drill methods, by G. A. Hammond.

Mean-velocity and area curves, by F. W. Hanna.

Importance of general hydrographic data concerning basins of streams gaged, by R. E. Horton.

Effect of aquatic vegetation on stream flow, by R. E. Horton.

Sanitary regulations governing construction camps, by M. O. Leighton.

Necessity of draining irrigated land, by Thomas H. Means.

Alkali soils, by Thomas H. Means.

Cost of stream-gaging work, by E. C. Murphy.

Equipment of a cable gaging station, by E. C. Murphy.

Silting of reservoirs, by W. M. Reed.

Farm-unit classification, by D. W. Ross.

Cost of power for pumping irrigating water, by H. A. Storrs.

Records of flow at current-meter gaging stations during the frozen season, by F. H. Tillinghast.

147. Destructive floods in United States in 1904, by E. C. Murphy. 15c.

Contains a brief account of "A method of computing cross-section area of waterways," including formulas for maximum discharge and areas of cross section.

149. Preliminary list of deep borings in the United States, second edition with additions, by N. H. Darton. 1905. 175 pp. 10c.

Gives, by States (and within the States by counties), location, depth, diameter, yield, height of water, and other available information concerning wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 to 61; mentions also principal publications relating to deep borings.

150. Weir experiments, coefficients, and formulas, by R. E. Horton. 1906. 189 pp., 38 pls. (See Water-Supply Paper 200.) 15c.

Scope indicated by title.

151. Field assay of water, by M. O. Leighton. 1905. 77 pp., 4 pls. 10c.

Discusses methods, instruments, and reagents used in determining turbidity, color, iron, chlorides, and hardness in connection with the studies of the quality of water in various parts of the United States.

152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Scope indicated by title.

155. Fluctuations of the water level in wells, with special reference to Long Island, N. Y., by A. C. Veatch. 1906. 83 pp., 9 pls. 25c.

Includes general discussion of fluctuation due to rainfall and evaporation, barometric changes, temperature changes in rivers, changes in lake level, tidal changes, effects of settlement, irrigation, dams, underground water developments, and to indeterminate causes.

- *160. Underground water papers, 1906; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl. 10c.
Gives account of work in 1905; lists of publications relating to underground waters, and contains the following brief reports of general interest:
Significance of the term "artesian," by Myron L. Fuller.
Representation of wells and springs on maps, by Myron L. Fuller.
Total amount of free water in the earth's crust, by Myron L. Fuller.
Use of fluorescein in the study of underground waters, by R. B. Dole.
Problems of water contamination, by Isaiah Bowman.
Instances of improvement of water in wells, by Myron L. Fuller.
- *162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.
163. Bibliographic review and index of underground-water literature published in the United States in 1905, by M. L. Fuller, F. G. Clapp, and B. L. Johnson. 1906. 130 pp. 15c.
Scope indicated by title.
- *179. Prevention of stream pollution by distillery refuse, based on investigations at Lynchburg, Ohio, by Herman Stabler. 1906. 34 pp., 1 pl. 10c.
Describes grain distillation, treatment of slop, sources, character, and effects of effluents on streams; discusses filtration, precipitation, fermentation, and evaporation methods of disposal of wastes without pollution.
180. Turbine water-wheel tests and power tables, by R. E. Horton. 1906. 134 pp., 2 pls. 20c.
Scope indicated by title.
- *185. Investigations on the purification of Boston sewage, by C-E. A. Winslow and E. B. Phelps. 1906. 163 pp. 25c.
Discusses composition, disposal, purification, and treatment of sewages and recent tendencies in sewage-disposal practice in England, Germany, and the United States; describes character of crude sewage at Boston, removal of suspended matter, treatment in septic tanks, and purification in intermittent sand filtration and coarse material; gives bibliography.
- *186. Stream pollution by acid-iron wastes, a report based on investigations made at Shelby, Ohio, by Herman Stabler. 1906. 36 pp., 1 pl. 10c.
Gives history of pollution by acid-iron wastes at Shelby, Ohio, and resulting litigation; discusses effect of acid-iron liquors on sewage purification processes, recovery of copperas from acid-iron wastes, and other processes for removal of pickling liquor.
- *187. Determination of stream flow during the frozen season, by H. K. Barrows and R. E. Horton. 1907. 93 pp., 1 pl. 15c.
Scope indicated by title.
- *189. The prevention of stream pollution by strawboard waste, by E. B. Phelps. 1906. 29 pp., 2 pls. 5c.
Describes manufacture of strawboard, present and proposed methods of disposal of waste liquors, laboratory investigations of precipitation and sedimentation, and field studies of amounts and character of water used, raw material and finished product, and mechanical filtration.
- *194. Pollution of Illinois and Mississippi rivers by Chicago sewage (a digest of the testimony taken in the case of *The State of Missouri v. The State of Illinois and the Sanitary District of Chicago*), by M. O. Leighton. 1907. 369 pp., 2 pls. 40c.
Scope indicated by amplification of title.
- *196. Water supply of Nome region, Seward Peninsula, Alaska, 1906, by J. C. Hoyt and F. F. Henshaw. 1907. 52 pp., 6 pls. 15c.
Gives results of measurements of flow of Alaskan streams, discusses available water supply for ditch and pipe lines and power development; presents notes for investors.

- *200. Weir experiments, coefficients, and formulas, revision of paper No. 150, by R. E. Horton. 1907. 195 pp., 38 pls. 35c.
Scope indicated by title.
- *218. Water-supply investigations in Alaska, 1906-7 (Nome and Kougarok regions, Seward Peninsula; Fairbanks district, Yukon-Tanana region), by F. F. Henshaw and C. C. Covert. 1908. 156 pp., 12 pls. 25c.
Describes the drainage basins, gives results of observations at the gaging stations, and discusses the water supply of the ditches and pipe lines, and possibilities of development; gives also meteorological records.
- *226. The pollution of streams by sulphite-pulp waste, a study of possible remedies, by E. B. Phelps. 1908. 37 pp., 1 pl. 10c.
Describes manufacture of sulphite pulp, the waste liquors, and the experimental work leading to suggestions as to methods of preventing stream pollution.
228. Water-supply investigations of the Yukon-Tanana region, Alaska, 1907 and 1908 (Fairbanks, Circle, and Rampart districts), by C. C. Covert and C. E. Ellsworth. 1909. 108 pp., 7 pls. 20c.
Describes the drainage basins; gives results of observations at gaging stations; discusses the water supplies of the ditches and pipe lines and possibilities of hydraulic development.
- *229. The disinfection of sewage and sewage filter effluents, with a chapter on the putrescibility and stability of sewage effluents, by E. B. Phelps. 1909. 91 pp., 1 pl. 15c.
Scope indicated by title.
234. Papers on the conservation of water resources. 1909. 96 pp., 2 pls. 15c.
Contains the following papers, whose scope is indicated by their titles: Distribution of rainfall by Henry Gannett; Floods, by M. O. Leighton; Developed water powers, compiled under the direction of W. M. Steuart, with discussion by M. O. Leighton; Undeveloped water powers, by M. O. Leighton; Irrigation, by F. H. Newell; Underground waters, by W. C. Mendenhall, Denudation, by R. B. Dole and Herman Stabler; Control of catchment areas, by H. N. Parker.
- *235. The purification of some textile and other factory wastes, by Herman Stabler and G. H. Pratt. 1909. 76 pp. 10c.
Discusses waste waters from wool-scouring, bleaching, and dyeing cotton yarn, bleaching cotton piece goods, and manufacture of oleomargarine, fertilizer, and glue.
236. The quality of surface waters in the United States: Part I, Analyses of waters east of the one-hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.
Describes collection of samples, method of examination, preparation of solutions, accuracy of estimates, and expression of analytical results.
238. The public utility of water powers and their governmental regulation, by René Tavernier and M. O. Leighton. 1910. 161 pp. 15c.
Discusses hydraulic power and irrigation, French, Italian, and Swiss legislation relative to the development of water powers, and laws proposed in the French Parliament; reviews work of bureau of hydraulics and agricultural improvement of the French department of agriculture, and gives résumé of Federal and State water-power legislation in the United States.
255. Underground waters for farm use, by M. L. Fuller. 1910. 58 pp., 17 pls. 15c.
Discusses rocks as sources of water supply and the relative safety of supplies from different materials; springs, and their protection; open or dug and deep wells, their location, yield, relative cost, protection, and safety; advantages and disadvantages of cisterns and combination wells and cisterns.
257. Well-drilling methods, by Isaiah Bowman. 1911. 139 pp., 4 pls. 15c.
Discusses amount, distribution, and disposal of rainfall, water-bearing rocks, amount of underground water, artesian conditions, and oil and gas bearing formations; gives history of well drilling in Asia, Europe, and the United States; describes in detail the various methods and the machinery used; discusses loss of tools and geologic difficulties; contamination of well waters and methods of prevention; tests of capacity and measurement of depth; and costs of sinking wells.

258. Underground water papers, 1910, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and H. C. Wolff. 1911. 125 pp., 2 pls. 15c.

Contains the following papers (scope indicated by titles) of general interest:

Drainage by wells, by M. L. Fuller.

Freezing of wells and related phenomena, by M. L. Fuller.

Pollution of underground waters in limestone, by G. C. Matson.

Protection of shallow wells in sandy deposits, by M. L. Fuller.

Magnetic wells, by M. L. Fuller.

- *259. The underground waters of southwestern Ohio, by M. L. Fuller and F. G. Clapp, with a discussion of the chemical character of the waters, by R. B. Dole. 1912. 228 pp., 9 pls. 35c.

Describes the topography, climate, and geology of the region, the water-bearing formations, the source, mode of occurrence, and head of the waters, and municipal supplies; gives details by counties; discusses in supplement, under chemical character, method of analysis and expression of results, mineral constituents, effect of the constituents on waters for domestic, industrial, or medicinal uses, methods of purification, chemical composition; many analyses and field assays. The matter in the supplement was also published in Water-Supply Paper 254 (The underground waters of north-central Indiana).

274. Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses, by Herman Stabler. 1911. 188 pp. 15c.

Describes collection of samples, plan of analytical work, and methods of analyses; discusses soap-consuming power of waters, water softening, boiler waters, and water for irrigation; gives results of analyses of waters of the Rio Grande and of Pecos, Gallinas, and Hondo rivers.

280. Gaging stations maintained by the United States Geological Survey, 1888-1910, and Survey publications relating to water resources, compiled by B. D. Wood. 1912. 102 pp. 10c.

314. Surface water supply of Seward Peninsula, Alaska, by F. F. Henshaw and G. L. Parker, with a sketch of the geography and geology by P. S. Smith, and a description of methods of placer mining by A. H. Brooks. 1913. 317 pp., 17 pls. 45c.

Contains results of work at gaging stations.

- *315. The purification of public water supplies, by G. A. Johnson. 1913. 84 pp., 8 pls. 10c.

Discusses ground, lake, and river waters as public supplies, development of waterworks systems in the United States, water consumption, and typhoid fever; describes methods of filtration and sterilization of water, and municipal water softening.

- *318. Water resources of Hawaii, 1909-1911, by W. F. Martin and C. H. Pierce. 1913. 552 pp., 15 pls. 50c.

Describes the general features of the islands and gives results of measurements of streams and of observations of rainfall and evaporation; contains a gazetteer.

334. The Ohio Valley flood of March-April, 1913 (including comparisons with some earlier floods), by A. H. Horton and H. J. Jackson. 1913. 96 pp., 32 pls. 20c.

Although relating specifically to floods in the Ohio Valley, this report discusses also the causes of floods and the prevention of damage by floods.

336. Water resources of Hawaii, 1912, by C. H. Pierce and G. K. Larrison. 392 pp.

Contains results of stream measurements on the islands in 1912.

337. The effects of ice on stream flow, by William Glenn Hoyt. 1913. 76 pp., 7 pls. 15c.

Discusses methods of measuring the winter flow of streams.

ANNUAL REPORTS.

- *Fifth Annual Report of the United States Geological Survey, 1883-84, J. W. Powell, Director. 1885. xxxvi, 469 pp., 58 pls. \$2.25. Contains:

The requisite and qualifying conditions of artesian wells, by T. C. Chamberlain, pp. 125 to 173, Pl. XXI. Scope indicated by title.

- *Twelfth Annual Report of the United States Geological Survey, 1890-91, J. W. Powell, Director. 1891. 2 parts. Pt. II, Irrigation, xviii, 576 pp., 93 pls. \$2. Contains:

Irrigation in India, by H. M. Wilson, pp. 368-561, Pls. CVII to CXLVI. (See Water-Supply Paper 87.)

- Thirteenth Annual Report of the United States Geological Survey, 1891-92, J. W. Powell, Director. 1892. (Pts. II and III, 1893.) 3 parts. Pt. III, Irrigation, pp. xi, 486, 77 plates. \$1.85. Contains:

*American irrigation engineering, by H. M. Wilson, pp. 101-349, Pls. CXI to CXLV. Discusses the economical aspects of irrigation, alkaline drainage, silt and sedimentation; gives brief history of legislation; describes perennial canals in Idaho-California, Wyoming, and Arizona; discusses water storage at reservoirs of the California and other projects, subsurface sources of supply for pumping and subirrigation.

- Fourteenth Annual Report of the United States Geological Survey, 1892-93, J. W. Powell, Director. 1893. (Pt. II, 1894.) 2 parts. Pt. II, Accompanying papers, pp. xx, 597, 73 pls. \$2.10. Contains:

*Potable waters of the eastern United States, by W. J. McGee, pp. 1 to 47. Discusses cistern water, stream waters, and ground waters, including mineral springs and artesian wells.

*Natural mineral waters of the United States, by A. C. Peale, pp. 49-88, Pls. III and IV. Discusses the origin and flow of mineral springs, the source of mineralization, thermal springs, the chemical composition and analysis of spring waters, geographic distribution, and the utilization of mineral waters; gives a list of American mineral spring resorts; contains also some analyses.

- Nineteenth Annual Report of the United States Geological Survey, 1897-98, Charles D. Walcott, Director. 1898. (Parts II, III, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. Pt. II, papers chiefly of a theoretical nature, pp. v, 958, 172 plates. \$2.65. Contains:

*Principles and conditions of the movements of ground water, by F. H. King, pp. 59-294, Pls VI to XVII. Discusses the amount of water stored in sandstone, in soil, and in other rocks, the depth to which ground water penetrates; gravitational, thermal, and capillary movements of ground waters, and the configuration of the ground-water surface; gives the results of experimental investigations on the flow of air and water through a rigid, porous media, and through sands, sandstones, and silts; discusses results obtained by other investigators, and summarizes results of observations; discusses also rate of flow of water through sand and rock, the growth of rivers, rate of filtration through soil, interference of wells, etc.

*Theoretical investigation of the motion of ground waters, by C. S. Slichter, pp. 295-384, Pls. XVII. Scope indicated by title.

- Twentieth Annual Report of the United States Geological Survey, 1898-99, Charles D. Walcott, Director. 1899. (Parts II, III, IV, V, and VII, 1900.) 7 parts in 8 vols. and separate case for maps with Pt. V. Pt. IV, Hydrography, vii, 660 pp., 75 plates. \$1.85. Contains:

*Hydrography of Nicaragua, by A. P. Davis, pp. 563-637, Pls. LXIV to LXXXV. Describes the topographic features of the boundary, the lake basin, and Rio San Juan; gives a brief résumé of the boundary dispute; discusses rainfall, temperature, and relative humidity, evaporation, resources, and productions, the ship, railway, and canal projects; gives the history of the investigations by the Canal Commission, and results of measurements on the Rio Grande, on streams tributary to Lake Nicaragua, and on Rio San Juan and its tributaries.

- Twenty-second Annual Report of the United States Geological Survey, 1900-1901, Charles D. Walcott, Director. 1901. (Parts III and IV, 1902.) 4 parts. Pt. IV, Hydrography, 690 pp., 65 pls. \$2.20. Contains:

*Hydrography of the American Isthmus, by A. P. Davis, pp. 507-630, Pls. XXXVII to L. Describes the physiography, temperature, rainfall, and winds of Central America; discusses the hydrography of the Nicaragua Canal route and the Panama Canal route; gives estimated monthly discharges of many of the streams, rainfall, and evaporation tables at various points.

PROFESSIONAL PAPERS.

72. Denudation and erosion in the southern Appalachian region and the Monongahela basin, by L. C. Glenn. 1911. 137 pp., 21 pls. 35c.

Describes the relation of agriculture, lumbering, mining, and power development to erosion and denudation, and the nature, effects, and remedies of erosion; gives details of conditions in Holston, Nolichucky, French Broad, Little Tennessee, and Hiwassee river basins, along Tennessee River proper, and in the basins of the Coosa-Alabama system, Chattahoochee, Savannah, Saluda, Broad, Catawba, Yadkin, New, and Monongahela rivers.

BULLETINS.

- *32. Lists and analyses of the mineral springs of the United States (a preliminary study), by A. C. Peale. 1886. 235 pp.

Defines mineral waters, lists the springs by States, and gives tables of analyses so far as available.

264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

- *298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Bulletins 264 and 298 discuss the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describes the general methods of work; gives tabulated records of wells by States, and detailed records selected as affording valuable stratigraphic information.

- *319. Summary of the controlling conditions of artesian flows, by Myron L. Fuller. 1908. 10c.

Describes underground reservoirs, the sources of underground waters, the confining agents, the primary and modifying factors of artesian circulation, the essential and modifying factors of artesian flow, and typical artesian systems.

479. The geochemical interpretation of water analyses, by Chase Palmer. 1911. 31 pp. 5c.

Discusses the expression of chemical analyses, the chemical character of water, and the properties of natural waters; gives a classification of waters based on property values and reacting values, and discusses the character of the waters of certain rivers as interpreted directly from the results of analysis; discusses also the relation of water properties to geologic formations, silica in river water, and the character of the water of the Mississippi and the Great Lakes and St. Lawrence River as indicated by chemical analyses.

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¹ Many of the reports contain brief subject bibliographies. See abstracts.

² Many analyses of river, spring, and well waters are scattered through publications as noted in abstracts.

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Platte River, South, North Fork, Colo.	70	South Platte River, Colo., Nebr.	69
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Poplar River, Mont.	66	South Platte River, North Fork, Colo.	70
Popo Agie River, Wyo.	66	South Platte River, South Fork, Colo.	69
Popo Agie River, Little, Wyo.	66	Spearfish Creek, S. Dak.	68
Porcupine Creek, Mont.	65	Spring Creek, Mont.	65
Porcupine Creek, Little, Mont.	66	Spring Creek, S. Dak.	67
Powder River, Middle Fork, Wyo.	67	Spring Creek, Wyo.	69
Powder River, North Fork, Wyo.	67	Stillwater River, Mont.	66
Powder River, South Fork, Wyo.	67	Sun River, Mont.	64
Prairie Dog ditch, Wyo.	67	Sun River canals, Mont.	64
Prickly Pear Creek, Mont.	64	Sun River, North Fork, Mont.	64
Prickly Pear Creek, Little, Mont.	64	Sun River, South Fork, Mont.	64
Pryor Creek, Mont.	66	Sweetgrass Creek, Mont.	66
Rapid Creek, S. Dak.	67	Sweetwater River, Wyo.	69
Red Creek, Wyo.	66	Sybillee Creek, Wyo.	69
Red Deer Lake, Nebr.	68	Tarryall Creek, Colo.	69
Red Rock River, Mont.	63	Tenmile Creek, Mont.	64
Redwater canal, S. Dak.	68	Tensleep Creek, Wyo.	67
Redwater River, S. Dak.	68	Teton River, Mont.	65
Republican River, Nebr.-Kans.	70	Thompson Creek, Big, Colo.	70
Republican River, North Fork, Nebr.	70	Timber Creek, Big, Mont.	66
Republican River, South Fork, Nebr.	71	Tongue River, Wyo.	67
Reser ditch, Mont.	65	Trout Creek, Wyo.	66
Roaring Fork of North Platte River, Colo.	68	Turtle Creek, N. Dak.	67
Rock Creek, Mont.	65	Two Medicine River, Mont.	64-65
Rock Creek, Wyo.	69	Warm Spring Creek, Wyo.	66
Rock Creek Canal, Mont.	65	West Fork ditch, Mont.	65
Rock River, Minn.	66	West Gallatin River, Mont.	64
Rosebud River, Mont.	66	White River, Nebr., S. Dak.	68
Rottengrass Creek, Mont.	67	White River, Little, S. Dak.	68
Ruby River, Mont.	64	Whitetail Creek, Mont.	64
St. Lawrence Creek, Wyo.	66	Willow Creek, Mont. (Marias River Basin)	65
St. Vrain Creek, Colo.	70	Willow Creek, Mont. (Sun River Basin)	64
Saline River, Kans.	71	Willow Creek, Wyo. (Yellowstone River Basin)	66
Scott Gomer Creek, Colo.	70	Wind River, Wyo.	66
Sevenmile Creek, Mont.	64	Wind River, Little, Wyo.	66
Shoshone River, Wyo.	67	Wind River, Little, South Fork, Wyo.	66
Shoshone River, South Fork, Wyo.	67	Winter-Anderson Canal, Mont.	65
Sioux River, Big, S. Dak.	68	Wolf Creek, Mont.	66
Smelter Creek, Colo.	70	Wolf Point ditch, Mont.	66
Smith Creek, Mont.	64	Woodbine Creek, Mont.	66
Smith River, Mont.	64	Wood River, Wyo.	67
Smoky Hill River, Kans.	71	Yellowstone River, Mont.	66
Soap Creek, Mont.	67		