

DEPARTMENT OF THE INTERIOR  
UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

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WATER-SUPPLY PAPER 340—I

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

PART IX.—COLORADO RIVER BASIN

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COMPILED BY B. D. WOOD

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Part of Water-Supply Paper 340



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

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Compiled by B. D. Wood.

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## 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 12 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.  
 Madison, Wis., 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.

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

Report.	Character of data.	Year.
WS 65, 66.....	Descriptions, measurements, gage heights, and ratings.....	1901.
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 <sup>a</sup> .....	do.....	1912.
WS 351 to 362 <sup>a</sup> .....	do.....	1913.

<sup>a</sup> 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 in general 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 <sup>a</sup>	1900 <sup>b</sup>	1901	1902	1903	1904	1905	1906	1907-8	1909	1910	1911	1912	1913
North Atlantic.....	35	47, <sup>c</sup> 48	65, 75	82	97	<sup>d</sup> 124, <sup>e</sup> 125 <sup>f</sup> 126	<sup>d</sup> 165, <sup>e</sup> 166 <sup>f</sup> 167	<sup>d</sup> 201, <sup>e</sup> 202 <sup>f</sup> 203	241	261	281	301	321	351
South Atlantic and eastern Gulf of Mexico.....	<sup>g</sup> 35, 36	48	65, 75	<sup>g</sup> 82, 83	<sup>g</sup> 97, 98	<sup>f</sup> 126, 127	<sup>f</sup> 167, 168	<sup>f</sup> 203, 204	242	262	282	302	322	352
Ohio River.....	36	48, <sup>h</sup> 49	65, 75	83	98	128	169	205	243	263	283	303	323	353
St. Lawrence River and Great Lakes.....	36	49	65, 75	<sup>i</sup> 82, 83	97	129	170	206	244	264	284	304	324	354
Hudson Bay and Upper Mis- sissippi River.....	36	49	<sup>j</sup> 65, 66, 75	<sup>j</sup> 83, 85	<sup>j</sup> 98, 99, <sup>k</sup> 100	<sup>j</sup> 128, 130	171	207	245	265	285	305	325	355
Missouri River.....	<sup>l</sup> 36, 37	49, <sup>m</sup> 50	66, 75	84	99	130, <sup>n</sup> 131	172	208	246	266	286	306	326	356
Lower Mississippi River.....	37	50	<sup>j</sup> 65, 66, 75	<sup>j</sup> 83, 84	<sup>j</sup> 98, 99	<sup>j</sup> 128, 131	<sup>j</sup> 169, 173	<sup>j</sup> 205, 209	247	267	287	307	327	375
Western Gulf of Mexico.....	37	50	66, 75	84	99	132	174	210	248	268	288	308	328	358
Colorado River.....	<sup>o</sup> 37, 38	50	66, 75	85	100	133	175, <sup>p</sup> 177	211	249	269	289	309	329	359
Great Basin.....	38, <sup>q</sup> 39	51	66, 75	85	100	133, <sup>r</sup> 134	176, <sup>r</sup> 177	212, <sup>r</sup> 213	250, <sup>r</sup> 251	270, <sup>r</sup> 271	290, <sup>r</sup> 291	310	330	360
California.....	38, <sup>s</sup> 39	51	66, 75	85	100	134	177	213	251	271	291	311	331	361
North Pacific.....	38	51	66, 75	85	100	135	<sup>t</sup> 177, 178	214	252	272	292	312	<sup>u</sup> 332	<sup>u</sup> 362

<sup>a</sup> Rating tables and index to Water-Supply Papers 35-39 contained in Water-Supply Paper 39.

<sup>b</sup> 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.

<sup>c</sup> Wissahickon and Schuylkill rivers to James River.

<sup>d</sup> New England rivers only.

<sup>e</sup> Hudson River to Delaware River, inclusive.

<sup>f</sup> Susquehanna River to Yadkin River, inclusive.

<sup>g</sup> James River only.

<sup>h</sup> Scioto River.

<sup>i</sup> Lake Ontario and tributaries to St. Lawrence River proper.

<sup>j</sup> Tributaries of Mississippi from east.

<sup>k</sup> Hudson Bay only.

<sup>l</sup> Gallatin River.

<sup>m</sup> Loup and Platte Rivers near Columbus, Nebr., and all tributaries below junction with Platte.

<sup>n</sup> Platte and Kansas Rivers.

<sup>o</sup> Green and Gunnison Rivers and Grand River above junction with Gunnison.

<sup>p</sup> Below junction with Gila.

<sup>q</sup> Mohave River only.

<sup>r</sup> Great Basin in California, excepting Truckee and Carson drainage basins.

<sup>s</sup> Kings and Kern Rivers only.

<sup>t</sup> Rogue, Umpqua, and Siletz Rivers only.

<sup>u</sup> In three parts: *A*, Pacific basins in Washington and upper Columbia River; *B*, Snake River basin; *C*, Lower Columbia River and Pacific basins 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 IX. COLORADO RIVER BASIN.

### PRINCIPAL STREAMS.

The largest tributaries of the Colorado River are Green River (considered the continuation of the main stream), Grand River, Dolores, San Juan, Little Colorado, Virgin, and Gila Rivers. The principal streams flowing into the Green are Newfork Creek, Yampa River, Ashley Creek, Duchesne River, and White River. The principal tributaries of Grand River are Grand Lake, Frazier River, Williams Fork, Blue River, and Gunnison River. The streams of the Colorado basin drain wholly or in part the States of Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming.

In addition to the list of gaging stations and 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 p. 116.)

### GAGING STATIONS.

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

Green River, (head of Colorado River) near Kendall, Wyo., 1910–1912.  
Green River at Green River, Wyo., 1895–1906.  
Green River near Vernal, Utah, 1903–1906.  
Green River at Ouray, Utah, 1904–5; 1913–  
Green River near Bridgeport, Utah, 1911–  
Green River at Greenriver (formerly Blake), Utah, 1894–1899; 1905–1911.  
Green River at Little Valley near Greenriver, Utah, 1910–  
Colorado River at Hardyville, Ariz., 1905–1907.  
Colorado River near Mohave, Ariz., 1902–3.  
Colorado River at Yuma, Ariz., 1891–  
Newfork Creek near Cora, Wyo., 1905; 1910–11.  
Pine Creek near Pinedale, Wyo., 1905–1906; 1910–1912.  
Pole Creek near Fayette, Wyo., 1904–1906.  
Pole Creek near Pinedale, Wyo., 1910–1912.  
Fall Creek at Fayette, Wyo., 1904–5.  
Boulder Creek at Boulder (Newfork), Wyo., 1904–1906.  
Eastfork River at Newfork, Wyo., 1905–6.  
Black Fork of Green River at Granger, Wyo., 1896–1900.  
Big Sandy Creek at Leckies ranch, near Big Sandy, Wyo., 1910–

## Colorado River—Continued.

Big Sandy Creek near Eden, Wyo., 1911-

Dutch Jo Creek at Dutch Jo Ranger station, near Big Sandy, Wyo., 1911-1912.

Squaw Creek near Big Sandy, Wyo., 1911-1912.

Little Sandy Creek near Eden, Wyo., 1911-12.

Beaver Creek near Ladore, Colo., 1910-11.

Vermillion Creek near Ladore, Colo., 1910-11.

Yampa River at Yampa, Colo., 1910-

Yampa River at Steamboat Springs, Colo., 1904-1906; 1910-

Yampa River at Craig, Colo., 1901-2; 1904-1906; 1910-

Yampa River near Maybell, Colo., 1904-5; 1910-

Terrible Creek:

Trout Creek at Pinnacle, Colo., 1910-11.

Soda Creek at Steamboat Springs, Colo., 1910-1911.

Elk River at Hinman Park, Colo., 1912-

Elk River near Clark, Colo., 1910-

Elk River near Trull, Colo., 1904-1906; 1910-

Mad Creek near Steamboat Springs, Colo., 1912-

Sage Creek:

Fish Creek at Dunkley, Colo., 1910-11.

Elk Head Creek near Craig, Colo., 1906; 1910-

Fortification Creek at Craig, Colo., 1905-6; 1910-

Williams River near Pyramid, Colo., 1910-11.

Williams River at Hamilton, Colo., 1904-1906; 1910-

Milk Creek at Axial, Colo., 1904-5.

Little Snake River [Middle Fork] near Battle Creek, Colo., 1912-

Little Snake River at Dixon, Wyo., 1910-

Little Snake River near Maybell, Colo., 1904.

South Fork of Little Snake River near Battle Creek, Colo., 1912-

Slater Creek at Baxter ranch, near Slater, Colo., 1912-

Slater Creek near Slater, Colo., 1910-1912.

Beaver Creek:

Willow Creek near Baggs, Wyo., 1912-

Fourmile Creek near Baggs, Wyo., 1912-

Ashley Creek near Vernal, Utah, 1900-1904; 1911-

Dry Fork of Ashley Creek at Vernal, Utah, 1904.

North Fork of Duchesne River (head of Duchesne River), above Forks, Utah, 1904.

Duchesne River at Myton, Utah, 1899-

West Fork of Duchesne River above Forks, Utah, 1904.

Rock Creek (East Creek) 10 miles above mouth, Utah, 1904.

Strawberry River above mouth of Indian Creek, in Strawberry Valley, Utah, 1909-10.

Strawberry River below mouth of Indian Creek, in Strawberry Valley, Utah, 1903-1906; 1908-9.

Strawberry River at Theodore, Utah, 1908-1910.

Indian Creek in Strawberry Valley, Utah, 1905-6; 1909-10.

Trail Hollow Creek in Strawberry Valley, Utah, 1909-10.

Currant Creek, 13 miles above mouth, Utah, 1904.

Currant Creek, 3 miles above mouth, Utah, 1904.

Red Creek above Narrows, Utah, 1904.

West Fork of Lake Fork (head of Lake Fork), 10 miles above Forks, Utah, 1904.

Colorado River—Continued.

Duchesne River—Continued.

Lake Fork below Forks, Utah, 1904; 1907-1910.

Lake Fork near Myton, Utah, 1900-1903; 1907-

East Fork of Lake Fork, 8 miles above Forks, Utah, 1904.

Uinta River near Whiterocks, Utah, 1899-1904; 1907-1910.

Uinta River at Fort Duchesne, Utah, 1899-1904; 1906-1910.

Uinta River at Ouray School, Utah, 1899-1904.

Whiterocks River near Whiterocks, Utah, 1899-1904; 1907-1910.

North Fork of White River (head of White River) near Buford, Colo., 1903-1906; 1910-

White River at Meeker, Colo., 1901-1906; 1910-

White River at White River City, Colo., 1895.

White River at Rangely, Colo., 1904-5.

White River at Dragon, Utah, 1906.

White River at Ouray, Utah, 1904.

Marvine Creek near Buford, Colo., 1903-1906.

South Fork of White River near Buford, Colo., 1903-1906; 1910-

Price River near Helper, Utah, 1894-1895; 1904-

Price River at Woodside, Utah, 1909-1911.

San Rafael River near Greenriver, Utah, 1909-

Cottonwood Creek near Orangeville, Utah, 1909-

Ferron Creek near Ferron, Utah, 1909-1911.

Ferron Creek (upper station) near Ferron, Utah, 1911-

Ferron Creek near Castledale, Utah, 1911-

Huntington Creek near Huntington, Utah, 1909-

Huntington Creek (lower) near Castledale, Utah, 1911-

North Fork of Grand River (head of Grand River) near Grand Lake, Colo., 1904-

Grand River near Granby, Colo., 1908-1911.

Grand River at Sulphur Springs, Colo., 1904-

Grand River near Kremmling, Colo., 1904-

Grand River near Wolcott, Colo., 1906-1908.

Grand River at Shoshone, Colo., 1897.

Grand River at Glenwood Springs, Colo., 1899-

Grand River near Palisades, Colo., 1902-

Grand River near Grand Junction, Colo., 1895-1900.

Grand River near Fruita, Colo., 1911-

Grand River near Moab, Utah, 1913-

North inlet to Grand Lake at Grand Lake, Colo., 1905-1912.

Grand Lake outlet at Grand Lake, Colo., 1904-1913.

South Fork of Grand River, near Lehman, Colo., 1907-8.

Fraser River near Arrow, Colo., 1910-

Fraser River at upper station near Fraser, Colo., 1908-1911.

Fraser River at lower station near Fraser, Colo., 1907-1909.

Fraser River at Granby (Coulter), Colo., 1904-1909.

Big Jim Creek near Fraser, Colo., 1907-1909.

Little Jim Creek near Fraser, Colo., 1907-1909.

Vasquez Creek at upper station near Fraser, Colo., 1908-9.

Vasquez Creek at lower station near Fraser, Colo., 1907-1909.

Elk Creek near Fraser, Colo., 1907-1909.

St. Louis Creek at upper station near Fraser, Colo., 1908-9.

St. Louis Creek at lower station near Fraser, Colo., 1908-9.

Colorado River—Continued.

Grand River—Continued.

Fraser River—Continued.

North Ranch Creek at upper station near Rollins Pass, Colo., 1908-9.

North Ranch Creek at lower station near Rollins Pass, Colo., 1907-1909.

Middle Ranch Creek at upper station near Arrow, Colo., 1908-9.

Middle Ranch Creek at lower station near Arrow, Colo., 1907-1909.

South Ranch Creek at upper station near Arrow, Colo., 1908-9.

South Ranch Creek at lower station near Arrow, Colo., 1907-1909.

Williams Fork near Scholl, Colo., 1910-

Williams Fork near Sulphur Springs, Colo., 1904-

Troublesome Creek at Troublesome, Colo., 1904-5.

Muddy Creek at Kremmling, Colo., 1904-5.

Blue River at Dillon, Colo., 1910-

Blue River near Kremmling, Colo., 1904-1908.

Tenmile Creek near Kokomo, Colo., 1904.

Tenmile Creek near Uneva Lake, Colo., 1903.

Tenmile Creek at Dillon, Colo., 1910-

Snake River at Dillon, Colo., 1910-

Eagle River at Red Cliff, Colo., 1911-

Eagle River at Eagle, Colo., 1905-1907; 1911-

Eagle River at Gypsum, Colo., 1907-1909.

Turkey Creek at Red Cliff, Colo., 1913-

Homestake Creek at Red Cliff, Colo., 1911-

Gore Creek near Minturn, Colo., 1911-

Beaver Creek at Avon, Colo., 1911-

Brush Creek at Eagle, Colo., 1911-1913.

No Name Creek near Glenwood Springs, Colo., 1911-

Glenwood Light & Power Co.'s flume near Glenwood Springs, Colo., 1911-

Roaring Fork at Aspen, Colo., 1911-

Roaring Fork below Aspen, Colo., 1913-

Roaring Fork near Emma, Colo., 1908-9.

Roaring Fork at Glenwood Springs, Colo., 1906-

Hunter Creek at Aspen, Colo., 1911-1913.

Castle Creek near Aspen, Colo., 1911-

Maroon Creek near Aspen, Colo., 1911-

Snow Mass Creek at Snow Mass, Colo., 1911-1913.

Frying Pan Creek at Norrie, Colo., 1911-

Frying Pan Creek at Thomasville, Colo., 1911-

Frying Pan Creek at Basalt, Colo., 1908-9.

North Fork of Frying Pan Creek near Norrie, Colo., 1911-

Crystal River at Marble, Colo., 1910-

Crystal River near Carbondale (Sewell), Colo., 1908-9.

West Fork of Elk Creek (head of Elk Creek), near Newcastle, Colo., 1911.

Middle Fork of Elk Creek near Newcastle, Colo., 1911-

East Fork of Elk Creek near Newcastle, Colo., 1911-

## Colorado River—Continued.

## Grand River—Continued.

- West Divide Creek (head of Divide Creek) at Hostutler's ranch, near Raven, Colo., 1909.
- West Divide Creek at Beard's ranch, near Raven, Colo., 1910-11.
- West Divide Creek at Raven, Colo., 1909-1911.
- West Mamm Creek near Rifle, Colo., 1909-1910.
- Taylor River (head of Gunnison River) near Almont, Colo., 1905.
- Taylor River at Almont, Colo., 1910-
- Gunnison River near Gunnison, Colo., 1910-
- Gunnison River near Iola, Colo., 1900-1903.
- Gunnison River near Cimarron, Colo., 1903-1905.
- Gunnison River at River Portal, Colo., 1905-1911.
- Gunnison River near Cory, Colo., 1903-1905.
- Gunnison River at Roubideau, Colo., 1897.
- Gunnison River at Whitewater, Colo., 1897; 1901-1906.
- Gunnison River near Grand Junction, Colo., 1894-1895; 1897-1899.
- East River at Almont, Colo., 1905; 1910-
- Cement Creek near Crested Butte, Colo., 1910-1913.
- Tomichi Creek near Gunnison, Colo., 1910.
- Quartz Creek near Pitkin, Colo., 1910-1913.
- Cimarron Creek at Cimarron, Colo., 1903-1905.
- North Fork of Gunnison River near Hotchkiss, Colo., 1903-1906.
- Sapinero Creek at Sapinero, Colo., 1911-
- Uncompahgre River near Colona, Colo., 1903-1906.
- Uncompahgre River at Ouray, Colo., 1908; 1911-
- Uncompahgre River below Ouray, Colo., 1913-
- Uncompahgre River near Fort Crawford, Colo., 1910-11.
- Uncompahgre River at Fort Crawford, Colo., 1895-1899; 1908-1910.
- Uncompahgre River at Montrose, Colo., 1900; 1903-
- Uncompahgre River near Delta, Colo., 1903-
- Canon Creek at Ouray, Colo., 1911-
- Dolores River at Dolores, Colo., 1895-1903; 1910-
- San Miguel River near Fall Creek, Colo., 1895-1899; 1910.
- San Miguel River at Placerville, Colo., 1910-
- Fremont River near Thurber, Utah, 1909-1912.
- Muddy Creek near Emery, Utah, 1909-
- Muddy Creek (lower station) near Emery, Utah, 1911-
- Ivie Creek near Emery, Utah, 1911-12.
- Escalante Creek (head of Escalante River) near Escalante, Utah, 1909-1913.
- San Juan River at Pagosa Springs, Colo., 1911-
- San Juan River at Arboles, Colo., 1895-1899; 1910-
- San Juan River at Turley, N. Mex., 1907-8.
- San Juan River at Blanco, N. Mex., 1908-1910.
- San Juan River near Bloomfield, N. Mex., 1909-1912.
- San Juan River at Farmington, N. Mex., 1904-1906; 1912-
- San Juan River near Shiprock, N. Mex., 1911-1913.
- Navajo River at Chromo, Colo., 1911-12.
- Navajo River at Edith, Colo., 1912-
- Piedra River at Piedra, Colo., 1911-1912.
- Piedra River at Arboles, Colo., 1895-1899; 1910-

## Colorado River—Continued.

## San Juan River—Continued.

- Los Pinos River at Ignacio, Colo., 1899-1903; 1910-Animas River at Silverton, Colo., 1903.
- Animas River at Tacoma, Colo., 1908-1909; 1911.
- Animas River at Durango, Colo., 1895-1905; 1910-Animas River at Aztec, N. Mex., 1904; 1907-Animas River at Farmington, N. Mex., 1912-Animas River near Farmington, N. Mex., 1904-5.
- Hermosa Creek near Hermosa, Colo., 1911-Florida River near Durango, Colo., 1899; 1901-1903; 1910-La Plata River at Hesperus, Colo., 1904-1906; 1910.
- La Plata River at La Plata, N. Mex., 1905-Mancos River at Mancos, Colo., 1898-1901.
- West Mancos River near Mancos, Colo., 1910-11.
- Little Colorado River at St. Johns, Ariz., 1906-1909.
- Little Colorado River at Woodruff, Ariz., 1905-1908.
- Little Colorado River at Holbrook, Ariz., 1905-1909.
- Silver Creek at Snowflake, Ariz., 1906-1908.
- Silver Creek at Canyon Station, Ariz., 1906.
- Woodruff Ditch at Woodruff, Ariz., 1906.
- Chevelon Fork near Winslow, Ariz., 1906-1908.
- Clear Creek near Winslow, Ariz., 1906-1909.
- Virgin River at Virgin, Utah, 1909-
  - Santa Clara River near Central, Utah, 1909-
  - Santa Clara River near St. George, Utah, 1909-
  - Muddy River near Moapa, Nev., 1904-1906; 1909-10; 1913-
  - Muddy River near St. Thomas, Nev., 1913-
  - Zion Creek near Springdale, Utah, 1913-
- Bill Williams River near Swansea, Ariz., 1910-
- Gila River near Cliff, N. Mex., 1904-1907.
- Gila River near Silver City, N. Mex., 1912-
- Gila River near Redrock, N. Mex., 1908-
- Gila River at Guthrie, Ariz., 1910-
- Gila River at San Carlos, Ariz., 1899-1905; 1910-11.
- Gila River near Kelvin, Ariz., 1911-
- Gila River near Buttes, Ariz., 1889-90; 1895-1899.
- Gila River at Dome (Gila City), Ariz., 1903-1906.
- Gila River at Sentinel, Ariz., 1912-
- Gila River at mouth near Yuma, Ariz., 1903.
- San Francisco River at Alma, N. Mex., 1904-1907; 1909-
  - San Francisco River at dam above Clifton, Ariz., 1911-
  - San Francisco River at Clifton, Ariz., 1910-
  - Whitewater Creek near Mogollon, N. Mex., 1909-
- San Carlos River at San Carlos, Ariz., 1910-11.
- San Pedro River near Lewis Springs, Ariz., 1910-11.
- San Pedro River at Charleston, Ariz., 1904-1906.
- San Pedro River near Fairbank, Ariz., 1911-12.
- San Pedro River at Fairbank, Ariz., 1912-
- San Pedro River near Dudleyville, Ariz., 1890.
- Santa Cruz River near Nogales, Ariz., 1907; 1909-
- Santa Cruz River and ditches at Tucson, Ariz., 1905-Queens Creek at Whitlows, Ariz., 1896.
- Rillito Creek near Tucson, Ariz., 1911-

## Colorado River—Continued.

## Gila River—Continued.

- Salt River at Roosevelt, Ariz., 1901-1907; 1912.
- Salt River below mouth of Cherry Creek near Roosevelt, Ariz., 1906.
- Salt River 50 miles above Phoenix, Ariz., 1890.
- Salt River at Arizona Dam, Ariz., 1888-1891.
- Salt River at McDowell, Ariz., 1897-1910.
- Black River near White River, Ariz., 1912-
- Black River near Fort Apache, Ariz., 1912-
- North Fork of White River (head of White River) near Fort Apache, Ariz., 1912-
- East Fork of White River near Fort Apache, Ariz., 1912-
- Tonto Creek at Roosevelt, Ariz., 1901-1904.
- Verde River near Camp Verde, Ariz., 1911-
- Verde River at Camp Verde, Ariz., 1912-
- Verde River at McDowell, Ariz., 1889- (Records broken.)
- Beaver Creek at Camp Verde, Ariz., 1912-
- Agua Fria River near Glendale, Ariz., 1910-
- Hassayampa River at Walnut Grove, Ariz., 1912-
- Hassayampa River at Wickenburg, Ariz., 1910-1912.
- White River near Douglas, Ariz., 1911-<sup>1</sup>

## CANAL STATIONS IN COLORADO RIVER BASIN.

- Imperial canal (main) near Calexico, Cal., 1904-5.
- Boundary canal near Calexico, Cal., 1905.
- Wisteria canal near Calexico, Cal., 1905.
- Imperial canal 10 miles below Yuma, Ariz., 1903-1905.
- Holt canal at Calexico, Cal., 1905-
- Hemlock canal at Calexico, Cal., 1904-5.
- Alamo channel near Calexico, Cal., 1904-
- Alamitos canal near Calexico, Cal., 1904-5.
- Vernal Milling & Lighting Co.'s canal at Vernal, Utah, 1913-

## REPORTS ON WATER RESOURCES OF COLORADO 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.

2. Irrigation near Phoenix, Ariz., by A. P. Davis. 1897. 98 pp., 31 pls. 15c.

Describes physiographic features, temperature, rainfall, stream-flow, soils, and projected irrigation works in Gila River Basin; discusses briefly possible use of underground water for irrigation and gives data concerning wells in Pinal and Maricopa counties. Chiefly of historic interest, as indicated by the date of publication.

33. Storage of water on Gila River, Arizona, by J. B. Lippincott. 1900. 98 pp., 33 pls. 15c.

Describes conditions existing in 1898-99, available water supply, silt, and reservoir sites (Buttes, Riverside, San Carlos, and Queen Creek); contains section on cement, and treats of irrigable land, distribution canals, and organization of irrigation. Interest chiefly historic.

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<sup>1</sup> Flows into the Gulf of California in Mexico.

- \*43. Conveyance of water in irrigation canals, flumes, and pipes, by Samuel Fortier. 1901. 86 pp., 15 pls. 15c.  
Describes various types of canals for irrigation.
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. 5c.  
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" give information concerning temperature, quality of water, purposes of boring, etc. See also 149.
- \*73. Water storage on Salt River, Arizona, by A. P. Davis. 1902. 54 pp., 25 pls. 20c.  
Discusses Verde and Salt River basins and McDowell and Salt River reservoirs.
74. Water resources of the State of Colorado, by A. L. Fellows. 1902. 151 pp., 14 pls. 25c.  
Discusses drainage and irrigation; gives records of stream flow.
93. Proceedings of first conference of engineers of Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1904. 361 pp. 25c. [Inquiries concerning this report should be addressed to the Reclamation Service.] Contains:  
Investigations in Arizona, by A. P. Davis. Describes the proposed storage reservoir on Salt River at the mouth of Tonto Creek.  
Salt River Valley Water Users' Association, by B. A. Fowler. Contains Judge Kibbey's address presenting a plan for the organization of the owners of lands to be irrigated.  
Topographic work in the Grand Canyon of the Gunnison, by I. W. McConnell. Discusses the proposed diversion of water from Gunnison River into Uncompahgre Valley.  
Colorado River, by J. R. Lippincott.  
Colorado River reclamation projects, by E. T. Perkins. Describes the site of the Yuma dam and summarizes the advantages of the Yuma site.
104. The underground waters of Gila Valley, Arizona, by W. T. Lee. 1904. 71 pp., 5 pls. 10c.  
Presents information concerning the topographic features and surficial geology of the area between The Buttes, 12 miles east of Florence and the junction of Gila and Salt rivers; treats of the source, amount, quality, and methods of securing the underflow.
136. Underground waters of Salt River valley, Arizona, by W. T. Lee. 1905. 196 pp., 23 pls. 25c.  
Describes the physiography and geology of the Mesa and Phoenix region, gives many well records, and discusses the amount and chemical character of the underground waters, duty of water, and cost of pumping.
147. Destructive floods in United States in 1904, by E. C. Murphy and others. 15c. Contains:  
La Plata River flood, Colorado, from report of Theo Tobish. Describes floods on the headwaters of the Big Sandy (tributary to the Colorado through Bill Williams River), on Sacramento Wash, and on La Plata River (tributary to the Colorado through San Juan River).
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 location, depth, diameter, yield, height of water, and other valuable information concerning wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 and 61; mentions also principal publications relating to deep borings.



- \*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.

Contains accounts of floods on Colorado, Green, Grand, Gunnison, San Juan, Little Colorado, Gila, San Francisco, Verde, San Pedro, and Salt rivers, and of the flow of the Colorado into Salton Sink; gives index to literature on floods on American streams.

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 Colorado, Green, Grand, Gunnison, Animas, Little Colorado, Gila, San Francisco, Salt, and Verde rivers.

- \*320. Geology and water resources of the Sulphur Spring Valley, Arizona, by O. E. Meinzer and F. C. Kelton, with a section on agriculture, by R. H. Forbes. 45c.

Describes the physiography and drainage of the region, geologic formations, and geologic history; discusses the seasonal and geographic distribution of rainfall, the occurrence and level of ground waters, the flowing and non-flowing wells, the quality of ground waters, the effect of alkali on plant life and on waters for irrigation, the relation of zones of vegetation to water supply and geographic controls, and the plants used for pumping water; treats also of the early history of agriculture and agricultural methods.

#### 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.

#### Ninth Annual Report of the United States Geological Survey, 1887-88, J. W.

Powell, Director. 1889. xiii, 717 pp., 88 pls. \$2. Contains:

\*On the geology and physiography of a portion of northwestern Colorado and adjacent parts of Utah and Wyoming, by C. A. White, pp. 677-712, Pl. LXXXVIII. Describes the canyons of Green, Yampa, Snake, and White rivers.

#### \*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 measurement, 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. Contains:**

\*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.

\***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 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.

**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 pls. \$1.75. Contains:**

\*Reservoirs for irrigation, by J. D. Schuyler, pp. 617-740, Pls. XLVII-CII. Describes the Agua Fria dam, Arizona, and reservoir projects on Rio Verde, Salt River, Queen Creek, Hassayampa River, and Little Colorado River, Arizona, and in the Tonto basin; gives tables of reservoir capacities and areas.

**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. V, Forest reserves, pp. xix, 498, 159 plates, 8 maps in separate case. \$2.80. Contains:**

\*White River Plateau timber land reserve, by G. B. Sudworth, pp. 117-179, Pls. XLVIII-LVIII; Battlement Mesa forest reserve, by G. B. Sudworth, pp. 181-243, Pls. LIX-LXXV. Describes briefly the streams and lakes in the reserves.

#### 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. Bulletins are of octavo size.

\*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 Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming; and detailed record of well near Phoenix, Maricopa County, Ariz. The well of which a detailed section is given was selected because it affords valuable stratigraphic information.

\*350. Geology of the Rangely oil district, Rio Blanco County, Colorado, with a section on the water supply of the Raven-Park district, by H. S. Gale, 1908. 60 pp., 4 pls. 20c.

Discusses White River and its tributaries as sources of water supply and the possibility of obtaining artesian flows; treats of the quality of the water of White River and gives analyses.

## 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.<sup>1</sup> 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.

**111. Globe, Arizona.**

Describes the physiographic divisions of Arizona and the topography, climate, and vegetation of the Globe quadrangle; discusses general geology and geologic history and structure, and, under "Economic geology," gives a brief account of the water resources.

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<sup>1</sup> Index maps showing areas in the Colorado 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.

**120. Silverton, Colorado.**

Describes an area in the San Juan Mountains including a portion of the Continental Divide, and sending streams through Animas River to the San Juan, through Uncompahgre to the Gunnison and the Colorado, and through small creeks to the Rio Grande. Folio describes topography and general geology of the region, the petrography and the areal geology, and includes in the discussion of the economic geology a brief study of the ground waters.

**129. Clifton, Arizona.**

Describes the relief and drainage of an area in eastern Graham County, the stratigraphic and structural geology, the streams and springs of the area; gives analyses of spring water from San Francisco River.

**130. Rico, Colorado.**

Describes the Rico Mountains and Dolores River valley, and the stratigraphic, structural, and historical geology of the Rico quadrangle, and, under "Economic geology," includes a brief paragraph on water resources.

**153. Ouray, Colorado.**

Describes the relief of the Ouray quadrangle, in southwestern Colorado, whose streams belong to the Gunnison River system and are thus tributary through Colorado River to the Gulf of California; discusses the stratigraphic, structural, and historical geology; and, under "Economic geology," describes the river waters used for irrigation, the underground waters, and the thermal springs; gives analyses of water from Hot Spring at Ouray.

**171. Engineer Mountain, Colorado.**

Describes the topography and geology of the Engineer Mountain quadrangle, in southwestern Colorado, about 60 miles east of the Utah boundary and 34 miles north of New Mexico; discusses the drainage, which passes to the Gulf of California through Colorado River; under "Economy geology" gives a brief paragraph on the water resources.

**MISCELLANEOUS REPORTS.**

Other Federal bureaus, State and other organizations have from time to time published reports relating to water resources of various sections of the country. Notable among those pertaining to the Colorado River basin are the reports of the State engineers of Colorado, Nevada, New Mexico, and Wyoming, and the annual reports of the United States Reclamation Service. The following reports deserve special mention:

Canyons of the Colorado, by J. W. Powell. 1895. A popular, revised, and enlarged edition of his original journal of exploration which appeared as part of a report entitled "Exploration of the Colorado River of the West and its tributaries, explored in 1869, 1870, 1871, and 1872 under the direction of the Secretary of the Smithsonian Institution," published by the Smithsonian Institution in 1875.

A canyon voyage; the narrative of the second Powell expedition down the Green-Colorado River from Wyoming and the explorations on land in the year 1871-72, by Frederick S. Dellenbaugh, artist and assistant topographer of the expedition. 1908.

Preliminary examination of reservoir sites in Wyoming and Colorado; letter from the Secretary of War transmitting a letter from the Chief of Engineers, together with a report of Captain Chittenden. 55th Cong., 2d sess., House Doc. 141.

Irrigation pumping in Nevada, etc., by Charles Norcross: Nevada Bureau of Industry, Agriculture, and Irrigation, Bull. 8, 1913.

Report on irrigation investigations in Utah under the direction of Elwood Mead: U. S. Dept. Agr., Office of Experiment Stations, Bull. 124, 1903.

Irrigation in Utah. Utah Irrigation Commission, 1894.

## 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.) 10c.  
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. 10c.  
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. 10c.  
Discusses efficiency of pumps and water lifts of various types.
- \*20. Experiments with windmills, by T. O. Perry. 1899. 97 pp., 12 pls. 15c.  
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. 15c.  
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. 15c.
- 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. 5c.  
 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. 25c. [Inquiries concerning this report should be addressed to the Reclamation Service.]  
 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 Geo. 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. 10c.  
 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.)  
 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.

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.

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. 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. 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 problems, 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 Thos. H. Means.

Alkali soils, by Thos. 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 and 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. 195. 149 pp.

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.

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 Kougarek 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 water 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. 1914. 392 pp. 50c.

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. 368-551, 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, 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 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. \$1.40. Contains:

\*Hydrography of Nicaragua, by A. P. Davis, pp. 563-637, Pls. LXIV to LXXV. 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 topography, geology, drainage, forests, climate and population, and transportation facilities of the region, 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 water; 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 analyses; 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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<sup>1</sup> Many of the reports contain brief subject bibliographies. See abstracts.

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

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