

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 340—C

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

PART III.—OHIO RIVER BASIN

COMPILED BY B. D. WOOD

Part of Water-Supply Paper 340



WASHINGTON
GOVERNMENT PRINTING OFFICE
1914

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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 12 parts, each part covering an area whose boundaries coincide with natural drainage features as indicated below:

- Part I. North Atlantic coast basins.
- II. South Atlantic coast 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 coast basins in California.
- XII. North Pacific coast 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.
 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.....	1884 to Sept.,
11th A, pt. 2	Monthly discharge and descriptive information.....	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 coast.....	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 coast 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.....	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 Mis- sissippi 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
Pacific coast in California....	38, ^s 39	51	66, 75	85	100	134	177	213	251	271	291	311	331	361
North Pacific coast.....	38	51	66, 75	85	100	135	^t 177, 178	214	252	272	292	312	332	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.

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 III. OHIO RIVER BASIN.

PRINCIPAL STREAMS.

The Ohio River basin includes Ohio River with all its tributaries, the most important being Allegheny, Monongahela, Beaver, Muskingum, New (or Kanawha), Scioto, Miami, Kentucky, Wabash, Cumberland, and Tennessee rivers. The streams drain wholly or in part the States of Alabama, Georgia, Illinois, Indiana, Kentucky, Mississippi, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.

In addition to the list of gaging stations and the annotated list of publications relating specifically to the Ohio River basin, the following 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. 41.)

GAGING STATIONS.

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

Allegheny River (head of Ohio River) at Red House, N. Y., 1903-

Allegheny River at Kittanning, Pa., 1904-

Conewango Creek:

Chautauqua Lake outlet (Chadakoin River) near Jamestown, N. Y., 1895.

Chadakoin River near Jamestown, N. Y., 1904-5.

Kiskiminitas River at Avonmore, Pa., 1907-

Kiskiminitas River at Salina, Pa., 1904-1906.

Blacklick Creek at Blacklick, Pa., 1904-

Tygart River (head of Monongahela River) at Belington, W. Va., 1907-

Tygart River at Fetterman, W. Va., 1907-

Monongahela River at Lock No. 4, Pa., 1886-1906. Flood stage record only.

Buckhannon River at Hall, W. Va., 1907-

West Fork River at Enterprise, W. Va., 1907-

Elk Creek near Clarksburg, W. Va., 1913-

Buffalo Creek at Barrackville, W. Va., 1907-

Cheat River near Morgantown, W. Va., 1899-

Shavers Fork River at Parsons, W. Va., 1913-

Youghiogheny River at Friendsville, Md., 1898-1904.

Youghiogheny River at Confluence, Pa., 1904-

Casselman River at Confluence, Pa., 1904-

Laurel Hill Creek at Confluence, Pa., 1904-

Indian Creek in Westmoreland County, Pa., 1892-3.

Beaver River:

Mahoning River at Youngstown, Ohio, 1903-1906.

Ohio River tributaries—Continued.

- Cross Creek near Mingo Junction, Ohio, 1903.
 McMahon River at Steel, Ohio, 1903.
 Muskingum River at Zanesville, Ohio, 1905-
 Mohican River at Pomerene, Ohio, 1910-
 Licking River at Pleasant Valley, Ohio, 1902-1906.
 Jonathan Creek at Powells, Ohio, 1902-3.
 New River, South Fork (head of New River, which in turn is head of Kanawha
 River), at New River, N. C., 1900-01.
 New River, South Fork, near Crumpler, N. C., 1908-
 New River at Oldtown, Va., 1900-1903.
 New River near Grayson, Va., 1908-
 New River at Radford, Va., 1898-
 New River at Fayette, W. Va., 1895-
 New River, North Fork, at Weaversford, N. C., 1900-1901.
 New River, North Fork, near Crumpler, N. C., 1908-
 Reed Creek at Grahams Foige, Va., 1908-
 Big Reed Island Creek near Allisonia, Va., 1908-
 Little River near Copper Valley, Va., 1908-
 Walker Creek at Staffordsville, Va., 1908-
 Wolf Creek near Narrows, Va., 1908-
 Bluestone River at Lilly, W. Va., 1908-
 Bluestone River near True, W. Va., 1911-
 Greenbrier River near Marlinton, W. Va., 1908-
 Greenbrier River at Alderson, W. Va., 1895; 1908-
 Gauley River at Allingdale, W. Va., 1908-
 Gauley River near Summersville, W. Va., 1908-
 Gauley River near Belva, W. Va., 1908-
 Cherry River at Richwood, W. Va., 1908-
 Meadow River near Russellville, W. Va., 1908-
 Elk River at Webster Springs, 1908-
 Elk River at Gassaway, W. Va., 1908-
 Elk River at Clendennin, W. Va., 1908-
 Coal River at Brushton, W. Va., 1908-
 Coal River at Fuqua, W. Va., 1911-
 Coal River at Tornado, W. Va., 1908-
 Pocotaligo River at Sissonville, W. Va., 1908-
 Mill Creek at Arlington Heights, Ohio, 1913-
 Mill Creek at Cincinnati, Ohio, 1913-
 Scioto River near Columbus, Ohio, 1898-1906.
 Olentangy River near Columbus, Ohio, 1898-1905.
 Little Miami River at Loveland, Ohio, 1906.
 Little Miami River near Morrow, Ohio, 1903.
 Miami River at Hamilton, Ohio, 1910-
 Miami River at Dayton, Ohio, 1905-1910.
 Mad River near Springfield, Ohio, 1904-1906.
 Kentucky River at Frankfort, Ky., 1905-6.
 Dix River near Danville, Ky., 1905.
 Dix River near Burgin, Ky., 1910-
 Salt River, Rolling Fork, at New Haven, Ky., 1905-6.
 Wabash River at Logansport, Ind., 1903-1906.
 Wabash River at La Fayette, Ind., 1901-1903.
 Wabash River at Terre Haute, Ind., 1902-3 and 1905-6.

Ohio River tributaries—Continued.

- Wabash River at Mount Carmel, Ill., 1884—
- Tippecanoe River at Delphi, Ind., 1903–1908.
- Embarrass River near Oakland, Ill., 1909—
- Embarrass River at St. Marie, Ill., 1909—
- White River, West Branch, at Indianapolis, Ind., 1904–1906.
- Eel River at Cataract, Ind., 1903–1906.
- White River, East Branch, at Shoals, Ind., 1903—
- Little Wabash River near Clay City, Ill., 1909—
- Little Wabash River near Golden Gate, Ill., 1909—
- Little Wabash River at Carmi, Ill., 1909—
- Skillet Fork near Wayne City, Ill., 1909—
- Skillet Fork near Mill Shoals, Ill., 1909—
- Cumberland River at Nashville, Tenn., 1901–1904.
- French Broad River (head of Tennessee River) at Rosman, N. C., 1907–1909.
- French Broad River at Horseshoe, N. C., 1904–1906.
- French Broad River at Asheville, N. C., 1895—
- French Broad River at Newport, Tenn., 1900–1907.
- Tennessee River at Knoxville, Tenn., 1899—
- Tennessee River at Chattanooga, Tenn., 1895—
- Davidson River near Davidson, N. C., 1904–1909.
- Little River at Calhoun, N. C., 1907–8.
- Mills River, North Fork, at Pinkbed, N. C., 1904–1909.
- Mills River, South Fork, near Sitton, N. C., 1904–1909.
- Mud Creek at Naples, N. C., 1907.
- Swannanoa River at Swannanoa, N. C., 1907–1909.
- Swannanoa River at Biltmore, N. C., 1905.
- Ivy River at Democrat, N. C., 1907.
- Pigeon River at Canton, N. C., 1907–1909.
- Pigeon River at Newport, Tenn., 1900–1909.
- Nolichucky River at Chucky Valley, Tenn., 1900–1901.
- Nolichucky River at Greeneville, Tenn., 1903–1908.
- North Toe River at Spruce Pine, N. C., 1907–8.
- Holston River, South Fork (head of Holston River), near Chilhowie, Va., 1907–1909.
- Holston River, South Fork, at Bluff City, Tenn., 1900.
- Holston River near Rogersville, Tenn., 1904—
- Holston River, Middle Fork, at Chilhowie, Va., 1907–1910.
- Watauga River at Butler, Tenn., 1900–1901.
- Watauga River near Elizabethton, Tenn., 1903–1908.
- Elk Creek at Lineback, Tenn., 1900–1901.
- Roane Creek at Butler, Tenn., 1900–1901.
- Doe River at Blevins, Tenn., 1911—
- Doe River at Valley Forge, Tenn., 1913—
- Doe River near Elizabethton, Tenn., 1907—
- Holston River, North Fork, at Daltville, Va., 1907–8.
- Little Tennessee River at Franklin, N. C., 1907–1910.
- Little Tennessee River at Judson, N. C., 1896—
- Little Tennessee River at McGhee, Tenn., 1905—
- Cullasagee River at Cullasagee, N. C., 1907–1909.
- Nantahala River near Nantahala, N. C., 1907–1909.
- Tuckasegee River near East Laport, N. C., 1907–1909.

Ohio River tributaries—Continued.

Tennessee River tributaries—Continued.

- Tuckasegee River at Bryson, N. C., 1896-
 Scotts Creek near Dillsboro, N. C., 1907-8.
 Oconalufly River near Cherokee, N. C., 1907-8.
 Cheoah River at Millsaps, N. C., 1907-8.
 Clinch River at Clinchport, Va., 1907-1909.
 Hiwassee River near Hayesville, N. C., 1907-1909.
 Hiwassee River at Murphy, N. C., 1907-
 Hiwassee River at Reliance, Tenn., 1900-
 Hiwassee River at Charlestown, Tenn., 1899-1903.
 Tusquitee Creek near Hayesville, N. C., 1907-1909.
 Valley River at Tomotla, N. C., 1904-1909.
 Nottely River at Ranger, N. C., 1901-1905.
 Toccoa River near Dial, Ga., 1907-8.
 Toccoa River at Blueridge, Ga., 1899-1903.
 Ocoee River at Copper Hill, Tenn., 1903-1910.
 Elk Creek near Elkmont, Ala., 1904-1908.
 Duck River at Columbia, Tenn., 1904-1908.

REPORTS ON WATER RESOURCES OF THE OHIO RIVER BASIN.¹**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 from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Water-supply Papers are of octavo size.

- *21. Wells of northern Indiana, by Frank Leverett. 1899. 82 pp., 2 pls. (Continued in No. 26.)
 Discusses by counties the glacial deposits and the sources of well waters; gives many well sections.
- *24. Water resources of the State of New York, Part I, by G. W. Rafter. 1899. 99 pp., 13 pls.
- *25. Water resources of the State of New York, Part II, by G. W. Rafter. 1899. 100 pp., 12 pls.
 No. 24 contains descriptions of the principal rivers of New York and their more important tributaries, and data on temperature, precipitation, evaporation, and stream flow.
 No. 25 contains discussion of water-storage projects on Genesee and Hudson rivers, power development at Niagara Falls, descriptions and early history of State canals, and a chapter on the use and value of the water power of the streams and canals; also brief discussion of the water yield of land areas of Long Island.
26. Wells of southern Indiana (continuation of No. 21), by Frank Leverett. 1899. 64 pp.
 Discusses by counties the glacial deposits and the sources of well water; contains many well sections.
- *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. 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.).

¹ For stream-measurement reports see tables on pages IV-VI.

62. Hydrography of the southern Appalachian Mountain region, Part I, by H. A. Pressey. 1902. 95 pp., 25 pls. 15c.
63. Hydrography of the southern Appalachian Mountain region, Part II, by H. A. Pressey. 1902. 96-190 pp., pls. 26-44. 15c.
- Nos. 62 and 63 describe in a general way the mountains, rivers, climate, forests, soil, vegetation, and mineral resources of the southern Appalachian Mountains, and then discuss in detail the drainage basins, giving for each an account of the physical features, rainfall, forests, minerals, transportation, discharge measurements, and water powers. Most of the streams described are tributary through Tennessee River to the Ohio, but Part II (No. 63) includes also descriptions of several streams in the south Atlantic and eastern Gulf of Mexico drainage basins.
79. Normal and polluted waters in northeastern United States, by M. O. Leighton. 1903. 192 pp. 10c.
- Defines essential qualities of water for various uses, the impurities in rain, surface, and underground waters, the meaning and importance of sanitary analyses, and the principal sources of pollution; chiefly "a review of the more readily available records" of examination of water supplies derived from streams in the Merrimac, Connecticut, Housatonic, Delaware, and Ohio River basins; contains many analyses.
91. The natural features and economic development of the Sandusky, Maumee, Muskingum, and Miami drainage areas in Ohio, by B. H. and M. S. Flynn. 1904. 130 pp. 10c.
- Describes the topography, geology, and soils of the areas and discusses stream flow, dams, water powers, and public water supplies.
96. Destructive floods in the United States in 1903, by E. C. Murphy. 1904. 81 pp., 13 pls. 15c.
- Contains notes on early floods in Mississippi Valley.
102. Contributions to the hydrology of eastern United States, 1903; M. L. Fuller, geologist in charge. 1904. 522 pp. 30c.
- Contains brief reports on springs and wells of Alabama, Georgia, Tennessee, and Kentucky. 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.
107. Water powers of Alabama, with an appendix on stream measurements in Mississippi, by B. M. Hall. 1904. 253 pp., 9 pls. 20c.
- Contains gage heights, rating tables, estimates of monthly discharge at stations on Tallapoosa, Coosa, Alabama, Cahaba, Black Warrior, Tombigbee, and Tennessee rivers and their tributaries; gives estimates and short descriptions of water powers.
110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.
- Contains reports as follows: Water resources of the Middlesboro-Harlan region of southeastern Kentucky, by George H. Ashley. Describes briefly the topographic features of the area and the water supply of Middlesboro and Pineville.
- Water resources of the Cowee and Pisgah quadrangles, North Carolina, by Hoyt S. Gale. Discusses drainage, springs, and mineral waters of one of the units of the geologic atlas of the United States.
113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4 pls. 5c.
- Contains a brief report on the topography, drainage, geology, and the pollution of wells and streams by oil waste and brine in an area drained by Mississinewa River, a tributary of the Wabash.
114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.
- Contains brief reports relating to Ohio River drainage areas, as follows:
 Tennessee and Kentucky, by L. C. Glenn.
 Ohio, by Frank Leverett.
 Illinois, by Frank Leverett.
 West Virginia, by M. L. Fuller.
 Indiana, by Frank Leverett.
 North Carolina, by M. L. Fuller.
 South Carolina, by L. C. Glenn.
 Georgia, by S. W. McCallie.
 Alabama, by E. A. Smith.
- Each of these reports describes the geology of the area in its relation to water supplies; notes the principal mineral springs, and gives list of pertinent publications.

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. Gives elevations and distances along Hiwassee, Nottely, and Toccoa rivers.
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 "Water resources of the Nicholas quadrangle, West Virginia," by George H. Ashley. Describes topography, geology, and domestic water supply of the hilly region in central West Virginia, a little east of New and Kanawha rivers.
147. Destructive floods in United States in 1904, by E. C. Murphy. 15c.
Contains "Wabash River flood, Indiana," by F. W. Hanna. Describes causes of flood, discharge, damage, and prevention of damage; also the drought in the Ohio River basin, its causes and effects; flood in Scottdale Valley, caused by failure of dam on Jacobs Creek (tributary to the Ohio through Youghiogheny 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 (and within the States by counties), 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.
159. Summary of the underground-water resources of Mississippi, by A. F. Crider and L. C. Johnson. 1906. 88 pp., 6 pls. 20c.
Describes geography, topography, and general geology of the State; discusses the source, depth of penetration, rate of percolation, and recovery of underground waters; artesian requisites, and special conditions in the Coastal Plain formations; gives notes on wells by counties, deep well records, and selected records in details; treats of sanitary aspect of wells and gives analyses.
- *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 on Allegheny and Ohio rivers, and estimates of flood discharge and frequency on Monongahela, Youghiogheny, and Tennessee rivers; also index to literature on floods in American streams.
164. Underground waters of Tennessee and Kentucky west of Tennessee River and of an adjacent area in Illinois, by L. C. Glenn. 1906. 173 pp., 7 pls.
Describes static level and uses of waters, artesian conditions, and source properties of underground water; discusses topography, geology, and water resources by counties; gives logs of wells, analyses of waters, and bibliography of most important reports.
- *197. Water resources of Georgia, by B. M. and M. R. Hall. 1907. 342 pp., 1 pl. 50c.
Describes topographic and geologic features of the State; discusses by drainage basins stream flow, river surveys, and water powers.
233. Water resources of the Blue Grass region, Kentucky, by G. C. Matson, with a chapter on the quality of the waters, by Chase Palmer. 1909. 96 pp., 2 pls. 20c.
Describes the geologic formations, physiographic features, soils, and surface waters of the region; the source, conditions of occurrence, amount and recovery of the underground waters, collection and storage of rainwaters, municipal water supplies, and conditions in each county; discusses under "Quality" the industrial uses of the water, comparative hardness, and mineral and table waters; many analyses.
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; gives results of analyses of waters of Allegheny, Cumberland, Kentucky, Miami, Wabash, and Tennessee rivers and some of their tributaries.

239. The quality of the surface waters of Illinois, by W. D. Collins. 1910. 94 pp., 3 pls. 10c.
Discusses the natural and economic features that determine the character of the streams; describes the larger drainage basins and the methods of collecting and analyzing the samples of water, and discusses each river in detail with reference to its source, course, and quality of water; includes short chapters on municipal supplies and industrial uses.
254. Ground waters of north-central Indiana, by S. R. Capps, with a chapter on the chemical character of the waters, by R. B. Dole. 1910. 279 pp., 7 pls. 40c.
Describes relief, drainage, vegetation, soils and crops, industrial development, geologic formations; sources, movements, occurrence, and volume of ground water; methods of well construction and lifting devices; discusses in detail for each country, surface features and drainage, geology and ground water, city, village, and rural supplies, and gives records of wells and analyses of waters. Discusses also, under chemical character, methods of analyses and expression of results, mineral constituents, effect of the constituents on waters for domestic and industrial and medicinal uses, methods of purification, chemical composition; many analyses and field assays.
- *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).
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.
Although relating specifically to floods in the Ohio Valley, this report discusses also the causes of floods and the prevention of damage by floods.

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.

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, xx, 597 pp., 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.

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. Contains:

*The water resources of Illinois, by Frank Leverett, pp. 695-849, Pls. CVIII to CXIII. Describes the physical features of the State, and the drainage basins, including Illinois, Des Plaines, Kankakee, Fox, Illinois-Vermilion, Spoon, Mackinaw, and Sangamon rivers, Macoupin Creek, Rock River, tributaries of the Mississippi in western Illinois, Kaskaskia, Big Muddy, and tributaries of the Wabash; discusses the rainfall and run-off, navigable waters and water powers, the wells supplying water for rural districts, and artesian wells; contains tabulated artesian well data and water analyses.

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. Contains:

*The water resources of Indiana and Ohio, by Frank Leverett, pp. 419-560. pls. xxxij to xxxvii. Describes the Wabash, Whitewater, Great Miami, Little Miami, Scioto, Hocking, Muskingum, and Beaver rivers and lesser tributaries of the Ohio in Indiana and Ohio, the streams discharging into Lake Erie and Lake Michigan, and streams flowing to the upper Mississippi through the Illinois; discusses shallow and drift wells, the flowing wells from the drift and deeper artesian wells, and gives records of wells at many of the cities; describes the mineral springs, and gives analyses of the waters; contains also tabulated lists of cities using surface waters for waterworks, and of cities and villages using shallow and deep well waters; discusses the source and quality of the city and village supplies; and gives precipitation tables for various points.

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. Contains:

*The rock waters of Ohio, by Edward Orton, pp. 633-717, pls. lxxi to lxxiii. Describes the principal geological formations of Ohio and the waters from the different strata; discusses the flowing wells at various points and the artesian wells of pre-Glacial channels in Allen, Auglaize, and Mercer counties; discusses city and village supplies; gives analyses of waters from various formations.

MONOGRAPHS.

Monographs are of quarto size. They are not distributed free, but may be obtained from the Geological Survey or from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C., at the prices indicated. An asterisk (*) indicates that the Survey's stock of the paper is exhausted.

XLI. Glacial formations and drainage features of the Erie and Ohio basins, by Frank Leverett. 1902. 802 pp., 26 pls. \$1.75.

Treats of an area extending westward from Genesee Valley in New York across northwestern Pennsylvania and Ohio, central and southern Indiana, and southward from Lakes Ontario and Erie to the vicinity of Allegheny and Ohio rivers.

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.

37. The southern Appalachian forests, by H. B. Ayres and W. W. Ashe. 1905. 291 pp., 37 pls. 80c.

Describes the relief, drainage, climate, natural resources, scenery, and water supply of the southern Appalachian forests, the trees, shrubs, and rate of growth; gives details concerning forests by drainage basins, including, New, Holston (southern tributaries of South Fork only), Watauga, Nolichucky, French Broad, Pigeon, Little Tennessee, Hiwassee, Tallulah-Chatooga, Toxaway, Saluda, and First and Second Broad rivers, Catawba and Yadkin rivers; describing many of the tributaries of each of the master streams.

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.

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.

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 method of work; gives tabulated records of wells in Illinois, Indiana, New York, Ohio, Pennsylvania, Tennessee, West Virginia, and Kentucky, and detailed records of wells in Delaware and Jay counties, Ind.; Greene, Warren, and Washington counties, Pa.; and Kanawha, Ritchie, and Wetzel counties, W. Va. These records 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 p. 25c.

Gives an account of progress in the collection of well records and samples; contains tabulated records of wells in Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Tennessee,

Virginia, and West Virginia, and detailed records of wells in Crawford County, Ill.; Delaware, Martin, Randolph, and Vanderburg counties, Ind.; Hopkins and Metcalf counties, Ky.; Hocking, Noble, Tuscarawas, and Wayne counties, Ohio; Armstrong, Greene, Warren, and Washington counties, Pa.; and Cabell, Harrison, Marion, Monongalia, Wayne, and Wetzel counties, W. Va. The wells of which detailed records are given were selected because they afford definite stratigraphic information.

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 (except reprints), 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 at higher prices. 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.

*16. Knoxville folio, Tennessee-North Carolina.

Describes the geography and geology of the area and, under "Mineral resources," the water supply.

¹ Index maps showing areas in the Ohio 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.

67. Danville folio, Illinois-Indiana.

Describes the topography and geology of the area and, under "Mineral resources," discusses the shallow dug or open wells, the tubular wells, and the flowing wells; gives also tabulated data concerning depth, head, water-bearing bed, etc., of the wells in the quadrangle.

84. Ditney folio, Indiana.

Describes the drainage and relief of the area, the geologic formation, and geologic structure and history, and, under "Economic resources," briefly discusses the underground water supply.

90. Cranberry folio, North Carolina-Tennessee.

Describes the geology and topography of an area in Carter and Johnson counties, Tenn., and Ashe, Watauga, Wilkes, Caldwell, and Mitchell counties, N. C., drained in part eastward into the Atlantic, in part southward into the Gulf of Mexico, and in part westward into the Mississippi. Under "Mineral resources" discusses water power.

102. Indiana folio, Pennsylvania.

Describes the physiographic relations, relief, and drainage of the Indiana quadrangle, the stratigraphic and structural geology, and under "Mineral resources" the surface and underground waters; indicates promising localities for artesian water.

105. Patoka folio, Indiana-Illinois.

Describes the drainage and relief of the area, the stratigraphic and structural geography and the geologic history, and under "Mineral resources" the water supply of the streams, springs, wells, cisterns, and artificial ponds.

121. Waynesburg folio, Pennsylvania.

Describes the drainage and surface relief of the area, the geologic formations and the geologic history, and in connection with the discussion of the mineral resources gives an account of the surface and underground water supplies.

123. Elders Ridge folio, Pennsylvania.

Describes the topography and stratigraphic, structural, and historical geology of the Elders Ridge quadrangle, and under "Mineral resources" discusses briefly the water supplies.

124. Mount Mitchell folio, North Carolina.

Describes the topography and geology of an area whose waters pass through Tennessee River and the Ohio into the Mississippi, and through Catawba and Broad rivers directly to the Atlantic; under "Economic geology" describes water powers and the various sources of water used for industrial and domestic supplies.

144. Amity folio, Pennsylvania.

Describes the relief and drainage of the Amity quadrangle in southwestern Pennsylvania, the stratigraphic, structural, and historical geology, and under "Mineral resources" gives a brief discussion of the water supply of the town of Washington.

146. Rogersville folio, Pennsylvania.

Describes the relief and drainage of the quadrangle in the extreme southwestern corner of Pennsylvania—principally in Greene County; under "Mineral resources" treats briefly of the water supply.

147. Pisgah folio, North Carolina-South Carolina.

Describes the topography and geology of an area drained in part by streams flowing to the Atlantic and in part by those flowing through Tennessee River into the Ohio and into the Mississippi; under "Economic geology" discusses streams, water powers, and underground waters.

151. Roan Mountain folio, Tennessee-North Carolina.

Describes the quadrangle in Tennessee and North Carolina which includes Johnson City, Tenn., and Elizabethton, N. C., which is drained by tributaries of Tennessee River; describes the relief and the rivers, the stratigraphic and structural geology, and under "Economic geology" the streams and their water powers and the waters available for wells.

160. Accident-Grantsville folio, Maryland-Pennsylvania-West Virginia.

Describes the drainage, relief, and geology of two quadrangles lying chiefly in Garrett County, Md.; the waters of the Accident quadrangle pass north and west to rivers that join the Ohio; those of the Grantsville quadrangle are about equally divided between tributaries of the Ohio and Savage River and Georges Creek which flow into the Potomac; under "Mineral resources" the folio describes Youghiogheny and Casselman rivers, Savage River, and Georges Creek, and the spring waters; notes possibility of obtaining artesian water.

172. Warren folio,¹ Pennsylvania-New York.

Describes the topography, drainage, and geology of the Warren quadrangle in the basin of Allegheny River in northwestern Pennsylvania; under "Economic geology" describes briefly the streams, springs, and underground waters.

174. Johnstown folio,¹ Pennsylvania.

Describes the relief, drainage, and geology of the Johnstown quadrangle, which lies mostly in Cambria County, Pa., but covers also small parts of Somerset, West Moreland, and Indiana counties. Most of it is included in the valley of Conemaugh River and its tributaries; under "Economic geology" describes the city water supply at Johnstown and the water resources of the quadrangle in general.

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 Ohio River basin are the reports of the Chief of Engineers, United States Army; the State geological surveys of Alabama, Illinois, Kentucky, North Carolina, Tennessee, and Virginia; the Illinois Water-Supply Commission and the Rivers and Lakes Commission of Illinois; the New York State Conservation Commission and State Water-Supply Commission; the Water-Supply Commission of Pennsylvania and the Pittsburgh Flood Commission; and the water-power report of the Tenth Census (vol. 17). The following reports deserve special mention:

The Mississippi and Ohio rivers, by Charles H. Ellet. 1853.

Report upon the physics and hydraulics of the Mississippi River, by A. A. Humphreys and H. L. Abbot. 1876.

Preliminary report on a part of the water powers of Alabama, by B. M. Hall: Alabama Geol. Survey Bull. 7, 1903.

The underground water resources of Alabama, by Eugene A. Smith: Alabama Geol. Survey Mon. 6, 1907.

Preliminary report on a part of the water powers of Georgia, compiled by B. M. Hall: Georgia Geol. Survey Bull. 3 A, 1896.

Preliminary report on the underground waters of Georgia, by S. W. McCallie: Georgia Geol. Survey Bull. 15, 1908.

The mineral content of Illinois waters, by Edward Bartow, J. A. Udden, S. W. Parr, and George T. Palmer: Illinois State Geol. Survey Bull. 10, 1909.

Chemical survey of the waters of Illinois, report for the years 1897-1902, by A. W. Palmer, with Geology of Illinois as related to its water supply, by Charles W. Rolfe: University of Illinois publications.

Chemical and biological survey of waters of Illinois, by Edward Bartow: University of Illinois publications 3, 6, 7, 1906-1909.

Report upon the prevention of overflow of Little Wabash and Skillet Fork rivers, by W. J. McEathron and L. L. Hiding. Rivers and Lakes Commission, 1911.

¹ Issued in two editions. (See p. 39.) Specify which edition is wanted.

Papers on the water power of North Carolina, a preliminary report by George F. Swain: North Carolina Geol. Survey Bull. 8, 1899.

Report of the investigations into the purification of the Ohio River water for the improved water supply of the city of Cincinnati, Ohio; made for the board of trustees, commissioners of waterworks, Cincinnati, 1899.

Progress report on a plan of sewerage for the city of Cincinnati, 1912-13.

The mineral waters of Indiana, their location, origin, and character, by W. S. Blatchley: Indiana Dept. Geology and Nat. Res. Twenty-sixth Ann. Rept. 1901.

Report on the flow of Dix River as a source of water power, by August F. Foerste, and Supplementary report on Dix River, by August F. Foerste: Kentucky Geol. Survey Bull 21, 1912.

Underground waters of Mississippi; a preliminary report, by W. N. Logan and W. R. Perkins: Mississippi Agr. Exper. Sta. Bull. 89.

Hydrology of the State of New York, by George W. Rafter: New York State Mus. Bull. 85, 1905.

A report to the mayor and city council on flood prediction for the city of Columbus, Ohio, 1913.

Report of the filtration commission of the city of Pittsburgh, Pa., 1899.

The water powers of Tennessee, by J. A. Switzer, including a report on Doe River, by A. H. Horton: Tennessee Geol. Survey Bull. 17, 1914.

Hydrography of Virginia, by N. C. Grover and R. H. Bolster: Virginia Geol. Survey Bull. 3, 1906.

Report of the Secretary of Agriculture in relation to the forests, rivers, and mountains of the Southern Appalachian region: 57th Congress, 1st sess., S. Doc. 84, 1902.

Many of these reports can be obtained by applying to the several commissions, and most of them can be consulted in the public libraries of the larger cities.

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, Kans.; 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 planetable, 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. McCallee.
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 problems, by O. H. Ensign.
Estimates on tunneling in irrigation projects, by A. I. 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.
Siltling 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, and 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.
 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.
 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.
 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 XLV. 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. \$1.85. 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,

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 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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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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