Water-Supply and Irrigation Paper No. 120 Series O, Underground Waters, 34

DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

BIBLIOGRAPHIC REVIEW AND INDEX

OF

PAPERS RELATING TO UNDERGROUND WATERS

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1879-1904

BY

MYRON L. FULLER

WASHINGTON
GOVERNMENT PRINTING OFFICE
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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
HYDROGRAPHIC BRANCH,
Washington, D. C., February 21, 1905.

SIR: I transmit herewith a manuscript entitled "Bibliographic Review and Index of Papers Relating to Underground Waters published by the United States Geological Survey, 1879–1904," prepared by Myron L. Fuller, geologist in charge of the eastern section, division of hydrology, to meet the urgent need for definite information as to what has been accomplished by the Survey in the line of underground-water investigations and what has appeared in Survey publications bearing on the subject.

Very respectfully,
F. H. NEWELL,
Chief Engineer.

HON. CHARLES D. WALCOTT,
Director United States Geological Survey.

BIBLIOGRAPHIC REVIEW AND INDEX OF PAPERS RELATING TO UNDERGROUND WATERS PUBLISHED BY THE UNITED STATES GEOLOGICAL SURVEY, 1879-1904.

By Myron L. Fuller.

INTRODUCTION.

On the organization of the division of hydrology in 1903, and the beginning of systematic work on underground waters, an urgent need was felt for more definite information as to what had been published on the subject by both the National and the State surveys and in other publications. Plans were accordingly made for preparing a bibliography of underground waters, but it was soon found that owing to inadequate indexes it would be necessary to scan nearly every page of geologic publications. As this was not feasible, it became necessary to limit the work, for the time at least, to the preparation of a review and index of the publications of the United States Geological Survey.

These publications, amounting to about 400 volumes and embracing about 1,500 papers, were examined, many of them page by page, and brief summaries of the facts relating to underground waters were compiled. A large proportion of the references to underground waters are given in connection with geologic descriptions, and most of them are very brief, although some are of importance. Being incidental to discussions of other subjects, many would doubtless be ordinarily overlooked, especially as in a large number of cases no reference is made to them in the indexes. There are about 600 titles in the bibliography, an average of about 21 for each year from 1880 to 1903, but in 1904, owing to the publication of the results of the systematic work of the new division of hydrology, this number was increased to about 130.

In preparing the index two distinct classes of readers were kept in mind, the first including those who are interested in the underground-water resources of special regions, and the second those interested in some particular type of ground water or in one or more of the many problems of ground-water occurrence. For the benefit of the first, comprehensive entries are given under States and other political or natural divisions, while for the benefit of the second are given the numerous subject entries. The aim has been to assemble the latter entries into comprehensive groups, each including references to papers containing material bearing on the subject of the group. The State entries will be found the most complete, as they include many which it is impossible to satisfactorily classify.

The subject entries are grouped mainly into a series of what may be termed principal subject entries, which are outlined in the "Classified key to principal subject entries in index," but a large number of other entries, including those which it was impracticable to classify and numerous cross references, are included with the view of increasing the usefulness of the index.

The general plan followed is the same as that of the geologic bibliographies of Mr. F. B. Weeks, which more nearly meet the demands of the user than any other publications of the kind seen by the writer. The principal point of difference is the omission of the abbreviated titles in the index of the present bibliography, due to the fact that the titles of the papers in most cases express little or nothing as to their contents in respect to underground-water descriptions or discussions. On the other hand, the present bibliography attempts to give, in connection with the titles, summaries indicating in considerable detail the nature of the portion of the contents bearing on underground waters.

BIBLIOGRAPHIC REVIEW.

A.

1 **Adams** (George I.). Preliminary report on the lead and zinc deposits of the Ozark region: Physiography.

U. S. Geol. Surv., 22d Ann. Rept., pt. 2, pp. 69–75, 1901.

Mentions the springs of the Ozark Plateau and Boston Mountains.

2 —— Oil and gas fields of the Western Interior and Northern Texas Coal Measures.

U. S. Geol. Surv., Bull. no. 184, pp. 1–29, 1901.

Contains references to and partial sections of a large number of water, oil, and gas wells.

3 —— Oil and gas fields of the Upper Cretaceous and Tertiary formations of the Western Gulf coast.

U. S. Geol. Surv., Bull. no. 184, pp. 31–62, 1901.

Mentions salt springs (p. 39), gives logs of wells (pp. 57–59), and discusses the association of petroleum, sulphur, gypsum, rock salt, and saline and sulphur waters (pp. 49–53).

4 —— Geology and water resources of the Patrick and Goshen Hole quadrangles in eastern Wyoming and western Nebraska.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 70, pp. 50, 1902.

Describes the geology, physiography, and drainage, including streams, ponds, and springs. The springs mainly seep out and are of small volume, but occur at several horizons (pp. 27–28). Deep pump wells are obtained from near contact of Arikaree and Brule Clays (pp. 29–30), and some water is afforded by the Cretaceous, although it is likely to be alkaline or salty (p. 30). The seepage waters are also highly mineralized (p. 30).

5 —— Zinc and lead deposits of northern Arkansas.

U. S. Geol. Surv., Bull. no. 213, pp. 187–196, 1903.

Discusses the character of solutions and the circulation of ground water in shales, limestones, and dolomites with relation to ore deposits (pp. 190–192).

6 —— Zinc and lead deposits of northern Arkansas.

U. S. Geol. Surv., Professional Paper no. 24, pp. 1–89, 1904.

Notes the action of underground waters in ore deposition (p. 32), and discusses the geological factors affecting the circulation (pp. 34–36). The part of waters in ore deposition is further discussed on pages 44–46, and the circulation on page 89. J. C. Branner is quoted on the formation of breccias by underground waters (p. 87).

7 **Adams** (George I.). The Rabbit Hole sulphur mines near Humboldt House, Nevada.

U. S. Geol. Surv., Bull. no. 225, pp. 497–500, 1904.

Describes the occurrence of hot springs and silicious sinter in the region, and associates the deposition of sulpur with such ascending waters (p. 499).

8 **Ahern** (Jeremiah). Investigations in northern Wyoming.

U. S. Geol. Surv., 2d Ann. Rept. Reclamation Service 1902–3, pp. 507–528, 1904.

Notes the occurrence of springs near Lake De Smet (p. 515).

9 **Alden** (William C.). Chicago folio. Illinois-Indiana.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 81, pp. 13, 1902.

Gives a number of deep-well sections (pp. 2–3) and discusses the water supplies of the drift and of the rock wells in the Potsdam and St. Peters sandstones and Trenton limestone. Analyses are given. The wells originally gave strong flows, but because of the large number drilled the water head has been lowered to 15 to 20 feet below the surface (p. 13).

10 **Ayers** (H. B.). The Flathead Forest Reserve, Montana.

U. S. Geol. Surv., 20th Ann. Rept., pt. 5, pp. 245–316, 1899.

Notes the disappearance of streams from the surface by absorption (p. 261).

B.

11 **Bain** (H. Foster). Preliminary report on the lead and zinc deposits of the Ozark region.

U. S. Geol. Surv., 22d Ann. Rept., pt. 2, pp. 33–227, 1901.

Contains a chapter on the relation of ores to the circulation of underground waters, in which general principles, circulation, courses of underground waters, structural conditions, work of underground waters, including solution, precipitation, diffusion, etc., are considered (pp. 95–110). The ores were in part deposited by ascending waters, in part by descending, and in part deposited by ascending and concentrated by descending waters (p. 203). The relation of the ores to underground circulation is also discussed (pp. 204–207).

12 —— Lead and zinc deposits of Illinois.

U. S. Geol. Surv., Bull. no. 225, pp. 202–207, 1904.

Notes burden imposed on mines by underground water (p. 203), and discusses the relation of underground waters to ore deposition (p. 206).

13 —— Fluorspar deposits of southern Illinois.

U. S. Geol. Surv., Bull. no. 225, pp. 505–511, 1904.

Discusses relation of underground waters to ore deposition (p. 510).

14 **Barbour** (Erwin Hinckley). Wells and windmills of Nebraska.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 29, pp. 85, 1899.

Among the subjects discussed are underground-water conditions (pp. 13–16), sheet water (pp. 17–18), artesian waters and well records (pp. 18–24), springs (p. 24), surface and seepage waters (p. 27), fluctuations of water level (p. 28), windmills, turbines, and other methods of raising waters (pp. 28–70), well supplies for towns and cities (pp. 73–75), salt wells (p. 78), and blowing, breathing, and sucking wells (pp. 78–80).

15 **Barker** (F. C.). Irrigation in Mesilla Valley, New Mexico.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 10, pp. 51, 1898.

The occurrence and source of the ground water in Mesilla Valley (pp. 18–19) and the relative efficiency and cost of bringing it to the surface by wind and steam power (pp. 35–36) are considered.

16 **Bascom** (Florence). Water resources of the Philadelphia district.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 106, pp. 75, 1904.

This paper contains detailed discussions of geology, rainfall, stream measurements, water powers, wells, springs, and public supplies, including those from streams, wells, and springs. Among the geological formations yielding water to wells are the Chickies quartzite, Chester Valley limestone, Wissahickon gneiss, Triassic rocks, and Raritan, Matawan, and Monmouth formations, etc.

17 **Bayley** (William Shirley). The Menominee iron-bearing districts of Michigan.

U. S. Geol. Surv., Mon. 46, pp. 513, 1904.

Notes the relation of descending meteoric water to ores (pp. 27–29), and quotes C. Rominger on action of percolating waters and D. H. Browne on aqueous origin of ores (pp. 90–91). The action of percolating waters, either ascending or descending, is considered in connection with ores in the Randville dolomite (p. 224), the origin of cherts (p. 231), and in the deposition or enrichment of Algonkian ores (pp. 395–401).

18 —— Maine. [Well and spring records.]

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 27–55, 1904.

Discusses the general underground-water conditions (pp. 27–28), and gives tables and notes of wells (pp. 29–47) and springs (pp. 47–55). The well statistics include data on elevation, temperature, analyses, and uses, and the spring statistics data on temperature, quality, analyses, yield, and uses.

19 **Becker** (George F.). Administrative report [1879-80].

U. S. Geol. Surv., 1st Ann. Rept., pp. 37–47, 1880.

Discusses the occurrence, temperatures, and composition of the Comstock mine waters [Nevada].

20 —— Geology of the Comstock lode and the Washoe district, with atlas.

U. S. Geol. Surv., Mon. 3, pp. 422, atlas, 1882.

Analyses of mine waters are given (p. 152) and the hot waters encountered, some of which have a temperature of 170°, are described (pp 228–243). Kaolinization of feldspar, alteration of pyrite, faulting, and solfataric action are considered as sources of heat, most weight being given to the last (pp. 231–243). The water is supposed to have come from a considerable distance, and to have penetrated several miles below the surface (pp. 264 and 387–397).

21 **Becker** (George F.). Geology of the quicksilver deposits of the Pacific coast, with an atlas.

U. S. Geol. Surv., Mon. 13, pp. 486, atlas, 1888.

Among the subjects discussed are the following: Geysers of Iceland (pp. 24–26), heat of thermal springs (p. 441), hot springs in mines (pp. 381–382, 402), association of cinnabar with hot springs (p. 371), sulphur springs (pp. 367, 777), hot springs and their deposits (pp. 50, 52), and origin of ore, solvents, etc. (pp. 438–475). The sinter, ore, and waters of Steamboat Springs (pp. 331–353) and of Sulphur Bank (pp. 251–268) are described and analyses given. The ores are supposed to have been deposited by hot ascending solutions (p. 416).

22 —— Summary of the geology of the quicksilver deposits of the Pacific slope.

U. S. Geol. Surv., 8th Ann. Rept., pt. 2, pp. 961–985, 1889.

Ascribes the heat of the solfataric springs at Sulphur Bank, California, as resulting from basalt eruption. The water carries sulphydric acid, which attacks basalt and deposits sulphur and cinnabar. Discusses composition of the waters and refers deposition to loss of heat and pressure. Some of the veins mark former solfataras (pp. 975–976). The springs of the Knoxville district, Steamboat Springs, and Bailey Point, California, carry alkaline sulphosalts and deposit quicksilver and gold. They are associated with basaltic masses of late geological age. The hot springs at Oat Hill are also mentioned (pp. 976–980).

23 —— Administrative report [1887–88].

U. S. Geol. Surv., 9th Ann. Rept., pp. 100–102, 1889.

Notes the conditions of deposition of cinnabar in hot springs.

24 —— Report of the geology of the Philippine Islands.

U. S. Geol. Surv., 21st Ann. Rept., pt. 3, pp. 487–614, 1900.

In connection with the discussion of volcanoes the warm springs of Panay, the solfataras and hot springs of Albay and their deposits, and the Hot Springs of Los Baños are described (pp. 531–534).

25 **Beede** (J. W.). **Prosser** (Charles S.) and. Cottonwood Falls folio, Kansas.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 109, pp. 6, 1904.

See Prosser (Charles S.) and Beede (J. W.)

26 **Boutwell** (J. M.). Progress report on the Park City mining district, Utah.

U. S. Geol. Surv., Bull. no. 213, pp. 31–40, 1903.

Describes the underground waters encountered in the mines and the collection of the domestic supply from a tunnel (p. 33).

27 —— Ore deposits of Bingham, Utah.

U. S. Geol. Surv., Bull. no. 213, pp. 105–122, 1903.

Notes the occurrence of springs in Bingham Canyon and the tapping of subterranean water courses by the underground workings. The water supply is thus obtained (p. 107).

28 **Boutwell** (J. M.). Progress report on the Park City mining district, Utah.

U. S. Geol. Surv., Bull. no. 225, pp. 141–150, 1904.

Notes difficulties with water in mines and their removal by tunnels (p. 149).

29 —— New Hampshire. [Well and spring records.]

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 56–72, 1904.

Considers briefly the general underground-water conditions (p. 56), and gives tables and notes relating to wells (pp. 57–63) and springs (pp. 64–72). The well statistics include data on yield, quality, composition (with analyses), materials penetrated, uses, etc., and the spring statistics data on source, yield, composition (including analyses), temperature, and uses.

30 **Boyd** (David). Irrigation near Greeley, Colorado.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 9, pp. 90, 1897.

Discusses nature (p. 79), composition (p. 79), and damages by seepage waters at Greeley, and considers remedies (p. 80). The wells in the region above Greeley are described and legal decisions relating to underground waters given. Artesian flows (weak) are obtained at 1,150 feet at Greeley, but underground waters generally fail to reach the surface.

31 **Burchard** (Ernest F.). Lignites of the middle and upper Missouri Valley.

U. S. Geol. Surv., Bull. no. 225, pp. 276–288, 1904.

Gives data relating to borings and well records in Iowa and Nebraska (pp. 277–278, 281).

32 [**Burnett** (Charles A.) and others.] Irrigation literature.

U. S. Geol. Surv., 11th Ann. Rept., pt. 2, pp. 345–388, 1891.

Many of the irrigation papers listed contain references to underground waters and springs.

33 **Burrows** (John Shober). The Barnesboro-Patton coal field of central Pennsylvania.

U. S. Geol. Surv., Bull. no. 225, pp. 295–310, 1904.

Notes occurrence of mine waters (pp. 304, 306).

C.

34 **Campbell** (Marius R.). Richmond folio, Kentucky.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 46, pp. 4, 1898.

Mentions the sulphur, chalybeate, and alum springs of the Chattanooga shale (p. 2), and notes the occurrence of caves, sinks, and underground channels of the Newman limestone (p. 3).

35 —— London folio, Kentucky.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 47, pp. 3, 1898.

The occurreuce of chalybeate, sulphur, and alum springs in the Chattanooga shale, and of sinks, caves, and underground channels in the Newman limestone is mentioned.

36 **Campbell** (Marius R.). Standingstone folio, Tennessee.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 53, pp. 5, 1899.
The oil springs which led to the drilling for oil in the region are described.

37 —— Danville folio, Illinois-Indiana. General geology.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 67, pp. 1–7 (in part), 1900.
Gives a number of deep-well records in connection with the discussion of stratigraphy (p. 2).

38 —— Huntington folio, West Virginia-Ohio.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 69, pp. 6, 1900.
Gives a number of deep-well records (pp. 3–4).

39 —— Charleston folio, West Virginia.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 72, pp. 9, 1901.
Gives several deep-well records (pp. 3–4).

40 —— Raleigh folio, West Virginia.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 77, pp. 8, 1902.
Gives a number of well and boring records and sections (p. 7).

41 —— Masontown-Uniontown folio, Pennsylvania.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 82, pp. 2, 1902.
Gives deep-well record in connection with stratigraphic discussion of the rocks (p. 8).

42 —— [and **Fuller** (Myron L.)]. Natural gas: Petroleum. Masontown-Uniontown folio, Pennsylvania.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 82, pp. 18–20, 1902.
Gives a number of deep-well records and a table showing depths of coal, oil sands, etc., in 24 wells.

43. **Campbell** (Marius R.). Brownsville-Connellsville folio.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 94, pp. 19, 1903.
Gives partial records of several wells (pp. 7–8).

44 —— Latrobe folio, Pennsylvania.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 110, pp. 15, 1904.
Gives a large number of sections based on well records (pp. 5–10) and a sheet of well sections.

45 **Chamberlin** (Thomas C.). The requisite and qualifying conditions of artesian wells.
U. S. Geol. Surv., 5th Ann. Rept., pp. 125–173, 1885.
Embodies descriptions and critical discussions of the lithologic and structural requisites for artesian flows, and considers in some detail the problems of capacity, height of flow, utilization, causes of decrease or failure of flow, arrangement, and testing of wells. The report is illustrated by numerous figures.

46 **Chamberlin** (T. C.) and **Salisbury** (R. D.). Preliminary paper on the Driftless Area of the upper Mississippi Valley.

U. S. Geol. Surv., 6th Ann. Rept., pp. 199–322, 1885.

Mentions artesian wells at La Crosse, Prairie du Chien, Dubuque, etc., and gives thickness of drift penetrated (pp. 223, 303).

47 **Champlin** (F. A.). Additional well records in Massachusetts.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 112–117, 1904.

Gives tables showing among other data the depth, supply, and cost of a considerable number of wells located at East Longmeadow and other Massachusetts localities.

48 —— Additional well records in Connecticut.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 165–168, 1904.

Gives tables showing among other data the depth, yield, and cost of wells at various Connecticut localities.

49 **Chandler** (Albert E.). Water storage, Cache Creek, California.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 45, pp. 48, 1901.

Gives well statistics, including depth, cost, efficiency of pumping, and use for irrigation (pp. 24–26), and describes the artesian well near Woodland and the artesian water of Scotts Valley and Upper Lake (pp. 26, 32).

50 **Chatard** (Thomas M.), **Clarke** (F. W.) and. A report of work done in the Washington laboratory during the fiscal year 1883–84.

See Clarke (F. W.) and Chatard (T. M.)

51 **Chatard** (Thomas M.). Salt-making processes in the United States,

U. S. Geol. Surv., 7th Ann. Rept., pp 491–535, 1888.

Discusses the chemistry of brines from wells and other sources (pp. 498–499), and the product and cost of obtaining salt from brines of different density (pp. 527–529).

52 **Clapp** (Frederick G.), **Fuller** (Myron L.) and. Patoka folio, Indiana-Illinois.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 105, pp. 12, 1904.

See Fuller (Myron L.) and Clapp (Frederick G.).

53 **Clarke** (Frank Wigglesworth) and **Chatard** (Thomas M.). A report of work done in the Washington laboratory during the fiscal year 1883–84.

U. S. Geol. Surv., Bull no. 9, pp. 40, 1884.

Includes a considerable number of water analyses from springs and lakes in California, Montana, Nevada, Oregon, Utah, and Virginia.

54 **Clarke** (F. W.). Administrative report [1883–84].

U. S. Geol. Surv., 5th Ann. Rept., pp. 59–62, 1885.

Gives partial list of thermal spring or geyser waters analyzed at the Survey during the year, including waters from Yellowstone National Park, Montana and Virginia.

55 —— Report of work done in the division of chemistry and physics, mainly during the fiscal year 1884–85.

U. S. Geol. Surv., Bull. no. 27, pp. 80, 1886.

Contains the following analyses (pp. 71–): (1) Incrustation of silica and alumina from gas well in Armstrong County, Pennsylvania (Whitfield); (2) water from Matthews Warm Springs, near Bozeman, Montana (Riggs); (3) water from White Sulphur Springs, Meagher County, Montana (Riggs); and (4) water from mineral spring near Santa Fe, New Mexico (Clarke).

56 —— Report of work done in the division of chemistry and physics, mainly during the fiscal year 1885–86.

U. S. Geol. Surv., Bull. no. 42, pp. 152, 1887.

Contains analyses by R. B. Riggs of waters from two springs near Farnwell Station, Loudoun County, Virginia; from two artesian wells at Story City, Iowa; and from Becks Hot Springs, near Salt Lake City, Utah.

57 —— Administrative report [1885–86].

U. S. Geol. Surv., 7th Ann. Rept., pp. 127–130, 1888.

Describes the work of F. A. Gooch and J. E. Whitfield on spring and geyser waters of the Yellowstone National Park, and announces the discovery of arsenic in the waters. The difficulties of analysis are mentioned.

58 —— Administrative report [1886–87].

U. S. Geol. Surv., 8th Ann. Rept., pt. 1, pp. 189–193, 1889.

Mentions the analysis of 18 spring and well waters, and notes the therapeutic value of the waters of the Yellowstone National Park on account of the boric acid and arsenic which they contain. Designates the studies of Gooch and Whitfield as among the most complete on record.

59 —— Report of work done in the division of chemistry and physics, mainly during the fiscal year 1886–87.

U. S. Geol. Surv., Bull. no. 55, pp. 96, 1889.

Contains analyses of artesian waters in Georgia and Alabama by Riggs; of water from Hot and Potash Sulphur Springs, Arkansas, by Clarke, and of a spring water from near Fort Wingate, New Mexico, by Clarke.

60 —— Report of work done in the division of chemistry and physics, mainly during the fiscal year 1887–88.

U. S. Geol. Surv., Bull. no. 60, pp. 174, 1890.

Analyses of the following waters are given (pp. 171–174): (1) Spring water, Lincoln County, North Carolina (Clarke); spring water, McLeansborough, Illinois (Riggs); (3) deep well water, Lebanon, Missouri, (Eakins); (4) and (5) spring waters, Hominy Hill, Arkansas, (Whitfield); (6) spring water, Denver, Colorado (Eakins), and (7) water from Matilija Hot Springs, near San Buenaventura, California (Riggs).

61 **Clarke** (F. W.). A report of work done in the division of chemistry and physics, mainly during the fiscal year 1888–89.

U. S. Geol. Surv., Bull. no. 64, pp. 60, 1890.

Contains analyses by T. M. Chatard of spring water from Mountain City, Tennessee; spring water from Grace Spring, Laurel Bloomery, Tennessee; water from the Murry Well, Frankfort, Kentucky; from two artesian wells at St. Augustine, Florida, and from wells near Clinton, Massachusetts (pp. 57–60).

62 —— Report of work done in the division of chemistry and physics, mainly during the fiscal year 1889–90.

U. S. Geol. Surv., Bull. no. 78, pp. 131, 1891.

Contains an analyses of a spring water from Webster Grove, near St. Louis, Missruri (Hillebrand and Howard).

63 —— Administrative report.

U. S. Geol. Surv., 13th Ann. Rept., pt. 1, pp. 159–162, 1892.

Describes analysis showing sulphate of zinc in springs in Missouri, and mentions temperature work in deep wells at Wheeling and Crumps Bottom, West Virginia.

64 —— Report of work in the division of chemistry during the fiscal years 1891–92 and 1892–93.

U. S. Geol. Surv., Bull. no. 113, pp. 115, 1893.

Gives analyses of waters from Caledonia and American Carlsbad springs of Caledonia and Nashville, New York, and of a thermal spring near Ojo Caliente, New Mexico (pp. 113–114).

65 —— Analyses of rocks from the laboratory of the United States Geological Survey, 1880–1903.

U. S. Geol. Surv., Bull. no. 228, pp. 375, 1904.

Among analyses are included travertines, tufas, and calcareous and silicious sinters from Yellowstone National Park, by J. E. Whitfield and F. A. Gooch (pp. 298–299, 322–323). Several of the analyses are published for the first time.

66 **Clements** (J. Morgan) and **Smith** (H. L.). Crystal Falls iron-bearing district of Michigan.

U. S. Geol. Surv., 19th Ann. Rept., pt. 3, pp. 19–145, 1898.

Notes the work of infiltrating waters in the deposition of ores of the Mansfield formation (p. 43) and Upper Huronian (p. 80).

67 **Clements** (J. Morgan). The Crystal Falls iron-bearing district of Michigan: The western part of the Crystal Falls district.

U. S. Geol. Surv., Mon., vol. 36, pp. 11–322, 1899.

In the discussion of the ores of the Mansfield slate the drowning of the Mansfield mine by a caving of the roof, allowing the river to enter, is mentioned (pp. 65–66). The ores are regarded in part as replacement deposits, due to alteration by downward infiltrating waters (p. 76, etc.). The ores of the Upper Huronian are regarded as concentrations in a synclinal trough (pp. 183–184).

68 **Clements** (J. Morgan), **Leith** (C. K.), **Van Hise** (C. R.) and. Iron-ore deposits of Lake Superior region.

See Leith (C. K.) and Clements (J. Morgan) and Van Hise (C. R.).

69 —— The Vermilion iron-bearing district of Minnesota, with an atlas.

U. S. Geol. Surv., Mon., vol. 45, pp. 463, atlas, 1903.

The ores of the Soudan formation are ascribed to replacement of cherty carbonates in sedimentary rocks, including jaspellites, by downward percolating waters (pp. 227–234). Underground circulation and processes of replacement are considered (pp. 228–230). Explanations similar to those of the Soudan ores are applied to those of the Agawa formation (p. 329).

70 **Collier** (Arthur J.). A reconnaissance of the northwestern portion of Seward Peninsula, Alaska.

U. S. Geol. Surv., Prof. Paper no. 2, pp. 70, 1902.

Describes the boiling sulphur springs along Spring Creek in the Shishmaref region. They are surrounded by a mound of deposits 10 feet wide and 2 feet high (p. 56).

71 **Cooper** (W. F.). Lower Michigan. [Well and spring records.]

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 489–512, 1904.

Considers briefly the general underground water conditions (p. 489), and gives tables and notes on wells (pp. 490–506) and springs (pp. 507–512). The well data includes depth, head, source, temperature, yield, quality (with analyses), uses, and records; the spring data, temperature, quality (with analyses), yield, source, uses, and improvements.

72 **Cowgill** (Elias Branson). Irrigation practice on the Great Plains.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 5, pp. 39, 1897.

Among other methods the paper considers pumping for irrigation purposes (p. 14).

73 **Crosby** (William O.) and **La Forge** (Laurence). Massachusetts. [Well and spring records.]

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 94–111, 1904.

Considers briefly the general underground water conditions (pp. 94–95) and gives tables and notes relating to wells (pp. 96–102) and springs (pp. 102–111). The well data includes source, yield, quality, temperature, uses, records, and analyses; the spring data, temperature, quality, yield, source, uses, and analyses.

74 **Crosby** (William O.). Rhode Island. [Well and spring records.]

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 119–125, 1904.

Gives well tables showing diameter, depth, source, temperature, yield, quality, uses, analyses, etc., and spring tables giving temperature, quality, yield, source, analyses, and uses, 75 **Cross** (Whitman). Geology of the Rico Mountains, Colorado: Outline of the geology.

U. S. Geol. Surv., 21st Ann. Rept., pt. 2, pp. 17–36, 1900. Landslides, ibid., pp. 129–151.

Describes the occurrence of springs charged with H_2S, CO_2, and $CaCO_3$, which are perhaps remnants of solfataric action (p. 33). Describes the work of underground waters in assisting landslides.

76 **Curtis** (Joseph Story). Silver-lead deposits of Eureka, Nevada.

U. S. Geol. Surv., Mon., vol. 7, pp. 200, 1884.

Gives a chapter on the water in mines, discussing its relation to fissures and types of rock (pp. 107–110). Notes the influence of water level on oxidation (p. 51). Mentions ore deposits of caves in Missouri and upper Mississippi Valley (pp. 65–66), and ascribes the chamber deposits of Eureka to ascending underground waters (pp. 71–74).

D.

77 **Dall** (William Healey), and **Harris** (Gilbert Dennison). Correlation papers. Neocene.

U. S. Geol. Surv., Bull. no. 84, pp. 349, 1892.

A number of well sections are given in connection with descriptions of rocks of New Jersey (pp. 41–44), Delaware (p. 46), and Florida (pp. 103, 108–109). The natural wells of North Carolina (p. 72), and the circulation of water, including underground streams in Florida, is considered, and sinks and other topographic features resulting from solution mentioned. Some of the Florida springs are described (pp. 88–95).

78 **Darton** (Nelson Horatio). Bibliography of North American geology for 1886.

U. S. Geol. Surv., Bull. no. 44, pp. 35, 1887.

Several water papers are listed under author's name, but are not indexed by subjects.

79 —— Record of North American Geology for 1887 to 1889, inclusive.

U. S. Geol. Surv., Bull. no. 75, pp. 173, 1891.

Water papers listed in general only under authors.

80 —— Record of North American Geology for 1890.

U. S. Geol. Surv., Bull. no. 91, pp. 88, 1891.

Water papers are not listed except under authors.

81 —— Record of North American Geology for 1891.

U. S. Geol. Surv., Bull. no. 99, pp. 73, 1892.

Papers relating to water are listed only under authors' names.

82 —— Fredericksburg folio, Virginia-Maryland.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 13, pp. 6, 1894.

Describes the underground waters at the base of the Columbia and Lafayette formations and the artesian waters of the sandy horizons of the Potomac and Pamunkey. The areas of probable flowing waters are defined (p. 6).

83 —— Administrative report.

U. S. Geol. Surv., 15th Ann. Rept., pp. 153–155, 1895.

Describes work relating to artesian waters (p. 155).

84 **Darton** (Nelson Horatio.) Preliminary report on artesian waters of a portion of the Dakotas.

U. S. Geol. Surv., 17th Ann. Rept., pt. 2, pp. 603, 1896.

The paper gives an outline of the geologic conditions (pp. 610–612) and describes the various water horizons (pp. 612–614) and their extent (pp. 614–617), after which the descriptions of the wells and of the well prospects in the Dakotas are taken up by counties (pp. 617–665). The pressure and head (pp. 665–670), composition (pp. 676–679), origin (pp. 679–680), and amount (pp. 680–681) of the waters, together with their use for irrigation (pp. 681–690) and power (pp. 690–691) are considered. The problems of construction and management are also treated. Numerous sections and other illustrations are given.

85 —— Catalogue and index to contributions to North American geology, 1732–1891.

U. S. Geol. Surv., Bull. no. 127, pp. 1045, 1896.

Artesian waters and springs are not indexed as such, but a few reference occur under geologic philosophy, miscellaneous, and under geologic philosophy, chemic geology.

86 —— Artesian well prospects in the Atlantic Coastal Plain region.

U. S. Geol. Surv., Bull. no. 138, pp. 232, 1896.

Discusses the geologic structure and artesian conditions (pp. 18–22) and describes the water horizons, wells, structure, conditions, prospects, composition of waters, etc., for each of the States from New York to Georgia. Among the water-bearing formations considered are the Crystalline rocks, Potomac, Matawan, Middle Marl (Rancocas) Miocene, Pamunkey, Redbank, Chesapeake, Columbia, etc.

87 —— Nomini folio, Maryland-Virginia.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 23, pp. 4, 1896.

Describes springs and shallow and artesian wells. Flowing water comes from the Chesapeake formation, but occurs only in the lowlands, pumping being resorted to in the uplands. The shallow waters are from the base of the Columbia or Lafayette. Gives a map showing the areas of flowing wells and the depths to the basal sands of the Chesapeake, and the sands within and at the base of the Pamunkey (p. 4).

88 —— Franklin folio, West Virginia-Virginia.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 32, pp. 6, 1896.

Notes the occurrence of sinks in the Shenandoah and caverns in the Lewistown limestone (pp. 2–3).

89 —— New developments in well boring and irrigation in eastern South Dakota, 1896.

U. S. Geol. Surv., 18th Ann. Rept., pt. 4, pp. 561–615, 1897.

Gives progress of well sinking by counties (pp. 568–590) and shows view of lake supplied by artesian water (pl. 39). Area of known artesian water has been extended up the Missouri Valley above Pierre and probably to Bismarck, up the Big Cheyenne to the Black Hills, and up Moreau River and elsewhere. Many heavy pressures have been encountered (pp. 590–592). Other points considered or illustrated are depth to bed rock, use of well water for irrigation, temperature of well waters, chemical analyses of wells and springs, and volume (pp. 592–615).

90 **Darton** (Nelson Horatio). Preliminary report on the geology and water resources of Nebraska west of the one hundred and third meridian.

U. S. Geol. Surv., 19th Ann. Rept., pt. 4, pp. 719–785, 1898.

Discusses topography and geology (pp. 727–760), underground waters (pp. 761–766), springs (pp. 766–768), and windmill irrigation from wells (p. 780). The following water horizons are considered: Alluvium, Pierre, Ogallala, Arikaree, Gering, Brule, Chadron, Laramie, and Dakota formations, and the Carboniferous limestones. Many illustrations and two underground water maps are given.

91 —— Underground waters of a portion of southeastern Nebraska.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 12, pp. 56, 1898.

Describes the topography (pp. 12–14) and the geology (pp. 14–24) of the region and considers the shallow water-bearing horizons (largely under 150 feet in depth) in fifteen counties (pp. 24–45). Of the deep borings, from 590 to 2,460 feet, only one appears to have reached the Dakota sandstone, and this was a failure. Although drilling through the Cretaceous would be expensive, Dakota water could probably be obtained at many points (pp. 47–48). The use of underground waters for irrigation is described for seven counties.

92 —— Monterey folio, Virginia-West Virginia.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 61, pp. 7, 1899.

Notes the occurrence of thermal springs, sinks, and caves in the Shenandoah limestone (p. 2).

93 —— Preliminary description of the geology and water resources of the southern half of the Black Hills and adjoining regions of South Dakota and Wyoming.

U. S. Geol. Surv., 21st Ann. Rept., pt. 4, pp. 489–599, 1900.

Discusses the topography and geology (pp. 498–562) and considers the waters of the Dakota-Lakota, Minnelusa, and Deadwood sandstones, including wells and springs (pp. 563–574).

94 —— Washington folio, District of Columbia-Maryland-Virginia. Underground water.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 70, pp. 7, 1901.

Describes the sources of water supplies, including the crystalline rocks, and the Potomac, Columbia, and other sedimentary beds. A map showing depths to the top and base of the Potomac formation is given.

95 —— Preliminary list of deep borings in the United States. Part 1 (Alabama-Montana).

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 57, pp. 60, 1902.

Consists of tables giving town, county, depth, diameter, yield, head, temperature, quality, etc., of wells over 400 feet alphabetically arranged by States from Alabama to Montana. References to published records are given.

96 **Darton** (Nelson Horatio). Preliminary list of deep borings in the United States. Part 2 (Nebraska-Wyoming).

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 61, pp. 67, 1902.

Contains well statistics alphabetically arranged by States from Nebraska to Wyoming.

97 —— Norfolk folio, Virginia-North Carolina.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 80, pp. 4, 1902.

Gives a number of shallow well sections in the text and columnar sections of the deep wells at Norfolk and Fort Monroe on the Well Section Sheet. Most of the well supplies are from the base of the Columbia, the deep wells reaching into the Potomac generally obtaining salt water. Several analyses are given. The results of the deep wells at Norfolk, Fort Monroe, Newport News, and Virginia Beach are discussed.

98 —— Oelrichs folio, South Dakota-Nebraska.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 85, pp. 6, 1902.

Describes the thermal springs of the Minnekahta limestone (p. 3), and gives a map showing the outcrop of the Dakota sandstone, the areas of flowing and pump wells, the depth to the top of the Dakota sandstone, and the altitude to which the water will rise (pp. 5–6).

99 —— Preliminary report on the geology any water resources of Nebraska west of the one hundred and third meridian.

U. S. Geol. Surv., Prof. Paper no. 17, pp. 69, 1903.

Revised edition of no. 90.

100 —— Camp Clarke folio, Nebraska.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 87, pp. 4, 1903.

Describes the character and volume of springs and notes the sinking into the ground of the waters (p. 1). The shallow waters of the river bottoms and the waters of the Arikaree and Ogallala formations are considered. On the table-land abundant and good water can be obtained at depths of from 200 to 300 feet. The Dakota sandstone is untested, but is probably within reach of the drill and will yield good and abundant flows (p. 6).

101 —— Scotts Bluff folio, Nebraska.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 88, pp. 5, 1903.

Notes the occurrence of spring and seepage water in the valley of Pumpkin Creek (p. 1) and describes the underground waters of the alluvium, etc., along the North Platte (p. 5). The presence of shallow water on the uplands is uncertain, as is also the case in the Brule clay, because of its fissures and crevices. The Laramie is regarded as a possible source of water. The Dakota is untested, but could probably be reached at 2,000 feet or more and be likely to furnish good flows. The Arikaree formations furnishes water on the plateau at a depth of 200 feet and outcrops with springs in the canyons (p. 5).

102 —— Newcastle folio, Wyoming-South Dakota.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 107, pp. 9, 1904.

Gives a number of well records (pp. 3–5, 8) and discusses at length the underground waters of the Dakota, Lakota, and Pahasapa horizons (pp. 8–9). An analysis of Dakota water is given (p. 8). The artesian water map shows the depths of the Dakota and Pahasapa standstones and the areas of flowing and pump wells. The finding of brines is recorded and an analysis given (p. 9).

103 **Darton** (Nelson Horatio) and (**Smith**) W. S. Tangier. Edgemont folio, South Dakota-Nebraska.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 108, pp. 10, 1904.

Describes the occurrence of sinks and caves in the Minnekahta limestone (p. 3) and of recent calcareous tufa deposits (p. 7). The occurrence of underground waters from the Dakota and Lakota sandstones, together with records and analyses, are discussed (p. 9) and a map showing the areas of flowing and pump wells and the depth and head of the water is given.

104 **Darton** (Nelson Horatio). Western hydrology.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 93, pp. 117-120, 1904.

Tells of the formation and scope of the western section, division of hydrology, and describes the work in Arizona, California, Colorado, Kansas, Nebraska, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Washington, and Wyoming. The work of the following men is considered: W. T. Lee, W. C. Mendenhall, C. E. Siebenthal, G. E. Condra, E. H. Barbour, C. R. Keyes, C. N. Gould, D. E. Willard, C. M. Hall, F. A. Wilder, I. C. Russell, J. E. Todd, G. B. Richardson, Henry Landes, C. A. Fisher, and C. C. O'Harra.

105 **Davis** (Arthur Powell). Report of progress of stream measurements for the calendar year 1896.

U. S. Geol. Surv., 18th Ann. Rept., pt. 4, pp. 1-418, 1897.

Notes the decrease in flow of wells and springs in Georgia (p. 71) and describes the limestone springs along the Etowah River, Georgia (p. 109). Seepage into lava from Malad River, Idaho (p. 337), and the springs and underflow along Little Fountain Creek, California (p. 231), are also considered.

106 —— Irrigation near Phoenix, Arizona.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 2, p. 98, 1897.

Discusses underground waters briefly (pp. 86-92), naming Phoenix and Mesa as examples of localities having large flows due in part to additions received by the underground supplies through seepage from irrigated tracts. Gives a list of wells of Pinal and Maricopa counties, together with statistics; considers the amount of underflow to be overestimated, the effect of evaporation underestimated; discusses the cost of pumping.

107 —— Investigations in Arizona.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 93, pp. 128-130, 1904.

Irrigation of 50,000 acres by wells is expected (p. 128).

108 **Day** (David T.). Bromine.

U. S. Geol. Surv., Min. Res., 1883-84, pp. 851-853, 1885.

Notes the brines of the wells of West Virginia and Ohio as sources of bromine.

109 —— Iodine.

U. S. Geol. Surv., Min. Res., 1883-84, pp. 854-858, 1885.

Like bromine, iodine is derived from the waters of salt wells.

110 **Day** (David T.). Sulphur.

U. S. Geol. Surv., Min. Res., 1883-84, pp. 864-876, 1885.

Notes the derivation of sulphur from hot spring deposits in Nevada and from solfataras in Utah (pp. 865-866).

111 —— Bromine.

U. S. Geol. Surv., Min. Res., 1885, pp. 486-487, 1886.

Notes the extraction of bromine from the brines of the salt wells.

112 [——] Salt.

U. S. Geol. Surv., Min. Res., 1885, pp. 474-485, 1886.

Discusses the brines from wells or springs of Michigan, New York, California, Nevada, and Idaho.

113 —— Administrative report [1886-87].

U. S. Geol. Surv., 8th Ann. Rept., pt. 1, pp. 195-201, 1889.

Reports 8,950,317 gallons of mineral water, with a value of $1,284,070, sold during 1886. This is a slight increase over the previous year.

114 —— Administrative report [1887-88].

U. S. Geol. Surv., 9th Ann. Rept., pp. 134-140, 1889.

The production of mineral waters for 1887 is stated as 8,259,609 gallons, with a value of $1,261,473.

115 —— Administrative report [1888-89].

U, S. Geol. Surv., 10th Ann. Rept., pt. 1, pp. 182-188, 1890.

The product of mineral waters for 1888 is given as 9,628,568 gallons, valued at $1,709,302, an increase in both amount and value.

116 —— Administrative report [1890-91].

U. S. Geol. Surv., 12th Ann. Rept., pt. 1, pp. 129-134, 1891.

Gives the production of mineral waters for 1890 as 14,000,000 gallons, valued at $2,000,000.

117 [——] Salt [1891].

U. S. Geol. Surv., Min. Res. of U. S. 1891, pp. 572-578, 1893.

Gives production of salt from wells, springs, and other sources for the year 1891.

118 [——] Bromine [1891].

U. S. Geol. Surv., Min. Res. of U. S. 1891, p. 579, 1893.

Gives production of bromine as a by-product of brines, etc., for 1891.

119 —— Administrative report [1893-94].

U. S. Geol. Surv., 15th Ann. Rept., pp. 203-209, 1895.

Gives the production of mineral waters for 1893 as 23,544,495 gallons, with a value of $4,246,734 (p. 209).

120 **Day** (William C.). Potassium salts.

U. S. Geol. Surv., Min. Res., 1887, pp. 628-650, 1888.

These salts are obtained in part from the brine of wells and springs. Analyses are given.

121 **Diller** (Joseph Silas). Lassen Peak folio, California.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 15, p. 4, 1895.

Mentions or describes a number of solfataras, hot springs, mud pools, geysers, and sulphur deposits (p. 2).

122 **Diller** (Joseph Silas). Stalactites. The educational series of rock specimens collected and distributed by the United States Geological Survey.

U. S. Geol. Surv., Bull. no. 150, pp. 98-99, 1898.

Explains origin through action of underground waters.

123 **Dodwell** (Arthur) and **Rixon** (Theodore F). Forest conditions in the Cascade Forest Reserve, Oregon: Cascade Range Forest Reserve between townships 18 and 29 south.

U. S. Geol. Surv., Prof. Paper no. 9, pp. 147-227, 1903.

Describes underground channel through which fish pass from Deschutes River to Odell and Davis lakes (p. 148).

124 —— **Leiberg** (John B.), **Rixon** (Theodore), and. Detailed descriptions [of timber of townships]. Forest conditions in the San Francisco Mountains forest reserve, Arizona.

U. S. Geol. Surv., Prof. Paper no. 22, pp. 35-91, 1904.

See Leiberg (John B.), Rixon (Theodore), and Dodwell (Arthur).

125 **Drake** (Noah Field), **Lindgren** (Waldemar), and. Nampa folio, Idaho-Oregon.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 103, pp. 5, 1904.

See Lindgren (Waldemar) and Drake (N. F.).

126 —— Silver City folio, Idaho.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 105, pp. 6, 1904.

See Lindgren (Waldemar) and Drake (N. F.).

127 **Dutton** (Clarence E.). The physical geography of the Grand Canyon district.

U. S. Geol. Surv., 2d Ann. Rept., pp. 47-166, 1882.

Notes several springs available for camp supplies in the Kaibab and other parts of the plateau district, and mentions the occurrence of sinking streams (pp. 122, 134).

128 —— Tertiary history of the Grand Canyon district, with atlas.

U. S. Geol. Surv., Mon., vol. 2, 264 pp., atlas, 1882.

Springs in canyons are mentioned or described on pages 130, 135, 158, 159, and 168; on the Kaibab on pages 129, 139, 157, 166, 171, 172, on the Uinkaret, page 82. Springs are also treated on pages 158, 159, 168, and 234. Sinking streams are considered on pages 129 and 138, and subterranean drainage on page 138.

129 —— Administrative report. [1886-87.]

U. S. Geol. Surv., 8th Ann. Rept., pt. 1, pp. 156-165, 1889.

Mentions two immense springs giving rise to Metolias River, on east flank of cascades, which is 70 to 80 feet wide and too deep to ford. Other large springs are noted.

130 **Dutton** (Clarence E.). The earthquake at Charleston of August 31, 1886.

U. S. Geol. Surv., 9th Ann. Rept., pp. 203–328, 1889.

Notes the forcing up of fresh water and mud, the formation of mud craterlets, sink holes, etc. (pp. 224, 241, 246, 280–281, 283, 296, 297, 298, 302, 322). Mention is made of the failure of artesian wells at Ten Mile Hill, Georgia (p. 284), and of rise of water in certain wells in Alabama (p. 411). The supposed effect on Iowa wells is discredited (p. 443).

E.

131 **Eckel** (Edwin C.). Salt and gypsum deposits of southwestern Virginia.

U. S. Geol. Surv., Bull. no. 213, pp. 406–416, 1903.

Describes salt wells (pp. 407, 408, 413) and gives records (pp. 408–409). Analyses of brines from Virginia, New York, Ontario, Michigan, Pennsylvania, West Virginia, England, and France are also given (p. 414).

132 —— **Hayes** (C. Willard) and. Iron ores of the Cartersville district, Georgia.

See Hayes (C. W.) and Eckel (E. C.).

133 —— **Hayes** (C. W.) and. Occurrence and development of ocher deposits in the Cartersville district, Georgia.

See Hayes (C. W.) and Eckel (E. C.).

134 **Eckel** (Edwin C.). The salt industry in Utah and California.

U. S. Geol. Surv., Bull. no. 225, pp. 488–495, 1904.

Notes the derivation of salt from springs in California (p. 494).

135 —— **Johnson** (Lawrence C.) and, Mississippi. [Well records.]

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 102, pp. 332–357, 1904.

See Johnson (Lawrence C.) and Eckel (Edwin C.).

136 **Eldridge** (George Homans). A geological reconnoissance in northwest Wyoming.

U. S. Geol. Surv., Bull. no. 119, pp. 72, 1894.

The paper describes the Stinking Water, Big Horn, and Fort Washakie Sulphur Springs. All are hot or warm, have copious flows, and are surrounded by mineral deposits, the first by a geyser cone. The waters are considered to possess valuable medicinal properties. The Big Horn and Fort Washakie springs occur at the crest of anticlines.

137 —— Anthracite-Crested Butte folio. Description of the sedimentary formations.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 9, pp. 6–10, 1894.

Describes hot springs and calcareous tufa mounds along Ament Creek (p. 9).

138 **Eldridge** (George Homans). Geology of the Denver Basin in Colorado: Economic geology, artesian wells.

U. S. Geol. Surv., Mon., vol. 27, pp. 401–465, 1896.

The chapter includes a history of the development of the basin, and discussions of the artesian conditions, water horizons, source of water, absorption, transmission, capacity, and yield of water horizons, and life of wells. Chemical analyses, sections, and descriptions of wells are given, together with statistics of location, date, casing, water horizon, depth, discharge in 1886 and 1890, cost, etc., for 357 wells.

139 **Emerson** (Benjamin Kendall). Geology of old Hampshire County, Massachusetts, comprising Franklin, Hampshire, and Hampden counties.

U. S. Geol. Surv., Mon., vol. 29, pp. 790, 1898.

Gives a number of deep-well records in Triassic rocks (pp. 380–389), but little information relating to water. Springs are described and analyses given (pp. 751–752).

140 —— The geology of eastern Berkshire County, Massachusetts.

U. S. Geol. Surv., Bull. no. 159, pp. 139, 1899.

Describes the wells on the Dalton fault, giving record, map, and analysis. The water comes from solution passages in the limestone along the fault (pp. 90–92).

141 **Emmons** (Samuel Franklin). Geology and mining industry of Leadville, Colorado, with atlas.

U. S. Geol. Surv., Mon., vol. 12, pp. 770, atlas, 1886.

Among the topics relating to underground waters, the following may be noted: Caves in limestone (p. 394), warm springs (p. 169), and water level in mines (p. 378). Ores are regarded as having been deposited by descending aqueous solutions following natural water channels including bedding planes, joints, and cleavage (p. 378). The thermal spring origin of fissure veins is also mentioned on page 576.

142 —— Anthracite-Crested Butte folio. Description of the Elk Mountains.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 9, pp. 1–2, 1894.

Mentions the travertine and tufa deposits of hot springs and describes the formation of bog ore by the leaching of sulphurets by thermal waters (p. 2).

143 —— Introduction. Economic geology of the Mercur mining district, Utah. By J. Edward Spurr.

U. S. Geol. Surv., 16 Ann. Rept., pt. 2, pp. 349–369, 1896.

Considers the part of hot underground waters in ore deposition (pp. 367–369).

144 —— Mines of Custer County, Colorado.

U. S. Geol. Surv., 17th Ann. Rept., pt. ii, pp. 465–472, 1896.

Ascribes ores of Bull Domingo and Geyser mines to aqueous deposition (pp. 445–447, 458–464). The latter mine is characterized by strong flows of water charged with carbonates, sulphates, nitrates, etc., of the alkalies, alkaline earths, and metals. Analyses of the water and of the tufaceous deposits formed by it on its emergence are given.

145 **Emmons** (Samuel Franklin) and **Tower** (George Warren). Butte Special folio, Montana.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 39, pp. 8, 1897.

Notes the action of thermal waters on andesites (p. 6) and describes the superficial and deep-seated springs of the area. The former are generally located at the base of prominences of porous igneous rocks, and are numerous and copious in flow. The latter are both cold and warm, and are generally more or less mineralized, some being used for medicinal purposes. Alkaline carbonates, carbon dioxide, and sulphuretted hydrogen are common constituents. Some mineral deposits occur (p. 8).

146 **Emmons** (Samuel Franklin). Tintic Special folio, Utah. General conclusions.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 65, pp. 7-8, 1900.

Discusses the significance of the ground-water level and describes certain cave deposits.

147 —— Homestake mines.

U. S. Geol. Surv., Prof. Paper no. 26, pp. 55-80, 1904.

Notes relation of underground waters to ore deposition.

F.

148 **Fairbanks** (H. A.). San Luis folio, California.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 101, pp. 14, 1904.

Describes a number of strong iron and other springs, some of which are used for bathing (pp. 14).

149 **Fellows** (A. L.). Water resources of the State of Colorado.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 74, pp. 151, 1902.

Notes the absorption of rainfall by different varieties of rocks (p. 17) and describes seepage of the South Platte (pp. 65-66), Arkansas River (p. 100), and the Rio Grande (pp. 109-110).

150 **Fenneman** (N. M.). The Boulder, Colorado, oil field.

U. S. Geol. Surv., Bull. no. 213, pp. 322-332, 1903.

Discusses the occurrence of fresh and salt water in oil wells, some of which are cased to over 2,000 feet. The lower waters are thermal and rise with some force.

151 **Field** (John E.). Diversion of North Platte River [Wyoming-Nebraska].

U. S. Geol. Surv., 2d Ann. Rept. Reclamation Service, 1902-3, pp. 499-507, 1904.

Notes occurrence of hot springs, and describes honeycombing of rock by their agency at Alcova, Wyo. (p. 506).

152 **Flynn** (Benjamin H.), and **Flynn** (Margaret S.). The natural features and economic development of the Sandusky, Maumee, Muskingum, and Miami drainage areas in Ohio.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 91, pp. 130, 1904.

Discusses public water supplies, including those from springs, galleries and from shallow and deep-seated wells, both flowing and nonflowing (pp. 58-124).

153 **Foerste** (Aug. F.). Geology of the Carboniferous strata of the southwestern portion of the Narragansett basin, with an account of the Cambrian deposits.

U. S. Geol. Surv., Mon., vol. 33, pp. 214–393, 1899.

Gives record of deep boring in Rhode Island (p. 322).

154 **Fontaine** (William Morris). The Potomac formation in Virginia.

U. S. Geol. Surv., Bull. no. 145, pp. 149, 1896.

Gives an artesian-well section at Fort Monroe (p. 44) and describes an alum spring near Fredericksburg (p. 68).

155 **Fortier** (Samuel). Seepage water of northern Utah.

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 7, pp. 50, 1897.

Defines seepage waters (p. 11) and considers their importance (pp. 11–13) and origin (p. 13). A considerable number of measurements showing quantity of seepage water in Cache Valley (pp. 27–44) and in Ogden Valley (pp. 44–47) are given. In the lower portion of the latter more water is returned by seepage than taken out for irrigation during certain months.

156 —— Conveyance of water in irrigation canals, flumes, and pipes.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 43, pp. 86, 1901.

Notes the effect of irrigation in raising the groundwater level (p. 16).

157 [**Fuller** (Myron L.)], **Campbell** (Marius R.) [and]. Masontown-Uniontown folio, Pennsylvania natural gas; Petroleum.

See Campbell (Marius R.) and [Fuller (Myron L.)].

158 **Fuller** (Myron L.). Ditney folio, Indiana: General and Pleistocene geology.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 83, pp. 1–7, 1902.

Gives diamond drill section near Glezen post-office (p. 2) and a number of scattered drift well sections (p. 3).

159 —— Ditney folio, Indiana. Mineral waters: Water supply.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 84, p. 8, 1902.

Describes the character and composition of the mineral springs at the Degonia and Ash Iron Spring resorts, and mentions the occurrence and deposits of Chalybeate Springs. The amount and character of the water supply from drift and rocks is also discussed.

160 —— Gaines folio, Pennsylvania. General geology.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 92, pp. 9, 1903.

Gives deep well record at Gaines (p. 2) and describes a 2,880-barrel water well from a depth of 100 feet in the Chemung rocks at Harrison Valley. The water is mineralized and is regarded of medicinal value (p. 9).

161 —— Natural gas [Brownsville-Connellsville folio].

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 94, pp. 17–18, 1903.

Gives detailed records of several deep wells.

162 **Fuller** (Myron L.) and **Clapp** (Frederick G.). Patoka folio, Indiana-Illinois.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 105, 12 pp., 1904.

Gives a number of well records (p. 3) and discusses the occurrence of groundwater, including that of springs and wells, in considerable detail (pp. 11–12). The occurrence of calcareous tufa is described (p. 14).

163 **Fuller** (Myron L.). Hyner gas pool, Clinton County, Pennsylvania.

U. S. Geol. Surv., Bull. no. 225, pp. 392–395, 1904.

Gives record of 1,965-foot well and notes occurrence of fresh and salt waters at various horizons.

164 —— Water supply from wells in southern Louisiana.

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 101, pp. 74–81, 1904.

Discusses the use of well water for domestic, town, railroad, and manufacturing supplies, giving a list of towns supplied from wells and a table of analyses. The subject of contamination is also discussed.

165 —— Rice irrigation in southern Louisiana.

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 101, pp. 82–94, 1904.

Deals mainly with irrigation by water obtained from wells, giving tables showing number of farms and acres irrigated by such waters in 1902 (pp. 82–91). A map showing wells and canals is included.

166 —— Introduction: Contributions to the hydrology of Eastern United States, 1903.

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 102, pp. 9–13, 1904.

States object of progress reports, gives list of publications of the Survey and a bibliography of principal Survey publications relating to underground waters.

167 —— Organization of the division of hydrology and work of the eastern section.

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 102, pp. 15–20, 1904.

Gives an account of early Survey work on underground waters, of the organization and scope of the division of hydrology, and a description of the work by States as follows: Maine, W. S. Bayley, G. O. Smith, W. C. Washburn, and L. G. Lord; New Hampshire, J. M Boutwell; Vermont, G. H. Perkins; Massachusetts and Rhode Island, W. O. Crosby; Connecticut, H. E. Gregory; New York, A. C. Veatch, Arthur Hollick, M. L. Fuller, C. S. Slichter, W. O. Crosby, and F. B. Weeks; New Jersey, G. N. Knapp; Georgia, S. W. McCallie; Florida, M. L. Fuller; Minnesota, C. W. Hall; Wisconsin, A. R. Shultz; Michigan, W. F. Cooper; Iowa, W. H. Norton; Missouri, E. M. Shepard; Arkansas, A. C. Veatch and A. H. Purdue; Louisiana, A. C. Veatch and G. D. Harris; Kentucky and Tennessee, L. C. Glenn; Alabama and Mississippi, E. A. Smith, L. C. Johnson, J. A. Anderson, R. S. Hodges, and B. F. Lovelace.

168 **Fuller** (Myron L.). Introduction. Notes on the wells, springs and general water resources of certain Eastern and Central States.

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 102, pp. 21–26, 1904.

Discusses the methods of work, including the collection, preparation, and presentation of data, the economic value of general water resources, well and spring records, analyses, etc., and gives an explanation of the tables of the report.

169 —— Florida. [Well and spring records.]

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 102, pp. 238–274, 1904.

Discusses the general underground water conditions (pp. 238–239) and gives tables and notes relating to wells (pp. 240–264) and springs (pp. 265–274). The well data include altitude, depth, source, head, temperature, quality (including analyses), records, and uses; the spring data, temperature, quality (including analyses), source, uses, improvements, etc.

G.

170 **Gilbert** (Grove Karl). Lake Bonneville.

U. S. Geol. Surv., Mon. vol. 1, 438 pp., 1890.

Mentions springs in Death Valley, California (p. 8), and elsewhere (p. 102), Ice spring, Utah (p. 325), hot springs of Fumerole Butte, Utah (p. 333), of Salt Lake City (p. 349), and of Bonneville village, Utah (p. 350), the last two being on faults, are also considered. Other hot springs are noted.

171 —— Administrative report [1890–91].

U. S. Geol. Surv., 12th Ann. Rept., pt. 1, pp. 52–65, 1891.

Discusses underground temperatures as based on observations in the 4,471-foot well at Wheeling, West Virginia.

172 —— Administrative report [1891–92].

U. S. Geol. Surv., 13th Ann. Rept., pt. 1, pp. 83–98, 1892.

Notes work of A. C. Peale on mineral waters (p. 88) and of William Hallock on temperatures of Wheeling deep well (p. 96).

173 —— Administrative report.

U. S. Geol. Surv., 15th Ann. Rept., pp. 144–148, 1895.

Gives an account of studies on the artesian conditions and of the contouring of the Dakota sandstone in southern Colorado, etc. (pp. 145–146).

174 —— The underground water of the Arkansas Valley in eastern Colorado.

U. S. Geol. Surv., 17th Ann. Rept., pt. 2, pp. 551–601, 1896.

Describes the geology of the region (pp. 560–580) and considers the derivation of underground waters (pp. 557–558) and general artesian conditions (p. 581). The character, catchment area, capacity, distribution, quality, analyses, and prospects of the Dakota sandstone or its waters are treated at length (pp. 582–595), while the ground water in gravels, in upland and dune sands, and in the terraces is discussed (pp. 595–598). The considerable underflow of the Arkansas and other streams is pointed out (pp. 599–601).

175 **Gilbert** (Grove Karl). Pueblo folio, Colorado.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 36, pp. 7, 1897.

Notes the loss of water through absorption by the beds of the Arkansas and St. Charles rivers (p. 1) and discusses the various water horizons in the Dakota sandstone, including their depth and head. A map showing the areas of flowing and nonflowing wells and the depths of the water horizons is given.

176 **Glenn** (L. C.). Tennessee. [Well records.]

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 102, pp. 358–367, 1904.

Gives a general statement of underground water conditions (pp. 358–359) and presents tables and notes relating to wells (pp. 360–365). These include data bearing on depth, head, source, yield, quality, records, and uses.

177 —— Kentucky. [Well records.]

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 102, pp. 369–373, 1904.

Considers briefly the general underground water conditions and gives tables and notes relating to wells. These include statistics on depth, head, yield, quality (including analysis), records, and uses.

178 **Gooch** (Frank Austin) and **Whitfield** (James Edward). Analyses of waters of the Yellowstone National Park with an account of the methods of analyses employed.

U. S. Geol. Surv., Bull. no. 47, pp. 84, 1888.

Gives the temperatures, specific gravities, and analyses of 43 waters including those from geysers, hot springs, cold springs, mud springs, etc. Among the rare compounds or elements of waters which were found are B_2O_3, As_2O_3, Br, Mn, Cs, and Rh. N_2O_5, TiO_2, I, Fl, Ba, and Sr were tested for but not found.

179 **Goodell** (Edwin B.). A review of the laws forbidding pollution of inland waters in the United States.

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 103, pp. 120, 1904.

Gives an abstract of laws relating to pollution of surface streams. Springs are specifically included with the streams in nearly all States and wells are included in many instances. Several States have special laws relating to springs.

180 **Gowsell** (M. G.), **Plummer** (Fred G.) and. Forest conditions in the Lincoln Forest Reserve, New Mexico.

U. S. Geol. Surv., Prof. Paper no. 33, pp. 47, 1904.

See Plummer (Fred G.) and Gowsell (M. G.).

181 **Grant** (C. L.). Additional well records in Connecticut.

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 102, pp. 160–165, 1904.

Gives tables showing depth and yield of wells at a considerable number of scattered localities.

182 **Graves** (Henry S.). Black Hills Forest Reserve.

U. S. Geol., Surv., 19th Ann. Rept.. pt. 5, pp. 67–164, 1898.

Mentions underground-stream channels in Bear Lodge Range (p. 163).

183 **Gregory** (Herbert E). Connecticut. [Well and spring records.]

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 102, pp. 127-159, 1904.

Considers briefly the general underground water conditions (p. 127), and gives tables and notes relating to wells (pp. 128–149) and springs (pp. 149–159). The well data include source, temperature, yield, quality (including analyses), and uses; the spring data, temperature, yield, source, use, improvements, and quality (including analyses).

184 **Grimsley** (G. P.). Gypsum deposits in Kansas.

U. S. Geol. Surv., Bull. no. 223, pp. 53–59, 1904.

Notes springs associated with gypsite (p. 57) and mentions the action of underground waters in the formation of gypsum (p. 58).

185 **Griswold** (W. T.). The Berea Grit Oil Sand in the Cadiz quadrangle. Ohio.

U. S. Geol. Surv., Bull. no. 198, pp. 43, 1902.

Discusses the relation of water to the accumulation of oil and gas, and gives a map and tables of the wells.

186 —— Structural work during 1901 and 1902 in the Eastern Ohio oil fields.

U. S. Geol. Surv., Bull. no. 213, pp. 336–344, 1903.

Discusses the relation of water to the occurrence of oil and gas (p. 337).

187 **Grunsky** (Carl Ewald). Irrigation near Bakersfield, California.

U. S. Geol. Surv., Water Supply and Irrigation Paper, no. 17, pp. 96, 1898.

Notes use of ground water for irrigation at Florin (p. 14), and reports successful pumping and the beginning of artesian developments in the San Joaquin Valley (p. 94). Irrigation by causing a general rise of the ground water into the subsoil is described (pp. 33–34).

188 —— Irrigation near Fresno, California.

U. S. Geol. Surv., Water Supply and Irrigation Paper, No. 18, pp. 94, 1898.

Discusses seepage (pp. 74–78) and describes irrigation by raising ground-water level to subsoil (p. 90). The effect of irrigation on ground-water level (p. 79) and the ground-water conditions near the Fresno Canal (p. 75) and along Kings River (pp. 86–87) are also considered.

H.

189 **Hague** (Arnold). Administrative report [1883–84].

U. S. Geol. Surv., 5th Ann. Rept., pp. 15–19, 1885.

Gives a brief summary of the work of W. H. Weed, A. C. Peale, and Wm. Hallock on the character, deposits, and causes of the hot springs and geysers of the Yellowstone National Park, and mentions the work of F. A. Gooch on the chemistry of the waters and their deposits.

190 —— Administrative report [1884–85].

U. S. Geol. Surv., 6th Ann. Rept., pp. 54–59, 1885.

Notes the chemical work of F. A. Gooch on methods and problems relating to the thermal waters of Yellowstone National Park, and mentions work of William Hallock on the physics of geyser action. Calls attention to changes in temperature of springs and to new vents.

191 **Hague** (Arnold). Administrative report [1885–86].

U. S. Geol. Surv., 7th Ann. Rept., pp. 87–91, 1888.

Gives list of basins and springs of the Yellowstone National Park from which waters have been analyzed by F. A. Gooch and J. E. Whitfield.

192 —— Administrative report [1886–87].

U. S. Geol. Surv., 8th Ann. Rept. pt. 1, pp. 149–153, 1889.

Mentions the work of W. H. Weed on geyser action in the Yellowstone National Park and states there is no diminution in the intensity of geyser action or other noticeable changes in the geyser region. Mentions the work of Gooch and Whitfield on the chemistry of the waters and notes the occurrence of arsenic in the waters. This may give to the waters an important medicinal value. The occurrence of scorodite in the siliceous sinter cones is mentioned.

193 —— Administrative report [1887–88].

U. S. Geol. Surv., 9th Ann. Rept. (pp. 91–96), 1889.

Describes the state of activity of the geysers of the Yellowstone National Park and mentions the outbreaks of the Excelsior after a dormant period of six years. Notes the work of W. H. Weed on the study of algeous growths in springs and describes the occurrence of scorodite, the hydrous arsenate of iron.

194 —— Administrative report [1888–89].

U. S. Geol. Surv., 10th Ann. Rept., pt. 1, pp. 132–137, 1890.

States that there has been no marked change in geyser action. Describes the work of W. H. Weed in exploring old and new geyser basins and mentions the discovery of arsenic in their waters. The publications of F. A. Gooch, J. E. Whitfield, and W. H. Weed relating to the waters and deposits of hot springs are noted and attention called to the method of inciting geyser action by "soaping."

195 —— Administrative report [1889–90].

U. S. Geol. Surv., 11th Ann Rept., pt. 1, pp. 83–87, 1891.

Notes works of W. H. Weed on the question of changes of activity of geysers and springs in the Yellowstone National Park.

196. —— Administrative report [1890–91].

U. S. Geol. Surv., 12th Ann. Rept., pt. 1, pp. 92–96, 1891.

Describes the work of W. H. Weed on geysers and hot springs.

197 —— Geology of the Eureka District, Nevada, with an atlas.

U. S. Geol. Surv., Mon., vol. 20, pp. 419, 1892.

Notes occurrence of enlarged fissures and caves antedating ore deposition (p. 308) and assigns ore deposition to ascending solfataric currents (p. 294).

198 —— Administrative report [1892–93].

U. S. Geol. Surv., 14th Ann. Rept., pt. 1, pp. 188–191, 1893.

Describes exhibit of hot-spring deposits at World's Fair at Chicago in 1893 (p. 191).

199 **Hague** (Arnold). Yellowstone National Park folio, General Description.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 30, pp. 1–4, 1896.

Describes the geysers, hot springs, and solfataras, and discusses the antiquity of some of the deposits. Glacial bowlders are found imbedded in travertine. The action of acid thermal waters in the decomposition of rocks and their intimate relation to rhyolite are considered. The spring and geyser waters are of three classes (1) calcareous, forming travertine; (2) siliceous, frequently acid, and carrying alum and iron, and (3) siliceous alkaline, forming geyser cones. The occurrence of iron, manganese, and arsenic in the waters and of realgar, orpiment, and scorodite in the deposits is noted. There are 4,000 thermal springs and 100 geysers in the park.

200 —— [and **Weed** (W. H.)]. Descriptive geology of Huckleberry Mountain and Big Game Ridge: Snake River Hot Springs.

U. S. Geol. Surv., Mon., vol. 32, pt. 2, pp. 177–178, 1899.

These are large calcareous thermal springs, associated with travertine deposits resembling those of Mammoth Hot Springs of Yellowstone National Park and occurring on the banks of Snake River. Their relation to rhyolite and to limestone is considered.

201 **Hague** (Arnold). Absaroka folio, Wyoming.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 52, pp. 6, 1899.

Describes the hot sulphur springs of Stinking Water River (p. 1) and mentions the occurrence of active and extinct thermal springs on west slopes of Saddle Mountain, just inside the limits of the Yellowstone National Park on the west. The occurrence of a solfataric area with whitened and decomposed rocks with sulphur deposits is also noted (p. 6).

202 **Hall** (Benjamin M.). Measurement of springs in Georgia.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 236–237, 1904.

Describes and gives results of measurements of flow of a number of large springs in Georgia.

203 —— Measurement of springs in Florida.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 274–275, 1904.

Gives description and statistics of flow for several of the larger springs in Florida.

204 —— Water powers of Alabama, with an appendix on stream measurements in Mississippi.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 107, 253 pp., 1904.

Gives measurements of springs in Cahaba (p. 129) and Tennessee (p. 207) valleys.

205 **Hall** (C. M.), **Todd** (James E.) and. Alexandria folio, South Dakota.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 100, pp. 6, 1903.

See Todd (J. E.) and Hall (C. M.).

206 —— Geology and water resources of part of the lower James River valley, South Dakota.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 90, 47 pp., 1904.

See Todd (James E.) and Hall (C. M.).

207 **Hall** (Christopher W.). Minnesota. [Well and spring records.]

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 441–488, 1904.

Discusses the general underground water conditions (pp. 441–443) and gives tables or notes of shallow wells (pp. 444–469), deep wells (pp. 470–480), and springs (pp. 481–488). The shallow-well data include range of depth of village wells, source, and yield; the deep-well data, depth, source, head, yield, quality, and uses; and the spring data, temperature, quality (including analyses), yield, source, uses, etc.

208 **Hamlin** (Homer). Water resources of the Salinas Valley, California.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 89, 91 pp., 1904.

Discusses underground waters under economic geology (pp. 21–23). Wells of stream deposits (p. 16); well statistics, including uses for irrigation, etc. (pp. 21–31); well records (pp. 31–32); and pumping from wells (pp. 82, 87) are other subjects considered.

209 **Harris** (Gilbert Dennison), **Dall** (William Healey) and. Correlation papers. Neocene.

See Dall (William Healey) and Harris (Gilbert Dennison).

210 **Harris** (Gilbert Dennison). Underground waters of southern Louisiana.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 101, pp. 11–73, 1904.

The paper includes discussions of the origin of underground waters (pp. 12–14); stratigraphy of southern Louisiana, including Oligocene, Miocene, and Quaternary horizons (pp. 17–26); well statistics and records (pp. 30–61); variation in flow and head (pp. 61–67); jetting and rotary processes of well drilling (pp. 68–71); analyses of well waters (pp. 44, 47–48); blowing wells (pp. 60–61); and pumping and use of screens (pp. 71–73). A brief account of certain Mississippi wells is included (pp. 30–33).

211 **Hawkins** (R.). Water supply of Livingston County [Missouri].

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 410–416, 1904.

Discusses the underground water conditions and gives detailed well records, etc.

212 **Haworth** (Erasmus). Underground waters of southwestern Kansas.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 6, pp. 65, 1897.

This paper discusses the original sources (p. 11), available amounts (p. 14), and geological conditions of ground water in general (p. 15), and describes the types and methods of locating ground waters (p. 18). The descriptions of the geography and geology of the area (pp. 19–37) are followed by a consideration of the source, occurrence, properties, flow, etc., of the waters of the Dakota sandstone (pp. 38–43), and of the Tertiary formations (pp. 43–57). The numerous and relatively shallow wells frequently used for irrigation and the springs of Meade County are considered (pp. 48–56). The writer concludes that there is an abundant supply both in the Arkansas Valley and on the uplands, but better means of raising it to the surface are needed (p. 62).

213 **Hay** (Robert). A geological reconnaissance in southwestern Kansas.

U. S. Geol. Surv., Bull. no. 57, pp. 49, 1890.

Notes occurrence of sulphate of lime in waters of Medicine River Valley, and describes the occurrence of water in the Dakota sandstone and in the Tertiary grits. Deep salt wells and borings (pp. 25–26) and artesian wells (pp. 13, 30, 48) are mentioned. The absorption of Bear Creek by its gravels is described.

214 —— Water resources of a portion of the Great Plains.

U. S. Geol. Surv., 16th Ann. Rept., pt. 2, pp. 535–588, 1896.

Describes and gives lists of springs of various water levels (pp. 545–547). Other topics considered are sources, catchment, etc., of the waters (pp. 550–557), volume (pp. 557–565), artesian flow (pp. 565–567), blowing wells (pp. 567–568), temperature (p. 568), geology and topography (pp. 569–579), water horizons of the Cretaceous, Tertiary, and Pleistocene formations (p. 580), and utilization of ground waters (pp. 585–586). Considerable supplies are obtainable, but not enough for all needs of irrigation and other purposes (pp. 586–588).

215 —— Geology of the Fort Riley Military Reservation and vicinity, Kansas.

U. S. Geol. Surv., Bull. no. 137, pp. 35, 1896.

In addition to the topography, geology, paleontology, etc., a number of copious springs, some used for water power, the flows of mineral waters in the wells of Geary County, and the value of the Carboniferous rocks, Tertiary gravels, and alluvium as sources of supplies are discussed (pp. 32–33). The occurrence of sinks is mentioned (pp. 15, 16, 26, and 27).

216 **Hayden** (F. V.). Administrative report [1884–85].

U. S. Geol. Surv., 6th Ann. Rept., pp. 48–53, 1885.

Notes progress of A. C. Peale on the bibliography of mineral waters and the preparation of a statistical paper (p. 53).

217 —— Administrative report [1885–86].

U. S. Geol. Surv., 7th Ann. Rept., pp. 85–87, 1888.

Mentions progress of work on mineral springs, and notes preparation of a second statistical paper and work on the bibliography of mineral waters by A. C. Peale.

218 **Hayes** (C. Willard). Ringgold folio, Georgia-Tennessee.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 2, pp. 3, 1894.
Ascribes the segregation of hematite, limonite, and manganese ores to the action of percolating underground waters (pp. 2-3).

219 —— Kingston folio, Tennessee.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 4, pp. 4, 1894.
Notes the disappearance of streams into underground channels or caves, and discusses the formation of "coves" or amphitheaters by the solution of limestone by underground waters (p. 1).

220 —— Chattanooga folio, Tennessee.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 6, pp. 3, 1894.
Disposition of limonite is referred to segregation in pockets or near the surface by percolating waters (p. 3).

221 —— Cleveland folio, Tennessee.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 20, pp. 4, 1895.
Refers the disposition of limonite ores to segregation by percolating waters (p. 4).

222 —— Pikeville folio, Tennessee.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 21, pp. 4, 1895.
Notes the occurrence of subterranean channels in region of Crab Orchard Mountains (p. 1).

223 —— The Arkansas beauxite deposits.
U. S. Geol. Surv., 21st Ann. Rept., pt. 3, pp. 435-472, 1901.
Provisionally ascribes origin of deposits to waters penetrating to heated syenite, dissolving parts of it, and returning to the surface as springs depositing beauxite (pp. 461-466).

224 —— Tennessee white phosphates.
U. S. Geol. Surv., 21st Ann. Rept., pt. 3, pp. 473-485, 1901.
Ascribes origin of ores to deposition from solution by underground waters in limestone cavities (p. 479).

225 —— Rome folio. Georgia-Alabama.
U. S. Geol. Surv., Geol. Atlas U. S., folio no. 78, p. 6, 1902.
Assigns the derivation of the limonite ores to the action of underground waters upon the Beaver limestone along its contact with the Weisner quartzite, and also along the contact of the Bangor limestone with the Oxmoor sandstone. Some iron has also been deposited by thermal springs along faults. In the formation of beauxite the surface waters penetrated downward to the Conasauga shale and, after dissolving out aluminum sulphate, passed upward along faults and deposited pisolitic grains of beauxite in springs (p. 6).

226 —— and **Kennedy** (William). Oil fields of the Texas-Louisiana Gulf Coastal Plain.
U. S. Geol. Surv., Bull. no. 212, p. 174, 1903.
In addition to the discussion of oil wells, mention or description is made of a considerable number of artesian (pp. 18, 33, 87, 118, 122) and thermal wells (pp. 60, 122). Lists of wells of the Jennings district, Louisiana (p. 130), and at Spindletop, Texas (pp. 77-85, 103-104), and records of a large number of gas, oil, and water wells at various points are given. The occurrence of sulphur in water (pp. 17, 18) and the relation of salt water to oil (p. 119) are discussed. A description of drilling methods is also given (pp. 166-170).

227 **Hayes** (C. Willard). Introduction. Contributions to economic geology, 1902.

U. S. Geol. Surv., Bull. no. 213, pp. 9-14, 1903.

Gives a table of the geologic folios of the survey, with lists of mineral products, including underground water, artesian water, and mineral springs.

228 —— and **Eckel** (E. C.). Iron ores of the Cartersville district Georgia.

U. S. Geol. Surv., Bull. no. 213, pp. 233-242, 1903.

The deposition of the ores is referred to solutions ascending from considerable depths along faults and other lines of passage.

229 **Hayes** (C. Willard). Oil fields of the Texas-Louisiana Gulf Coastal Plain.

U. S. Geol. Surv., Bull. no. 213, pp. 345-352, 1903.

Describes the occurrence of salt water in the Spindletop pool (p. 350).

230 —— origin and extent of Tennessee white phosphates.

U. S. Geol. Surv., Bull. no. 213, pp. 418-423, 1903.

Ores were deposited in quiet waters in caverns in the limestone, sometimes under hydrostatic pressure.

231 —— and **Eckel** (E. C.). Occurrence and development of ocher deposits in the Cartersville district, Georgia.

U. S. Geol. Surv., Bull. no. 213, pp. 427-432, 1903.

Notes the admission of surface waters to great depths by faults, and discusses the nature and movements of water connected with the formation of the ores (p. 429).

232 —— and **Ulrich** (Edward O.). Columbia folio, Tennessee.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 95, 6 pp., 1903.

Notes the occurrence of sinks, caves, and underground streams in the St. Louis limestone. Ordovician phosphates are ascribed to leaching of phosphatic limestones by acid surface waters along joint planes, etc. (pp. 5-6). The origin of blanket deposits through underground circulation and of collar deposits through capillary circulation are also considered (p. 6).

233 **Hayes** (C. Willard). Introduction: Contributions to economic geology, 1903.

U. S. Geol. Surv., Bull. no. 225, pp. 11-17, 1904.

Gives list of Survey publications and notes folios in which discussions of underground waters appear.

234 **Herrick** (H. N.). Gypsum deposits in New Mexico.

U. S. Geol. Surv., Bull. no. 223, pp. 89-99, 1904.

Notes presence of salt and hydrogen sulphide in wells penetrating the gypsum (p. 92), and the occurrence of sinks due to the solution of gypsum.

235 **Hilgard** (E. W.). Salines of Louisiana.

U. S. Geol. Surv., Min. Res. 1882, pp. 554-565, 1883.

Considers the wells and springs affording brines.

236 **Hill** (Benjamin F.). Gypsum deposits in Texas.

U. S. Geol. Surv., Bull. no. 223, pp. 68–73, 1904.

Notes impregnation of springs with gypsum, salt, and sulphur (p. 71), and mentions the filling of caves by the former mineral (p. 72).

237 **Hill** (Robert T.). The present condition of knowledge of the geology of Texas.

U. S. Geol. Surv., Bull. no. 45, pp. 95, 1887.

Describes the artesian-well experiment under Capt. John Pope in 1857–8 (p. 27).

238 —— Administrative report.

U. S. Geol. Surv., 15th Ann. Rept., pp. 170–171, 1895.

Describes artesian investigations in Texas (p. 171).

239 —— and **Vaughan** (T. Wayland). Geology of the Edwards Plateau and Rio Grande Plain adjacent to Austin and San Antonio, Texas, with reference to the occurrence of underground water.

U. S. Geol. Surv., 18th Ann. Rept., pt. 2, pp. 193–321, 1898.

Discusses the geography (pp. 201–212), geology (pp. 215–260), artesian principles (pp. 212–215), capacity of formations (pp. 260–264), and the underground waters, including artesian and nonflowing wells and springs of the Edwards Plateau (pp. 264–274) and the Rio Grande Plain (pp. 274–321). The identity of artesian and fissure spring waters in the latter, the source of the water, prospecting, chemical analyses, spring rivers, and fault springs are also considered, and the Edwards limestone and Travis Peak foundation discussed as sources of supply.

240 —— and **Vaughan** (T. Wayland). Nueces folio, Texas.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 42, pp. 4, 1898.

Describes caverns in limestones (p. 1), the honeycombed rocks of the Edwards formation (pp. 2–3), and notes the occurrence of springs and spring rivers throughout the Cretaceous (p. 2). Springs are divided into two groups, the fault springs, as those from Austin to Del Rio, and the gravity springs, as those of the Edwards formation (p. 3). Mentions the value of the Comanche Peak formation as a horizon marker in locating underground waters (p. 2). The Kickapoo water bed at the base of the Edwards formation, the Black Water Hole beds 150 feet higher, and the still higher Justice Spring horizon are described. They give nonflowing wells except along the Balcones fault (p. 4). Water is predicted in the Trinity beds 500 feet below the Comanche Peak limestone (p. 4).

241 **Hill** (Robert T.). Mineral resources of Porto Rico.

U. S. Geol. Surv., 20th Ann. Rept., pt. 6 cont., pp. 771–778, 1899.

Reports several thermal and mineral springs, some of which have been improved by the construction of baths, etc. Sulphur and ferruginous waters are the most common. An analysis of Coamo water is given (pp. 775–776).

242 **Hill** (Robert T.). Geography and geology of the Black and Grand prairies, Texas.

U. S. Geol. Surv., 21st Ann. Rept., pt. 7, pp. 1–666, 1900.

An elaborate report covering the geography of the Texas region, especially of the Black and Grand prairies (pp. 25–85), the geology (pp. 86–386), principles of the occurrence of underground waters (pp. 387–394), the artesian well systems of Texas (pp. 394–451), chemistry of the waters (pp. 447–451), and the artesian conditions of Black and Grand prairies by counties (pp. 452–649). The supplies are from the Cretaceous, including the base of the Trinity, a portion of the Glen Rose, the Paluxy, a part of the beds of the Edwards, Woodbine, and Denison formations and the Corsicana sands of the Navarro beds (p. 419).

243 —— and **Vaughan** (T. Wayland). Austin folio, Texas.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 76, pp. 8, 1902.

Notes the occurrence of interrupted streams and describes the springs of the honeycombed Edwards limestone (p. 2). The quadrangle is underlain by the Trinity group, which should furnish water rising 600 feet above sea level. The variations in depth of the beds are described (p. 8).

244 **Hills** (Richard Charles). Elmoro folio, Colorado.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 58, pp. 5, 1899.

Describes the artesian waters of the Dakota sandstone, together with the position, thickness, and depth of that bed. Strong flows are not probable, but small flows can be obtained in Purgatory Valley and elsewhere. The occurrence of springs is noted. In addition to the descriptions, a map showing the outcrop of the water horizon and the extent of and depths to the water bed in the flowing and nonflowing areas is given (pp. 4–5).

245 —— Walsenburg folio, Colorado.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 68, pp. 6, 1900.

Describes the Dakota sandstone and Lower Eocene beds and discusses the structure of the quadrangle. The prospects for flowing and nonflowing wells and the methods and cost of boring are considered, and the requisite conditions of artesian water are noted. A map showing the areas of outcrop of the Dakota sandstone and the Poison Canyon formation, the flowing, nonflowing, and unproductive areas, and the depth to the Dakota sandstone is given.

246 —— Spanish peaks folio, Colorado.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 71, pp. 7, 1901.

Discusses artesian conditions and the present and prospective supplies, and describes the Dakota sandstone and Poison Canyon formation. Notes the occurrence of springs. Gives a map showing areas underlain by water-bearing formations and the depth to the Dakota sandstone.

247 **Hobbs** (William Herbert). The Newark system of the Pomperang Valley, Connecticut.

U. S. Geol. Surv., 21st Ann. Rept., pt. 3, pp. 7–162, 1900.

Considers the rectilinear arrangement of certain springs as indicating fault lines (pp. 91–93).

248 **Holgate** (H. L.). The legal status of irrigation.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 93, pp. 296–300, 1904.

Devotes a section to underground waters, giving characteristic court decisions relating thereto (p. 299).

249 **Hollick** (Arthur). Cretaceous deposits of Staten Island. New York City folio, New York-New Jersey.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 83, pp. 10–11, 1902.

Notes the importance of the Cretaceous beds as a source of water supply, and mentions the drift and serpentine as additional sources.

250 **Hood** (Ozni Porter). New tests of certain pumps and water lifts used in irrigation.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 14, pp. 91, 1898.

A critical discussion of the various pumps and lifts used to raise underground waters to the surface.

251 **Hoyt** (John C.). Report of progress of stream measurements for the calendar year 1903. Part 4, Interior Basin, Pacific, and Hudson Bay drainage.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 100, pp. 533, 1904.

Gives spring measurements in Nevada (p. 227), mentions the springs of the San Francisco district (p. 277), describes briefly underflow and seepage at certain points in southern California (p. 339), and gives yield of wells and pumping plants in the same region (pp. 355–356).

252 **Hutson** (William Ferguson). Irrigation systems of Texas.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 13, pp. 68, 1898.

Discusses the pumping of underground waters for irrigation in the East Gulf Coast region (pp. 25–27), in central Texas (p. 29), along the Colorado River (p. 33), on the Llano Estacado (pp. 59–62), and at Laredo, Hidalgo, and Brownsville (pp. 58–59). The strong artesian flows near San Antonio and in the Pecos Valley, and the great San Marcos and Comal springs, together with the smaller springs of the Pecos Valley, are also described.

253 **Hydrography,** Division of. Operations at river stations, 1899. Part 2.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 36, pp. 198, 1900.

Gives the results of a number of spring measurements in Georgia (pp. 147–148).

254 —— Operations at river stations, 1899. Part 3.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 37, pp. 298, 1900.

Gives the result of spring measurements at Columbus, Nebr. (p. 276), and describes the big well at Uvalde, Tex., and the Las Moras and San Felipe springs, Texas (p. 277). The flow of the springs is 60 and 84 second-feet, respectively.

255 **Hydrography,** Division of. Operations at river stations, 1899. Part 5.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 39, pp. 471, 1900.

Gives measurements of the flows of artesian wells in the San Benardino Valley, California (p. 423).

256 —— Operations at river stations, 1900. Part 3.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 49, pp. 292, 1901.

Discusses the underground water supply of the South Platte Basin, Colorado (p. 279).

257 —— Operations at river stations, 1900. Part. 4.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 50, pp. 387, 1901.

Discusses seepage in Colorado (pp. 299–306, 320) and considers the underground waters of Arkansas Basin, Colorado (p. 320). The Barton (p. 335), San Antonio (p. 340), Leona (p. 342), San Felipe (p. 345), Toyale (p. 361), Saragossa (p. 362), and the springs of Lampasas River (p. 335), Nueces River (p. 343), and Mud Creek (p. 345), all of Texas, are described or mentioned, as are also the artesian wells of the San Antonio (p. 340).

258 —— Operations at river stations, 1900. Part 5.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 51, pp. 487, 1901.

Gives a number of discharge measurements of wells in California (pp. 482–484).

259 —— Operations at river stations, 1900. Part 6.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 52, pp. 575, 1901.

Describes the construction of wells in southern California (pp. 497–498).

260 —— Operations at river stations, 1901. Part 2 (west of Mississippi River).

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 66, pp. 188, 1902.

Notes the source of Mill Creek, Texas, in springs (p. 62), and describes the Carrizo Springs of Texas (p. 63) and the soda springs near the Tieton River, Washington (p. 135). An analysis of the waters of the Carrizo Springs (well) is given (p. 63).

I.

261 **Iddings** (Joseph P.) and **Weed** (Walter H.). Livingstone folio, Montana.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 1, pp. 4, 1894.

Describes travertine of present and extinct hot springs (p. 3).

262 **Irving** (John Duer). Economic resources of the northern Black Hills.

U. S. Geol. Surv., Professional Paper no. 26, pp. 222, 1904.

Mentions the relation of underground waters to ore deposits or mineralization (pp. 110, 136, 190), and gives a more complete discussion on pp. 155–157.

263 **Irving** (Roland Duer). On secondary enlargements of mineral fragments in certain rocks: Summary of general conclusions.

U. S. Geol. Surv., Bull. no. 8, pp. 48-52, 1884.

Ascribes enlargement of quartz grains in the Huron, Potsdam, and St. Peters quartzites to deposition from interstitially percolating waters (p. 49).

J.

264 **Jack** (John G.). Pikes Peak, Plum Creek, and South Platte [forest] reserves.

U. S. Geol. Surv., 20th Ann. Rept., pt. 5, pp. 39-115, 1899.

Notes the springs of the South Platte reserve (p.92).

265 **Johnson** (Lawrence C.) **Smith** (Eugene A.) and. Tertiary and Cretaceous strata of the Tuscaloosa, Tombigbee, and Alabama rivers.

See Smith (Eugene A.) and Johnson (Lawrence C.)

266 **Johnson** (Laurence C.) and **Eckel** (Edwin C.). Mississippi. [Well records.]

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 332-357, 1904.

Considers briefly the general underground water conditions and gives a table of geologic and water horizons (pp. 332-333). Tables of a large number of wells, giving depths, head, quality, supply, geologic horizon of water, etc., are included.

267 **Johnson** (Willard D.). The high plains and their utilization.

U. S. Geol. Surv., 21st Ann. Rept., pt. 4, pp. 601-741, 1900.

Describes their character, origin, geological structure, and climate (pp. 609-679), and notes the necessity of additional water supplies (pp. 680-691). The occurrence of underground waters, including the catchment through basins, sinks, sod cracks, etc., resulting from solution or caving of Tertiary or Cretaceous beds is discussed, and the ground water conditions of the Meade artesian basin and other regions described. Both wells and springs are considered (pp. 702-741).

268 —— The high plains and their utilization.

U. S. Geol. Surv., 22d Ann. Rept., pt. 4, pp. 631-669, 1901.

Gives a physical description of the plains (pp. 637-640) and considers the occurence and origin of the underground waters (pp. 640-642). There appears to be enough water for watering stock, but not enough for extensive irrigation, except in valleys. The importance of correct well construction is emphasized (p. 669).

K.

269 **Keith** (Arthur). Knoxville folio, Tennessee-North Carolina.

U. S. Geol. Surv., Geol. Atlas of U. S., folio No. 16, pp. 6, 1895.

Describes springs and other sources of water supply of the region of the Knox dolomite, and notes the value of spring-fed streams for water power.

270 **Keith** (Arthur). London folio, Tennessee.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 25, pp. 6, 1896.

Describes underground drainage through sinks into the Rutledge limestone, and in the Knox dolomite (p. 3). States that the abundant springs of the region give rise to streams affording permanent power (p. 6).

271 —— Morristown folio, Tennessee.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 27, pp. 5, 1896.

Mentions the underground drainage of the Knox dolomite and that through sinks into subterranean channels in the Rutledge limestone (p. 2). Steady water power is derived from streams fed chiefly by springs.

272 —— Briceville folio, Tennessee.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 32, pp. 4, 1896.

Describes the underground drainage and sinks of the Knox dolomite (p. 2).

273 —— Maynardville folio, Tennessee.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 75, pp. 6, 1901.

Notes the underground drainage and sinks of the Rutledge limestone and Knox dolomite (p. 2) and mentions the sulphur springs of the Chattanooga shale (p. 4).

274 —— Cranberry folio.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 90, pp. 9, 1903.

Mentions the occurrence of multitudes of springs feeding the streams, many of which have valuable water powers.

275 —— Recent zinc mining in East Tennessee.

U. S. Geol. Surv., Bull. no. 225, pp. 208–218, 1904.

Notes deposition of ores by ground waters and the occurrence of hot springs in limestones (p. 212).

276 **Kennedy** (William) **Hayes**, (C. W.) and. Oil fields of the Texas-Louisiana Gulf Coastal Plain.

See Hayes (C. W.) and Kennedy (William).

277 **King** (Franklin Hiram). Principles and conditions of the movements of ground water.

U. S. Geol. Surv., 18th Ann. Rept., pt. 2, pp. 59–294, 1897.

Among the subjects discussed are the water-holding capacity of soils and rocks (pp. 70–71); the gravitational, thermal, capillary, and seepage movements, and movements due to crust deformation and rock consolidation (pp. 71–94); experimental investigations of movements through wire gauze, tubes, rocks, sands, soils, etc. (pp. 107–206); movements through sand and rock in nature (pp. 207–292); influence on flow of form, diameter, and arrangement of grains (pp. 207–218, 228–242); determination of pore space and size of grains (pp. 218–228); movements over wide areas and in fissures (pp. 245–250); interference of wells (pp. 276–279); flow into wells (pp. 279–289); computation of capacity (pp. 289–290); flow into driven well points (pp. 290–292), and rate of pumping of different classes of wells (pp. 292–293).

L.

278 **La Forge** (Laurence) **Crosby** (William O.) and. Massachusetts. [Well and spring records.]

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 94–111, 1904.

See Crosby (William O.) and La Forge (Laurence).

279 **Lane** (Alfred C.). Water resources of the lower peninsula of Michigan.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 30, pp. 97, 1899.

Treats of the uses of surface and underground waters (pp. 11–48), climate (pp. 48–57), well temperatures (p. 56), geology and topography, including descriptions of shallow wells, methods of sinking wells (p. 69), deep wells of the Carboniferous, Devonian, and Silurian rocks (pp. 77–89), rock structure (pp. 90–91), and prospects in various districts (pp. 91–94).

280 —— Lower Michigan mineral waters. (A study into the connection between their chemical composition and mode of occurrence.)

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 31, pp. 97, 1899.

Considers the economic value of water (pp. 12–14) and discusses analyses of the waters of lakes, streams, wells, springs, etc. (pp. 14–57). The chemistry of the waters of the various geological formations, including the Marshall and Berea Grit and the Devonian and Silurian limestones, is treated at some length (pp. 58–86). Special attention is given to the brines (pp. 66–70).

281 **Langille** (H. D.). Forest conditions in the Cascade Forest Reserve, Oregon: Northern portion of Cascade Range Forest Reserve.

U. S. Geol. Surv., Prof. Paper no. 9, pp. 27–69, 1903.

Describes hot mineral springs (p. 28).

282 **Lee** (Willis T.). Underground waters of Salt River Valley [Arizona].

U. S. Geol. Surv., 2d Ann. Rept. Reclamation Service, 1902–3, pt. 73–76, 1904.

Describes the underflow and the various water horizons. Pumping for irrigation is proposed.

283 —— The underground waters of Gila Valley, Arizona.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 104, pp. 71, 1904.

Among the topics discussed are wells (pp. 14–23), return waters (pp. 23–25), underflow, including rate of movement and volume (pp. 26–63, 67, 68), composition of ground waters, including analyses (pp. 15, 20, 57, 61), well descriptions and records (pp. 14–23), capacity of wells and well tests (pp. 16–18), seepage ditches (pp. 23–25, 51–52), porosity of gravels (pp. 47–48), experiments with underflow (pp. 40–47), and pumping plants (pp. 52–57).

284 **Leiberg** (John B.). Priest River Forest Reserve [Idaho].

U. S. Geol. Surv., 19th Ann. Rept., pt. 5, pp. 217–252, 1898.

In connection with the discussion of water supplies the collection of water in fissured granite and its emergence as springs is noted (p. 220).

285 —— Bitterroot Forest Reserve [Montana].

U. S. Geol. Surv., 19th Ann. Rept., pt. 5, pp. 253–282, 1898.

Springs are numerous and give rise to small streams. It is thought that they might be used for irrigation (pp. 259–260).

286 —— The San Gabriel Forest Reserve [California].

U. S. Geol. Surv., 20th Ann. Rept., pt. 5, pp. 411–428, 1899.

Notes the absorption of water into the rocks and the reappearance as springs (p. 415).

287 —— The San Bernardino Forest Reserve.

U. S. Geol. Surv., 20th Ann. Rept., pt. 5, pp. 429–454, 1899.

Notes the disappearance of streams in gravel (p. 433) and mentions the practice of tunneling to intercept ground water (p. 435). Describes the artesian basins of the reserve (p. 435).

288 —— Cascade Range Forest Reserve [Oregon]; Ashland Forest Reserve.

U. S. Geol. Surv., 21st Ann. Rept., pt. 5, pp. 209–498, 1900.

Notes the occurrence of large springs giving rise to streams (p. 225) and the presence of hot springs (p. 229). Mention is made of the disappearance of streams into the lava (p. 231).

289 —— Forest conditions in the Cascade Forest Reserve, Oregon: Southern part of the Cascade Range Forest Reserve.

U. S. Geol. Surv., Prof. Paper no. 9, pp. 229–289, 1903.

Describes springs (pp. 239, 264, 281, 283) and notes absorption of water by pumice (p. 234) and by fissures in the lava (pp. 276, 281).

290 —— **Rixon** (Theodore F.), and **Dodwell** (Arthur). Detailed descriptions [of timber of townships]. Forest conditions in the San Francisco Mountains Forest Reserve, Arizona.

U. S. Geol. Surv., Prof. Paper no. 22, pp. 35–91, 1904.

Gives occasional references to springs in connection with discussion of forest conditions.

291 **Leiberg** (John B.). Forest conditions in the Little Belt Mountains Forest Reserve, Montana, and the Little Belt Mountains Quadrangle.

U. S. Geol. Surv., Prof. Paper no. 30, 75 pp., 1904.

Mentions springs under "Drainage conditions" in some of the township descriptions.

292 **Leighton** (Marshall Ora). Sewage pollution in the metropolitan area near New York City and its effect on inland water resources.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 72, pp. 75, 1902.

Discusses the normal composition of underground waters, including the normal chlorine, and mentions the loss of mechanical sediments and gain in material in solution in the passage of water into the ground.

293 **Leighton** (Marshall Ora). Normal and polluted waters in northeastern United States.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 79, pp. 192, 1903.

Notes the removal of albuminoid ammonia by natural filtration and discusses the normal composition, especially the chlorine constituent of ground and seepage waters. Points out the necessity of storing such waters in covered reservoirs on account of the abundant nitrates which favor algous growth (pp. 22–31).

294 —— Quality of water in the Susquehanna River drainage basin.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 108, 76 pp., 1904.

Describes coal mine waters (pp. 24–26) and the underground waters of the Chemung Valley of New York and Pennsylvania (pp. 51–52), the west branch of the Susquehanna (pp. 53–56) and the Juniata (pp. 63–65). Analyses of waters from mines, springs, wells, and streams are given.

295 **Leith** (Charles Kenneth), **Van Hise** (Charles Richard), **Clements** (J. Morgan) and. Iron-ore deposits of Lake Superior region.

See Van Hise (C. R.), and Leith (C. K.), and Clements (J. Morgan).

296 **Leith** (Charles Kenneth). The Mesabi iron-bearing district of Minnesota.

U. S. Geol. Surv., Mon., vol. 43, 316 pp., 1903.

Discusses the relation of water level to ores, waters in mines, etc. (pp. 234–235), the processes of alteration, including analyses (p. 265) and the laws of circulation (pp. 265–272). The ores are considered to have been derived from greenalite-bearing sedimentary rocks or from carbonates by the action of underground waters (pp. 237–238), the alteration taking place both above and below the water level. The presence of phosphates in waters from ores and the concentration of the ores by water is considered (pp. 274–275), and the influence of percolating water in the formation of other Lake Superior ores is noted (pp. 277–279).

297 —— Geologic work in the Lake Superior iron district, 1902.

U. S. Geol. Surv., Bull. no. 213, pp. 247–250, 1903.

Considers the relation of underground waters to ore deposition (pp. 249–250).

298 —— Iron ores in southern Utah.

U. S. Geol. Surv., Bull. no. 225, pp. 228–237, 1904.

Notes agency of percolating waters in ore deposition (p. 235).

299 —— The Lake Superior iron region during 1903.

U. S. Geol. Surv., Bull. no. 225, pp. 215–220, 1904.

Notes deposition of ores of Menominee district, Michigan, by circulating waters (p. 216).

300 **Leverett** (Frank). The water resources of Illinois.

U. S. Geol. Surv., 17th Ann. Rept., pt. 2, pp. 695–849, 1896.

Considers topography and drainage (pp. 703–717), rainfall (pp. 718–730), run-off (pp. 730–742), navigable waters (pp. 744–746), water powers (pp. 746–748), drift and shallow and deep rock wells, supplies for towns or cities (pp. 748–765), and rural supplies (pp. 765–782). A chapter is devoted to artesian wells, including a discussion of the geology and of the altitude, capacity, casing, head, and quality of water (pp. 785–818). A considerable number of analyses are given (pp. 819–829).

301 —— The water resources of Indiana and Ohio.

U. S. Geol. Surv., 18th Ann. Rept., pt. 4, pp. 419–559, 1897.

After considering the physical features, drainage, lakes, etc., of the region (pp. 426–474) a discussion of underground waters, including wells of the drift, shallow and deep rock wells, subterranean drainage lines, springs, analyses of the waters, etc., is given (pp. 474–501). This is followed by extended descriptions of the water supplies of cities and villages (pp. 502–559).

302 —— The Illinois glacial lobe.

U. S. Geol. Surv., Mon., vol. 38, 817 pp., 1899.

Gives a chapter on the wells of Illinois (pp. 550–787), in which a classification of underground waters, a discussion of artesian conditions, and detailed descriptions of the wells by counties, with many records, are included.

303 —— Wells of northern Indiana.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 21, pp. 82, 1899.

Gives maps showing distribution of drift and the relation of wells to the drift. Discusses the general conditions of underground supplies and describes and gives records of many wells, both flowing and nonflowing.

304 —— Wells of southern Indiana. (Continuation of Water Supply and Irrigation Paper no. 21.)

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 26, pp. 64, 1899.

Discusses the relations of wells to the geology, including both drift and rock, and describes and gives records of a large number of wells.

305 —— Danville folio, Illinois-Indiana. Underground water.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 67, pp. 7–9, 1900.

Gives a detailed discussion of underground waters and of wells, including both open and tubular, flowing and nonflowing, and drift and rock types. The problems of catchment and head are considered. More than a hundred records giving altitude, depth, head, etc., are included.

306 —— Glacial formations and drainage features of the Erie and Ohio basins.

U. S. Geol. Surv., Mon., vol. 41, 802 pp., 1902.

No special discussion of the waters of the drift is given, although many incidental references to wells and records are included, especially to the flowing wells of Ohio (see index of monograph).

307 **Lindgren** (Waldemar) and **Turner** (H. W.). Marysville folio, California.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 17, pp. 2, 1895.

Gives deep-well records at Marysville Buttes and discusses the value of wells as sources of water supply. Some of the water is charged with carbonates and sulphates.

308 **Lindgren** (Waldemar). The gold quartz veins of Nevada City and Grass Valley districts, California.

U. S. Geol. Surv., 17th Ann. Rept., pt. 2, pp. 1–262, 1896.

Notes the occurrence of strong ascending springs along the quartz veins (pp. 120–124), and ascribes the deposition of the ores to ascending thermal waters containing carbonates, silica, alkaline sulphates and sulphides, and metals (pp. 173, 262). Analyses of the water and deposits show carbonates and sulphates of Ca, Mg, Mn, As, Fe, Pb, Mo, etc., and silica (pp. 121–123). The amount of silica is compared with that of waters of Iceland geysers, Steamboat Springs, Nebraska, and Yellowstone National Park (p. 176).

309 —— The mining districts of the Idaho Basin and the Boise Ridge, Idaho.

U. S. Geol. Surv., 18th Ann. Rept., pt. 3, pp. 617–719, 1897.

Notes the occurrence of a hot mineral spring on a fault at Warm Spring (p. 667).

310 —— Boise folio, Idaho.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 45, pp. 7, 1898.

Notes the use of springs for irrigation (p. 1). The springs are especially numerous and copious in the sheeted granite area. Several large springs, some hot and weakly mineralized, occur in the Payette formation. The artesian wells of the granite and of the Neocene and Pleistocene formations, especially the Payette, are considered and the best locations discussed. The occurrence of hot artesian mineral waters near Boise is noted (p. 7).

311 —— The gold and silver veins of Silver City, De Lamar, and other mining districts in Idaho.

U. S. Geol. Surv., 20th Ann. Rept., pt. 3, pp. 65–256, 1899.

Describes silicious spring deposits with some gold and silver deposited by thermal waters at De Lamar (pp. 103–104), and the hydrothermal alteration of granite, basalt, and rhyolite are discussed from the chemical side (pp. 174–186). Notes the occurrence of hot artesian waters carrying gold and silver at De Lamar (p. 187), and mentions the deposition of ores by carbonated waters in the Wood River district (p. 217).

312 —— Colfax folio, California.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 66, pp. 10, 1900.

Mentions the numerous and copious springs of the igneous rocks and in the auriferous Neocene river gravels. They sometimes interfere seriously with mining (p. 10).

313 —— The gold belt of the Blue Mountains of Oregon.

U. S. Geol. Surv., 22d Ann. Rept., pt. 2, pp. 551–776, 1901.

Notes the occurrence of ascending thermal waters (p. 615) and describes thermal mineral springs and their deposits, giving analyses (pp. 641–642).

314 **Lindgren** (Waldemar.) The water resources of Molokai, Hawaiian Islands.

U. S. Geol. Surv., Water-Supply and Irrigation Paper, no. 77, pp. 62, 1903.

Discusses the physical conditions (p. 9–26), ground-water conditions, quality, etc. (pp. 26–28), low and high level springs (pp. 28–30), available ground water (pp. 47–49, 59), and the present and prospective uses for irrigation (p. 56). The wells, which are mostly shallow and uncertain as to the amount of water and as to the salt in solution, are described (pp. 37–47).

315 —— and **Drake** (N. F.). Nampa folio, Idaho-Oregon.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 103, pp. 5, 1904.

Gives a number of well records (p. 2), notes the work of hot springs in lake beds (p. 2), and describes the general occurrence of thermal springs, ground waters, and artesian wells (p. 5).

316 —— and **Drake** (N. F.). Silver City folio, Idaho.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 104, pp. 6, 1904.

Discusses in detail the occurrence of warm-spring and artesian waters and wells, giving a table of depths and temperatures of water of the latter (pp. 5–6).

317 **Lindgren** (Waldemar). A geological reconnaissance across the Bitteroot Range and Clearwater Mountains in Montana and Idaho.

U. S. Geol. Surv., Prof. Paper no. 27, pp. 116, 1904.

Describes the mineral springs of the region and their temperature, and notes their use for bathing, etc. (pp. 113–114).

318 —— and **Ransome** (Frederick Leslie). Report of progress in the geological resurvey of the Cripple Creek district, Colorado.

U. S. Geol. Surv., Bull. no 254, pp. 36, 1904.

Contains a section on underground waters in which depth of ground water and oxidation, mine waters, occurrence of water in joints of crystalline rocks, and drainage by tunnels are considered (pp. 31–32).

319 **Lippincott** (Joseph Barlow). Water supply of San Bernardino Valley.

U. S. Geol. Surv., 19th Ann. Rept., pt. 4, pp. 540–633, 1898.

Describes springs and their flow (pp. 563–564), and discusses the artesian wells fed by ground water and by underflow from San Antonio Creek (pp. 565–566).

320 —— Storage of water on Kings River, California.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 58, pp. 101, 1902.

Discusses the ground water of Kings River delta, from which abundant supplies are obtained (pp. 53–84), and gives statistical tables giving for the wells the depth, character of water-bearing beds, quality of water, methods of lifting, cost, and the amount, use, and saline contents of the waters. Seepage and its effect on ground-water level is noted (pp. 22–24, 80–82) and the alkalinity and replenishment of the ground water described (pp. 82–88).

321 **Lippincott** (Joseph Barlow). Development and application of water near San Bernardino, Colton, and Riverside, California. Part I.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 59, pp. 95, 1902.

Describes the artesian district (p. 22), the rate of underflow (p. 22), analyses (p. 23), details of artesian area, including amount and permanancy of supply (pp. 38–42), pumping (pp. 42–46), irrigation, springs and wells of Riverside district (p. 62), and wells of the Gage canal system (pp. 69–78).

322 —— Development and application of water near San Bernardino, Colton, and Riverside, California. Part II.

U. S. Geol. Surv., Water-Supply and Irrigation Paper, no. 60, pp. 102–141, 1902.

Discusses the artesian wells in the East Riverside district, in the Redlands and San Bernardino quadrangles, in the vicinity of Rincon, etc., and gives tables (pp. 115–134) showing type of wells, depth, height of water, character of strata, quality of water, method of lifting, quantity, and cost of water. Seepage in the San Bernardino Valley is also considered (pp. 108, 113).

323 —— California hydrography.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 81, pp. 488, 1903.

Describes the gravel fan at the base of the mountains at Pasadena Mesa. The gravel is saturated with water which is collected by wells and tunnels. Well statistics, including depth, flow, etc., are given (pp. 174–180).

324 **Lord** (Eliot). Comstock mining and miners.

U. S. Geol. Surv., Mon., vol. 4, 451 pp. 1883.

Gives a chapter on "The contest with water," describing the immense flows of thermal waters encountered and the methods of meeting the problems (pp. 230–244). Other incidental references to mine waters occur.

M.

325 **Martin** (George C.). Petroleum fields of Alaska and the Bering River coal fields.

U. S. Geol. Surv., Bull. no. 225, pp. 365–382, 1904.

Notes the occurrence of oil, gas, and sulphur springs (pp. 368, 378), and mentions the finding of large flows of water (p. 379). Underground water is assigned a part in the accumulation and distribution of ore (p. 369).

326 **Matthes** (Gerard H.). Grand River project [Colorado].

U. S. Geol. Surv., Second Ann. Rept. Reclamation Service, 1902–3, pp. 210–250, 1904.

Notes the settling of the ground because of accretions to the ground water through irrigation (pp. 213, 236).

327 **McCallie** (S. W.). Georgia. [Water supply, well, and spring records.]

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 207–236, 1904.

Gives tables showing the sources of public supplies (pp. 208–221) and tables and notes on wells (pp. 221–225) and springs (pp. 227–236). The data on public supplies includes source, quality, special uses, etc., on wells, the depth, head, quality, analyses, and yield; and on springs, quality, odor, taste, sediment, mineral deposits, yield, source, uses, improvements, and analyses.

328 **McGee** (W J). The geology of the head of Chesapeake Bay.

U. S. Geol. Surv., 7th Ann. Rept., pp. 537–646, 1888.

The investigation was made to determine the artesian conditions near Fishing Battery Station. Reviews the conditions necessary for artesian supplies and discusses the local structure and displacements in addition to a general consideration of Coastal Plain conditions. A moderate supply rising nearly to the surface is predicted from the Potomac sands (pp. 644–645).

329 —— Administrative report [1886–87].

U. S. Geol. Surv., 8th Ann. Rept., pt. 1, pp. 166–173, 1889.

Notes bearing of data collected at the head of Chesapeake Bay on artesian waters along the fall line.

330 —— Administrative report [1887–88].

U. S. Geol. Surv., 9th Ann. Rept., pp. 102–110, 1889.

Mentions the artesian well prospects of the Fort Riley Military Reservation, Kansas (p. 104), and notes an arrangement with A. J. Phinney to collect boring records in Indiana (p. 105).

331 —— Administrative report [1888–89].

U. S. Geol. Surv., 10th Ann. Rept., pt. 1, pp. 148–158, 1890.

Notes progress of the survey of the Fort Riley Military Reservation with a view of determining the water supply and other economic products (p. 154).

332 —— The Pleistocene history of northeastern Iowa.

U. S. Geol. Surv., 11th Ann. Rept., pt. 1, pp. 189–577, 1891.

Describes solution caverns in the Galena limestone and their ores (p. 329), and gives well sections in northeastern Iowa and adjacent portions of Illinois. They are mainly geological, but some notes on water are given (pp. 514–540).

333 —— Introduction: Rock gas and related bitumens. The natural gas field of Indiana, by Arthur John Phinney.

U. S. Geol. Surv., 11th Ann. Rept., pt. 1, pp. 589–616, 1891.

Notes the correspondence of laws governing the accumulation of the of lighter hydrocarbons and artesian waters and considers the requisites for artesian flows (pp. 603–604).

334 **McGee** (W J). The potable waters of the eastern United States.

U. S. Geol. Surv., 14th Ann. Rept., pt. 2, pp. 1–47, 1893.

Besides rain and stream water, the accumulation and utilization through wells or springs of shallow ground water (pp. 40–42), and the accumulation, underground conditions, etc., of "phreatic" or deep-seated waters of thermal springs and of artesian and other deep wells are considered, and local statistics given (pp. 42–47).

335 —— Administrative report [1892–93].

U. S. Geol. Surv., 14th Ann. Rept., pt. 1, pp. 210–244, 1893.

Notes work of the Survey on potable waters of wells and springs, the occurrence of artesian waters of District of Columbia, at Fortress Monroe, and at Crisfield, Maryland (pp. 216, 219), work on the artesian waters of Missouri (p. 232), and studies on general water supplies, including wells (p. 237). A summary of work on artesian waters is also given (p. 230).

336 **Mead** (Elwood). Water-right problems of the Bighorn Mountains.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 23, pp. 62, 1899.

Notes loss by seepage from Little Tongue River and loss through funnels, etc., in limestone (p. 49).

337 **Means** (Thomas H.). The use of alkaline waters for irrigation.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 93, pp. 255–258, 1904.

Notes the use of highly alkaline artesian waters for irrigation in Algiers (pp. 255, 258).

338 **Murphy** (Edward Charles). Windmills for irrigation.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 8, pp. 49, 1897.

In addition to the critical discussion of the use of windmills as a means of raising ground water for irrigation, a brief description is given of the wells near Garden, Kansas (p. 10).

339 —— The windmill: its efficiency and economic use. Part I.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 41, pp. 72, 1901.

Discusses the types and uses of windmills and gives the results of elaborate tests of their efficiency in raising ground water. The artesian wells near Garden, Kansas are also described (pp. 22–23).

340 —— The windmill: its efficiency and economic use. Part II.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 42, pp. 73–147, 1901.

Describes further tests relating to the efficiency of windmills in raising ground water to the surface.

341 **Murphy** (Edwin C.). Destructive floods in the United States in 1903.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 96, 81 pp., 1904.

In connection with the flood descriptions the author considers ground storage of water and its effect on the flow of streams (pp. 71–73.) Figures as to amount of porosity are given (p. 272).

N.

342 **Newell** (Frederick Haynes). Hydrography of the arid regions.

U. S. Geol. Surv., 12th Ann. Rept., pt. 2, pp. 213–361, 1891.

Discusses mainly the flow and uses of surface waters, but incidentally considers the wells of the Rio Grande Valley (pp. 247, 278), the large alkaline springs near Puerto de Luna (p. 284), the springs of Agua Negra (p. 205), Peers (p. 285), Berenda (p. 286), North Spring, Hondo, Block, and Seven rivers (p. 286), Gallinas springs (p. 287), and springs of the San Pedro district (p. 304). Lost and underground rivers are noted in several instances (pp. 232–234, 282, 287, 315).

343 —— Water supply for irrigation.

U. S. Geol. Surv., 13th Ann. Rept., pt. 3, pp. 1–99, 1892.

Estimates a total of 8,097 artesian wells in Western United States in 1890, 3,930 of which are used for irrigating 51,896 acres. In addition there is a still greater number of pumped wells (p. 28). The movement of water through rock and sediments and the use of underflow canals is considered (pp. 29–30). The use of seepage waters for irrigation near the Jefferson River, Montana (p. 52), and the deep wells at Helena (p. 55) are described.

344 —— Administrative report.

U. S. Geol. Surv., 15th Ann. Rept., pp. 196–198, 1895.

Describes work on artesian problems (p. 196).

345 —— Report of progress of the division of hydrography for the calendar years 1893 and 1894.

U. S. Geol. Surv., Bull. no. 131, pp. 126, 1895.

Contains an account of seepage along the Cache la Poudre River, Colorado, and the absorption of water by the bed of the Platte River (pp. 31–32). Tables of well records giving the location, year completed, diameter, depth, depth to water, cost of well and machinery, etc., for a large number of wells in Nebraska, Colorado, and Kansas are included (pp. 92–126).

346 —— The public lands and their water supply.

U. S. Geol. Surv., 16th Ann. Rept., pt. 2, pp. 457–533, 1896.

Gives information relating to the deep wells or springs of Arizona (p. 505), California (p. 509), Colorado (p. 511), Idaho (p. 512), Indian Territory (p. 512), valley of the Arkansas in Kansas (p. 514), of North Platte River, Nebraska (p. 517), New Mexico (p. 520), North Dakota (p. 521), Oklahoma (p. 522), South Dakota (p. 523), and of Texas (p. 524). Other subjects considered are supplies of streams from underground waters (p. 470), seepage (pp. 471, 529), pumping (p. 517), and wells as a source of supply for irrigation (pp. 499–502).

347 —— Report of progress of the division of hydrography for the calendar year 1895.

U. S. Geol. Surv., Bull. no. 140, pp. 356, 1896.

Mentions the springs of the sand-hill region of North Carolina (p. 65) and the San Marcos, San Felipe, Las Mosas, Leona, and the springs of Comal River and San Antonio, Texas (pp. 83–85). The seepage of the Ogden Valley, Utah (p. 223), the artesian supply of Caliente Valley, California (p. 267), the underground conditions and supply at Lindsay, California (p. 279), and seepage measurements in Nebraska (pp. 347–349) are also given.

348 **Newell** (Frederick Haynes). Preface. Pumping water for irrigation. By Herbert M. Wilson.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 1, pp. 11–13, 1896.

Defines scope and plan for the new series of papers of which this is the first, and gives a list of some of the surface and underground water problems under investigation.

349 —— Letter of transmittal: Hydrography.

U. S. Geol. Surv., 18th Ann. Rept., pt. 4, pp. VII–VIII, 1897.

Mentions work of Frank Leverett, N. H. Darton, and F. F. B. Coffin on underground waters.

350 —— Introduction: Hydrography.

U. S. Geol. Surv., 18th Ann. Rept., pt. 4, pp. IX–X, 1897.

Reviews work of Survey on streams and underground waters from 1888 to 1896.

351 —— Letter of transmittal: Underground waters of southwestern Kansas. By Erasmus Haworth.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 6, p. 9, 1897.

States object of investigatation.

352 —— Letter of transmittal: Seepage Water of northern Utah. By Samuel Fortier.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 7 (p. 9), 1897.

Gives a statement of the importance of underground seepage.

353 —— Letter of transmittal: Hydrography.

U. S. Geol. Surv., 19th Ann. Rept., pt. 4, pp. VII–VIII, 1898.

Describes work and papers of Edward Orton and N. H. Darton on underground waters of Ohio and Nebraska respectively.

354 —— Report of progress of stream measurements for the calendar year 1897.

U. S. Geol. Surv., 19th Ann. Rept., pt. 4, pp. 111, 539, 1898.

Describes or mentions the springs of Shenandoah Valley, Virginia, and the water supplies of the towns (p. 136), the catchment area of the Dakota sandstone and the artesian basins of the Arkansas Valley in Colorado, as investigated by G. K. Gilbert (p. 352), the hot springs of the Bitterroot Forest Reserve, Montana (p. 401), the artesian wells of the Moxee Valley, Washington (with records), and the large springs near the Deschutes River, a tributary of the Columbia basin, Washington (p. 497).

355 —— Letter of transmittal: Underground waters of a portion of southeastern Nebraska. By N. H. Darton.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 12, p. 9, 1898.

Describes character of the work and plans for future investigations.

356 **Newell** (Frederick Haynes). Introduction. Irrigation systems in Texas. By William Ferguson Hutson.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 13, pp. 9-16. 1898.

Considers in some detail the cost, capacity, and profit of pumping underground waters for irrigation.

357 —— Report of progress of stream measurements for the calendar year 1898.

U. S. Geol. Surv., 20th Ann. Rept., pt. 4, pp. 1-562, 1899.

Gives a summary of hydrographic investigations (p. 19) and describes the work on underground waters, artesian wells, pumping, and windmills (p. 44), and in the Black Hills and Bad Lands, by N. H. Darton (p. 252). Other topics relating to underground waters which are considered are the springs of Cache La Poudre River (p. 240), artesian wells of the Arkansas Valley, Colorado (p. 340), ground-water conditions in the Mississippi Valley (p. 350), use for irrigation and power of the springs of San Antonio River, Texas (p. 355), the hot sulphur waters of Steamboat Springs, California (pp. 384, 387), underground waters of the southern Ute Indian Reservation (p. 412), seepage in Boise Valley (p. 484), artesian well records, artesian wells of Moxee Valley, Washington (p. 508), artesian well discharge measurements (p. 509), underground water at Arroyo Seco and Pasadena Mesa, California, with records (pp. 543-549), and artesian wells of the San Bernardino Valley, California (p. 539).

358 —— Introduction. Experiments with windmills. By Thomas O. Perry.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 20, pp. 11-18, 1899.

Gives a general discussion of the uses of windmills in raising underground waters for irrigation and other purposes.

359 —— Letter of transmittal. Wells of northern Indiana. By Frank Leverett.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 21, p. 7, 1899.

States the nature of Mr. Leverett's work and gives reasons for publication in present form.

360 —— Letter of transmittal. Wells and windmills of Nebraska. By Erwin Hinckley Barbour.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 29, pp. 11-12, 1899.

Discusses the value of windmills, especially the home-made types, in developing underground waters.

361 —— Letter of transmittal. Hydrography.

U. S. Geol. Surv., 21st Ann. Rept., pt. 4, p. 7, 1900.

Notes the importance of work of N. H. Darton in the Black Hills region, South Dakota, and mentions that of W. D. Johnson on the High Plains.

362 **Newell** (Frederick Haynes). Report of progress of stream measurements for the calendar year 1899.

U. S. Geol. Surv., 21st Ann. Rept., pt. 4, pp. 9–488, 1900.

The report incidentally discusses the work of the Survey on underground waters (p. 27); the pumping of underground waters for irrigation in Georgia (p. 142); loss of water from the bed of Black Warrior River, Alabama (p. 152); the work of A. W. Palmer on the analysis of well and spring waters of Illinois (p. 178); springs of Yellowstone National Park (p. 190); ground water at Kearney, Nebraska (p. 26); springs at Mesa Verde and in cliff and Navajo Canyon, Colorado (p. 297); seepage in Mancos Canyon, Colorado (p. 294); artesian wells and seepage measurements in Arizona (pp. 252, 376, 379), and artesian or underground water in the San Antonio basin and along Lytle Creek and San Diego River, California (pp. 481, 482, 486).

363 —— Letter of transmittal. Hydrography.

U. S. Geol. Surv., 22d Ann. Rept., pt. 4, p. 7, 1901.

Mentions the paper of W. D. Johnson on "The High Plains and their Utilization."

364 —— Report of progress of stream measurements for the calendar year 1900.

U. S. Geol. Surv., 22d Ann. Rept., pt. 4, pp. 9–506, 1901.

Notes the value of artesian waters in desert lands (p. 49); mentions the springs near Johnson City, Tennessee, and gives analysis (pp. 231–233); describes the disappearance of water in sinks in the Thunder Bay region of Michigan (p. 261), and discusses the water resources, including artesian and other underground waters in southeastern Idaho (pp. 421–430), and in the Kings River Basin of California (pp. 479–480).

365 —— Letter of transmittal. Reconnaissance of Yuba River, California, by Marsden Manson.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 46, pp. 9–10, 1901.

Notes the advantages of wind and electric power in raising underground waters.

366 —— Letter of transmittal. Development and application of water near San Bernardino, Colton, and Riverside, California. Part 1, by Joseph Barlow Lippincott.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 59, pp. 95, 1902.

Discusses the resort to tunnels and wells for water supplies.

367 —— Letter of transmittal. The motions of underground waters. By Charles S. Slichter.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 67, pp. 106, 1902.

States the object and scope of the investigations of underground waters.

368 —— Letter of transmittal. Geology and water resources of the Patrick and Goshen Hole quadrangles in eastern Wyoming and western Nebraska. By George I. Adams.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 70, p. 9, 1902.

Points out the importance of the observations in the two quadrangles, which are typical of much of the public-land area in this region.

369 **Newell** (Frederick Haynes). Report of progress of stream measurements for the calendar year 1901.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 75, p. 246, 1903.

Describes the discharge of artesian wells in Moxee Valley, near North Yakima, Washington (pp. 204–205).

370 —— Report of progress of stream measurements for the calendar year 1902. Part 1, North Atlantic coast and St. Lawrence River drainage.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 82, pp. 199, 1903.

Discusses the necessity of data regarding depth, rate of flow, cost, etc., of artesian wells (p. 9).

371 —— Report of progress of stream measurements for the calendar year 1902. Part 2, southern Atlantic, eastern Gulf, and Great Lakes drainage.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 83, pp. 304, 1903.

Discusses the storage of water and possible loss by subterranean flow from sand belt of the Cape Fear basin, North Carolina (pp. 30, 60), the removal of ground water by ditching (p. 242), the ground waters north of Saginaw Bay, Michigan (p. 294), and the absorption of water by limestone in the Thunder Bay region, Michigan (p. 296).

372 —— Report of progress of stream measurements for the calendar year 1902. Part 3, western Mississippi River and western Gulf drainage.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 84, pp. 200, 1903.

Describes the character and flow of the large Barton Springs, near Austin, Texas (pp. 152–153), the Sloan Spring at the edge of the Edwards plateau, Texas (p. 155), and the San Felipe Springs at Del Rio, Texas (p. 161).

373 —— Report of progress of stream measurements for the calendar year 1902. Part 4, interior basin, Pacific coast, and Hudson Bay drainage.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 85, 250 pp., 1903.

Mentions inflow of rivers into Carson Sink, Nevada (pp. 78–79)

374 —— First Annual Report of the Reclamation Service.

June 17 to December 1, 1902, 317 pp. Atlas, 1903.

Quotes old laws authorizing investigation of underground currents and artesian waters (p. 36), and gives section of reclamation law covering the same point (pp. 61–63). Other underground-water topics treated are: Use of springs for irrigation in Idaho (p. 172), underflow in Kansas (p. 200), ground waters of Musselshell River basin, Montana (pp. 215–220), artesian investigations in Nebraska (p. 220), irrigation by underground waters (p. 196), springs of Nevada (p. 224), artesian waters of Oregon (p. 273) and South Dakota (p. 278), and artesian prospects on the Columbia p ains of Washington (p. 304).

375 **Newell** (Frederick Haynes). General discussion, organization, and summary of work.

U. S. Geol. Surv., 2d Ann. Rept. Reclamation Service, 1901-2, pp. 21-70, 1904.

Notes limitations imposed on Reclamation Service in regard to sinking deep wells (pp. 25-27, 39), and mentions pumping from underground waters in Kansas (p. 59).

376 —— Proceedings of first conference of engineers of the Reclamation Service with accompanying papers. Report of conference.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 93, pp. 1-116, 1904.

Mentions the work of Mr. N. H. Darton and of the western section of hydrology (p. 11), and gives an account of the organization of the hydrologic division (pp. 15, 16).

377 **Noble** (T. A.). Investigations in Washington.

U. S. Geol. Surv., 2d Ann. Rept. Reclamation Service, 1902-3, pp. 487-498, 1904.

Notes underground course of Crab Creek for most of course (p. 490).

O.

378 **Olmstead** (Frank H.). Physical characteristics of Kern River, California.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 46, pp. 11-38, 1901.

Describes the wells near Bakersfield which are perforated at each water horizon (p. 28).

379 **Orton** (Edward). The Trenton limestone as a source of petroleum and inflammable gas in Ohio and Indiana.

U. S. Geol. Surv., 8th Ann. Rept., pt. 2 (pp. 475-662), 1889.

Notes the penetration of surface waters into oil wells (p. 511) and the position of brine with reference to oil and gas. Analyses of salt water from the Trenton, Niagara, and Upper Helderberg, which form a special type of "limestone brines," are given. Some are used for bottling and medicinal purposes (p. 621). Notes the limitation of progress of water and oil by dolomitization (p. 644).

380 —— Rock waters of Ohio.

U. S. Geol. Surv., 19th Ann. Rept., pt. 4, pp. 633-717, 1898.

Discusses the geology (pp. 638-650) and considers the waters of the Trenton limestone, the Medina and Clinton horizons, Niagara, Onondaga, and Corniferous limestones, the Ohio shale, the rocks of the Waverly group, and the conglomerate and other Carboniferous beds (pp. 651-696). Flowing rock wells and artesian wells of buried glacial channels are described (pp. 697-717).

P.

381 **Parker** (Edward W.). Salt [1892].

U. S. Geol. Surv., Min. Res. of U. S., 1892, pp. 792-800, 1893.

Gives production of salt from wells, springs, and other sources for the year 1892.

382 **Parker** (Edward W.). Salt [1893].
U. S. Geol. Surv., Min. Res. of U. S., 1893, pp. 717–727, 1894.
Gives production of salt from wells, springs, and other sources for the year 1893.

383 —— Salt [1894].
U. S. Geol. Surv., 16th Ann. Rept., pt. 4, cont., pp. 646–657, 1895.
Gives production of salt from wells, springs, and other sources for the year 1894.

384 —— Salt [1895].
U. S. Geol. Surv., 17th Ann. Rept., pt. 3, cont., pp. 984–997, 1896.
Gives production of salt from wells, springs, and other sources for the year 1895.

385 —— Salt [1896].
U. S. Geol. Surv., 18th Ann. Rept., pt. 5, cont., pp. 1273–1314, 1897.
Gives production of salt from wells, springs, and other sources for the year 1896.

386 —— Salt [1897].
U. S. Geol. Surv., 19th Ann. Rept. pt. 6, cont., pp. 587–612, 1898.
Gives production of salt from wells, springs, and other sources for the year 1897.

387 —— Salt [1898].
U. S. Geol. Surv., 20th Ann. Rept., pt. 6, cont., pp. 667–688, 1899.
Gives production of salt from wells, springs, and other sources for the year 1898.

388 —— Salt [1899].
U. S. Geol. Surv., 21st Ann. Rept., pt. 6, cont., pp. 531–554.
Gives production of salt from wells, springs, and other sources for the year 1899.

389 —— Salt [1900].
U. S. Geol. Surv., Min. Res. of U. S., 1900, pp. 835–848, 1901.
Gives production of salt from wells, springs, and other sources for the year 1900.

390 **Peale** (Albert C.). Mineral waters.
U. S. Geol. Surv., Min. Res. of U. S., 1883–84, pp. 978–987, 1885.
Gives a list of mineral spring localities. States the output for 1883 as 47,289,743 gallons, with a value of $1,139,483, and for 1884 as 68,720,936 gallons, with a value of $1,665,490. Statistics of imports and exports are included.

391 —— Mineral waters.
U. S. Geol. Surv., Min. Res. of U. S., 1885, pp. 536–543, 1886.
A list of mineral spring localities and statistics of production, exports, and imports are given. The output for the year is given as 9,148,401 gallons, with a value of $1,312,845. The decrease in production is due to the exclusion of the artesian wells used for the public supply at Madison, Wisconsin.

392 **Peale** (Albert C.). Lists and analyses of the mineral springs of the United States (a preliminary study).

U. S. Geol. Surv., Bull. no. 32, pp. 235, 1886.

Discusses the flow, temperature, classification, and composition of 657 springs from 405 localities. One hundred and eighty-seven analyses are given. Seventy-four springs are developed as resorts and 72 are used commercially.

393 —— Mineral waters.

U. S. Geol. Surv., Min. Res. of U. S., 1886, pp. 715–721, 1887.

Includes the usual list of spring localities and statistics of production, imports, and exports. The total output for 1886 is given as 8,950,317 gallons, with a value of $1,284,070.

394 —— Mineral waters.

U. S. Geol. Surv., Min. Res. of U. S., 1887, pp. 680–687, 1888.

Spring localities are listed and statistics of production, import, and export given. The output for the year is placed at 8,259,609 gallons, with a value of $1,261,473.

395 —— Administrative report [1886–87].

U. S. Geol. Surv., 8th Ann. Rept., pt. 1, pp. 146–148, 1889.

Details progress of work on mineral waters and mentions papers published during the year.

396 —— Administrative report [1887–88].

U. S. Geol. Surv., 9th Ann. Rept., pp. 111–114, 1889.

Notes the preparation of a third paper on the statistics of mineral waters.

397 —— Administrative report [1888–89].

U. S. Geol. Surv., 10th Ann. Rept., pt. 1, pp. 130–132, 1890.

Mentions the work of Charles W. Redmond on mineral waters (p. 132).

398 —— Mineral waters.

U. S. Geol. Surv., Min. Res. of U. S., 1888, pp. 623–630, 1890.

The production for 1888 is stated as 9,578,648 gallons. Its value was $1,679,302. Both production and value show an increase over previous year. Other statistics and a list of springs are given.

399 —— Administrative report [1889–90].

U. S. Geol. Surv., 11th Ann. Rept., pt. 1, p. 82, 1891.

Mentions his assignment to the Eleventh Census to take charge of mineral waters.

400 —— Administrative report [1890–91].

U. S. Geol. Surv., 12th Ann. Rept., pt. 1, pp. 91–92, 1891.

Describes work on mineral waters for the Survey and for the Eleventh Census.

401 —— Administrative report [1891–92].

U. S. Geol. Surv., 13th Ann. Rept., pt. 1, p. 124, 1892.

Describes work ou mineral water statistics.

402 **Peale** (Albert C.). Mineral waters.

U. S. Geol. Surv., Min. Res. of U. S., 1889–90, pp. 521–536, 1892.

The number of springs reporting in 1889 was 258, their product 12,780,471 gallons, and the value of the water $1,748,458. In 1890, 273 springs reported an output of 13,907,418 gallons, with a value of $2,600,750. Other statistics and lists of springs are given.

403 —— Mineral waters.

U. S. Geol. Surv., Min. Res. of U. S., 1891, pp. 601–610, 1893.

This year 288 springs, with a production of 18,392,732 and value of $2,996,259, reported. Lists of springs and detailed statistics are presented.

404 —— Mineral waters.

U. S. Geol. Surv., Min. Res. of U. S., 1892, pp. 823–834, 1893.

In 1892 aggregate sales amounting to 21,876,604 gallons, with a value of $4,905,976, were reported by 283 springs. The usual statistics and lists of springs are included in the paper.

405 —— Mineral waters.

U. S. Geol. Surv., Min. Res. of U. S., 1893, pp. 772–794, 1894.

The number of springs reporting sales in 1893 was 330; the total amount sold, 23,544,495 gallons, and the value, $4,246,743. In addition to the usual statistics and list of commercial springs a list of springs used as resorts is given.

406 —— Natural mineral waters of the United States.

U. S. Geol. Surv., 14th Ann. Rept., pt. 2, pp. 49–88, 1894.

Discusses the history (pp. 53–57), origin (pp. 58–59), flow (pp. 59–61), source of mineralization (p. 61), relation to geology and geologic structure (pp. 62–64), classification (pp. 64–68), temperature (p. 68), composition (pp. 69–73), distribution (pp. 73–80), and uses of springs (pp. 80–81), and their development as resorts (pp. 81–88).

407 —— Mineral waters [1894].

U. S. Geol. Surv., 16th Ann. Rept., pt. 4, pp. 707–721, 1895.

A large falling off of production due to business depression is recorded. Total shipments in 1894 were 21,569,608 gallons, with a value of $3,741,846. Statistics of production, with summaries of exports and imports, are given.

408 —— Three Forks folio, Montana.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 24, pp. 5, 1896.

Describes sulphated alkaline saline thermal waters at Ferris Hot Springs, which resemble the Carlsbad Sprudel Springs. Other hot springs are mentioned (p. 5).

409 —— Mineral waters [1895].

U. S. Geol. Surv., 17th Ann. Rept., pt. 3, cont., pp. 1025–1044, 1896.

Gives product for 1895 as 21,463,543 gallons, a loss of 106,665 gallons from that of the previous year. The value, however, increased from $3,741,846 to $4,254,237. The product by States from 1883 to 1895 (pp. 1026–1031), lists of commercial springs (pp. 1031–1040), and statistics of imports and exports (pp. 1043–1044) are also given.

410 **Peale** (Albert C.). Mineral waters [1896].

U. S. Geol. Surv., 18th Ann. Rept., pt. 5, cont., pp. 1369–1389, 1897.

The statistics of production are given by States. The total sales in 1896 amount to 25,795,312 gallons, with a value of $4,136,192. These figures show a marked increase in volume, but a slight decrease in value. Lists of commercial springs and figures showing exports and imports are presented.

411 —— Mineral waters [1897].

U. S. Geol. Surv., 19th Ann. Rept., pt. 6, cont., pp. 659–685, 1898.

The year 1897 showed the largest number of springs yet reported, namely, 381. The production was 23,255,911 gallons, a slight decrease; but the value, which was $4,599,106, showed an increase over 1896. Production by States and districts, lists of commercial springs, and exports and imports are also given.

412 —— Mineral waters [1898].

U. S. Geol. Surv., 20th Ann. Rept., pt. 6, cont., pp. 747–769, 1899.

The output in 1898 is given as 28,853,464 gallons, with a value of $8,051,833, a large increase over 1897. Statistics of production by States, exports, imports, and lists of commercial springs are given.

413 —— Mineral waters [1899].

U. S. Geol. Surv., 21st Ann. Rept., pt. 6, cont., pp. 597–622, 1900.

Gives the product for 1899 as 39,562,136 gallons, with a value of $6,948,030; an increase of 10,708,672 gallons and decrease of $1,103,803. The products by States and districts, lists of commercial springs, imports, and exports are given.

414 —— Mineral waters.

U. S. Geol. Surv., Min. Res. of U. S., 1900, pp. 899–905, 1901.

Gives statistics of production, export and import, placing the total output as 47,558,784 gallons, with a value of $6,245,172. The number of springs reporting was 491.

415 [——] Mineral waters.

U. S. Geol. Surv., Min. Res. of U. S., 1901, pp. 961–966, 1902.

Gives statistics of production and of exports and imports. The total output for the year is given as 55,771,188 gallons, with a value of $7,586,962. The number of springs reporting was 659.

416 [——] Mineral waters [1902.]

U. S. Geol. Surv., Min. Res. of U. S. for 1902, pp. 993–1002, 1904.

Gives product for 1902 as 64,859,451 gallons, with a value of $8,793,761. The number of springs (721), output, and value all show an increase over the previous year.

417 [——] Mineral waters [1903.]

U. S. Geol. Surv., Min. Res. of U. S. for 1903, pp. 1137–1162, 1904.

The production of 725 springs is estimated at 51,242,757 gallons, valued at $9,041,078. The number of springs and value is the greatest ever recorded. A list of the springs of the United States is given.

418 **Penrose**, Jr. (R. A. F.). Mining geology of the Cripple Creek district, Colorado.

U. S. Geol. Surv., 16th Ann. Rept., pt. 2, pp. 111–209, 1896.

Considers the part of underground waters in ore deposition (p. 160).

419 **Peppel** (S. V.). Gypsum deposits in Ohio.

U. S. Geol. Surv., Bull. no. 223, pp. 38–44, 1904.

Notes sulphuratted hydrogen in gypsum mines and bore holes (p. 39), and gives record of boring (p. 43).

420 **Perkins** (George H.). Vermont. [Town water supplies, analyses, and well and spring records.]

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 73–93, 1904.

Gives tables showing sources of water of towns and cities (pp. 73–76), a large number of sanitary analyses of public and other supplies (pp. 77–81), tables and notes relating to wells (pp. 83–87), and to springs (pp. 87–93). The well data includes quality, yield, source of supply, and records; the spring data, yield, quality, source of water, temperature, and uses.

421 **Perry** (Thomas O.). Experiments with windmills.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 20, pp. 97, 1899.

A general description of experiments resulting in several improvements in the methods of raising ground water by windmills.

422 **Phinney** (Arthur John). The natural-gas field of Indiana.

U. S. Geol. Surv., 11th Ann. Rept., pt. 1, pp. 579–742, 1891.

Gives a large number of boring records, mainly geological. Discusses the relation of water to oil and gas, noting the rise of salt water to an average level of 600 feet (pp. 654–655), and ascribes the change of surface waters to brines (p. 656). The Trenton limestone is a great reservoir for water under hydrostatic pressure (pp. 656–663), the flow depending on porosity (pp. 657–658). A table of water pressures is given (p. 663).

423 **Pirsson** (Louis Valentine), **Weed** (Walter Harvey) and. Geology of the Castle Mountain mining district, Montana.

U. S. Geol. Surv., Bull. no. 139, p. 104, 1896.

See Weed (Walter H.) and Pirsson (Louis Valentine).

424 —— **Weed** (Walter Harvey) and. Geology and mineral resources of the Judith Mountains of Montana.

U. S. Geol. Surv., 18th Ann. Rept., pt. 3, pp. 437–616, 1897.

See Weed (Walter Harvey) and Pirsson (Louis Valentine).

425 **Plummer** (Fred G). Mount Rainier Forest Reserve, Washington.

U. S. Geol. Surv., 21st Ann. Rept., pt. 5, pp. 81–143, 1900.

Describes soda-iron-sulphur springs, giving analysis (pp. 94–96).

426 —— Forest conditions in the Cascade Range, Washington.

U. S. Geol. Surv., Prof. Paper no. 6, p. 42, 1902.

Describes a number of important common and hot soda and sulphur springs and gives an analyses of the water. Hotels using the waters for medicinal and bathing purposes are located at Hot Springs and Madison (pp. 37–39).

427 **Plummer** (Fred G.). Forest conditions in the Cascade Forest Reserve, Oregon: Central portion of Cascade Range Forest Reserve.

U. S. Geol. Surv., Prof. Paper no. 9, pp. 71–146, 1903.

Describes Breitenbush Hot Springs, Belknap Springs, and other hot and sulphur springs used for bathing, etc. The spring deposits are also described and an analysis of the water given (pp. 77–78).

428 —— Introduction: Forest conditions in the San Francisco Mountains Forest Reserve, Arizona.

U. S. Geol. Surv., Prof. Paper no. 22, pp. 11–35, 1904.

Mentions the sparing occurrence of springs and the absorption of water by the lava beds (pp. 16, 31).

429 —— and **Gowsell** (M. G.). Forest conditions in the Lincoln Forest Reserve, New Mexico.

U. S. Geol. Surv., Prof. Paper no. 33, 47 pp., 1904.

Mentions mineral wells (p. 17) and contains important references to common wells at a number of places.

430 **Powell** (John Wesley). Report of the Director [1883–84].

U. S. Geol. Surv., 5th Ann. Rept., pp. I–XXXVI, 1885.

Mentions the work of Dr. A. C. Peale on the preparation of a bibliography of thermal springs.

431 —— Report of the Director [1885–86]: Work in the Division of Mining Statistics and Technology.

U. S. Geol. Surv., 7th Ann. Rept., pp. 38–39, 1888.

The output of mineral waters in 1885 is given as 9,148,401 gallons, with a value of $1,312,845.

432 —— Report of the Director [1886–87].

U. S. Geol. Surv., 8th Ann. Rept., pp. 1–93, 1889.

Designates the work of Gooch and Whitfield on the mineral waters of the Yellowstone National Park as "the most complete study of mineral waters of any locality with special reference to their agency in mineral formation ever placed on record" (p. 84). Gives the product of mineral waters for 1886 as 8,950,317 gallons, with a value of $1,284,070 (p. 86).

433 —— Report of the Director [1887–88].

U. S. Geol. Surv., 9th Ann. Rept., pp. 1–46, 1889.

Notes the progress of work in the Yellowstone National Park (p. 16), and mentions the work of A. C. Peale on mineral waters (p. 21). The product of mineral waters for 1887 is stated as 8,259,609 gallons, with a value of $1,261,473 (p. 26).

434 —— Report of the Director [1888–89].

U. S. Geol. Surv., 10th Ann. Rept., pt. 1, pp. 3–80, 1890.

Describes the work in Yellowstone National Park and notes changes and irregularites of geyser action. The discovery of the sulphide of arsenic in the spring waters is announced (pp. 24–25). The extravasation of thermal waters in Florida is mentioned (p. 33). The product of mineral waters for 1888 is given as 9,628,568 gallons, with a value of $1,709,302.

435 **Powell** (John Wesley.) United States Irrigation Survey, First Annual Report, 1888–89.

U. S. Geol. Surv., 10th Ann. Rept., pt. 2, pp. 123, 1890.

Describes the transfer of surface streams to underground courses (p. 26).

436 —— Report of the Director [1889–90].

U. S. Geol. Surv., 11th Ann. Rept., pt. 1, pp. 1–30, 1891.

Gives the product of mineral waters in 1889 as 20,000,000 gallons, with a value of $3,000,000 (p. 20). Notes the discovery of oil and gas by borings suggested by the escape of gas from springs (p. 26).

437 —— United States Irrigation Survey, Second Annual Report, 1889–90.

U. S. Geol. Surv., 11th Ann. Rept., pt. 2, pp. 395, 1891.

Mentions and defines artesian reservoirs and "sand reservoirs" of underground waters (pp. 204–205). Notes the disappearance by absorption of Saginaches River of the Rio Grande Basin (p. 216). Describes the basins, water horizons, conditions, and sources of water of the artesian wells of the Dakotas (pp. 257–260), and makes a prediction that artesian reservoirs will not furnish important supplies for irrigation (p. 260). General artesian conditions, the Denver Basin of Colorado, the Dubuque wells of Iowa, the Chicago and Rockford wells of Illinois, the wells of Ohio and of Alabama are also considered (pp. 260–262). Other subjects discussed are irrigation from wells in Algeirs and other foreign countries, and the Dakota sandstone as a source of artesian waters. Lists of wells in Minnesota, North Dakota, South Dakota, Nebraska, Kansas, and Texas are given and the prediction made that pump wells will prove of more ultimate value than artesian wells.

438 —— Report of the Director [1890–91].

U. S. Geol. Surv., 12th Ann. Rept., pt. 1, pp. 1–19, 1891.

The output of mineral waters for 1890 is stated as 14,000,000 gallons, with a value of $2,000,000 (p. 15).

439 —— Report of the Director [1891–92].

U. S. Geol. Surv., 13th Ann. Rept., pt. 1, pp. 1–66, 1892.

Describes investigations of temperatures in deep well at Wheeling, West Virginia (p. 37), and mentions work on underground waters in Colorado, Florida, Iowa, Kansas, Louisiana, Montana, New Jersey, South Dakota, Texas, Virginia, and Washington (pp. 33–34). The output of mineral waters for 1891 is given as 18,392,732 gallons, with a value of $2,996,259 (pp. 45, 51).

440 —— Report of the Director [1892–93].

U. S. Geol. Surv., 14th Ann. Rept., pt. 1, pp. 1–165, 1893.

Mentions the work of F. H. Newell on artesian and underground waters in South Dakota, Nebraska, and Kansas (p. 20), and of A. C. Peale on thermal and mineral springs (p. 25). The work of the Survey on geysers and hot springs, and on temperature observations in the Wheeling deep well is described (pp. 158–159). The unreliability of underflow is pointed out (p. 47).

441 **Powell** (John Wesley). Report of the Director [1893–94].

U. S. Geol. Surv., 15th Ann. Rept., pp. 1–108, 1895.

Gives the production of mineral waters for 1893 as 23,544,495 gallons, with a value of $4,246,734 (p. 72). Contains an abstract of Bull. no. 108, "A geological reconnaissance in central Washington, by Israel C. Russel" (p. 101).

442 **Pressey,** (Henry Albert). Hydrography of the southern Appalachian Mountain Region. Part 1.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 62, pp. 95, 1902.

Describes or mentions springs of Grandfather Mountain, North Carolina (p. 19), Holsten River region, Tennessee (p. 40), Indian Creek, Tennessee (p. 54), Mill Creek, Virginia (p. 68), Hogthief Creek, Virginia (p. 74), and Watauga River, Tennessee (p. 82). The springs of Indian Creek are used for power (p. 54). An underground lakelet and sinks in the Watauga River region (p. 82) and sinks along Buffalo Creek, Tennessee (p. 87), are mentioned.

443 —— Hydrography of the southern Appalachian Mountain Region. Part 2.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 63, pp. 190, 1902.

Notes common, hot, and mineral springs, and sinks of the French Broad in North Carolina and Tennessee (pp. 116–122) and describes the Piedmont mineral springs and others of Upper Creek, North Carolina (p. 156). Also refers to springs of Grandfather Mountain, North Carolina (p. 158).

444 —— New York City folio, New York-New Jersey. Water supply of New York City.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 83, pp. 17–19, 1902.

Gives a history of the development of the public supplies, including descriptions of the early wells. Mentions the well supply of Elizabeth and notes the occurrence of strong wells in the Newark formation, as at Pattison. Describes the ground-water well supplies of Brooklyn and the boroughs of Queens and Richmond, and discusses the availability of the ground water and streams of Long and Staten islands as sources of additional supplies.

445 **Prosser** (Charles S.) and **Beede** (J. W.). Cottonwood Falls folio, Kansas.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 109, pp. 6, 1904.

Describes springs of Wriford limestone (p. 3).

446 **Purdue** (A. H.). Arkansas. [Well and spring records.]

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 374–388, 1904.

Discusses the general underground water conditions (pp. 374–375) and gives tables and notes on wells (pp. 376–384) and springs (pp. 385–388). The well statistics include depth, head, yield, quality (including analyses), records, and uses; the spring data, temperature, quality (including analyses), yield, source, uses, etc.

447 **Purington** (Chester Wells). Preliminary report of the mining industries of the Telluride quadrangle, Colorado.

U. S. Geol. Surv., 18th Ann. Rept., pt. 3, pp. 745–850, 1897.

Discusses the origin of heated waters and their work in vein formation (pp. 819–824), and considers the relation of ground-water level to mining (p. 826). Springs depositing iron oxides at Ophir Valley and in the La Plata Mountains are described (pp. 826–827).

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448 **Raborg** (William A.). Salt.

U. S. Geol. Surv., Min. Res., 1886, pp. 628–641, 1887.

The brines of the wells of Michigan and the springs and wells of New York are discussed.

449 —— Salt.

U. S. Geol. Surv., Min. Res., 1887, pp. 610–625, 1888.

The brines of the wells of West Virginia and Ohio and of the springs and wells of New York are considered and analyses given of the Ohio waters.

450 —— Salt.

U. S. Geol. Surv., Min. Res., 1888, pp. 597–612, 1890.

Salt wells of New York and Kansas are listed and described and the composition of brines discussed.

451 —— Salt.

U. S. Geol. Surv., Min. Res., 1889–1890, pp. 483–492, 1892.

Gives information pertaining to the salt wells of Michigan and New York.

452 **Rafter** (George W.) Sewage irrigation.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 3, pp. 100, 1897.

Discusses removal of suspended matter and bacteria of sewage waters in passage downward into the earth.

453 —— Sewage irrigation. Part 2.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 22, pp. 100, 1899.

Gives mechanical analyses of sands in relation to their water-holding capacities (pp. 31–33).

454 —— Water resources of the State of New York. Part 1.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 24, pp. 99, 1899.

Discusses the relation of character of rock to absorption of rainfall (pp. 21–22) and describes big springs near Morris Run, Wyoming County, and Canadaway Creek, Chautauqua County (pp. 93–94).

455 —— Water resources of the State of New York. Part 2.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 25, pp. 100–200, 1899.

Describes leakage from Glen Falls, feeder of Erie Canal, into limestone, amounting to 53 per cent of volume (pp. 159–160), and discusses the loss of water by absorption, etc., from artificial channels (pp. 173–178). Describes the wells of Long Island, both deep and shallow, including the flowing wells of the Brooklyn Water Company and the wells of the sand areas (pp. 191–198).

456 **Rafter** (George W.). The relation of rainfall to run-off.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 80, pp. 104, 1903.

Discusses the variations of level of ground water (p. 17), storage of water in soils, and feeding of streams (pp. 43–45) and movements of underground waters (p. 45). Underground streams or channels are noted in Mammoth and Lauray caves, and near Toyah Creek, Texas, and in the upper Mohawk region in Schoharie County, New York.

457 **Ransome** (Frederick Leslie), **Turner** (H. W.) and. Sonora folio, California.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 41, pp. 7, 1897.

See Turner (H. W.) and Ransome (F. L.).

458 **Ransome** (Frederick Leslie). Some lava flows of the western slope of the Sierra Nevada, California.

U. S. Geol. Surv., Bull. no. 89, pp. 74, 1898.

Describes strong springs from andesitic breccias (p. 22).

459 —— and **Turner** (H. W.). Big trees folio, California.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 51, pp. 8, 1898.

See Turner (H. W.) and Ransome (F. L.).

460 **Ransome** (Frederick Leslie). The ore deposits of the Rico Mountains, Colorado.

U. S. Geol. Surv., 22d Ann. Rept., pt. 2, pp. 229–397, 1901.

Regards the ores to have been derived from the rocks by percolating thermal waters (p. 302) and considers their deposition in blankets to have taken place when there was solution and caving of the gypsum beds, etc. (pp. 294–303).

461 —— A report on the economic geology of the Silverton quadrangle, Colorado.

U. S. Geol. Surv., Bull. no. 182, pp. 265, 1901.

Assigns the deposition of ores to ascending mineralized waters along fissures (p. 133) and discusses the descending sulphurous waters of the Red Mountain region (p. 135), the relation of ground waters to mining (p. 141), the mineral waters of mines (p. 113), and the ferruginous springs of the region. The limonite deposits of the last are described and an analyses of the waters given (pp. 113–114).

462 —— Geology of the Globe copper district, Arizona.

U. S. Geol. Surv., Professional Paper no. 12, pp. 168, 1903.

Ascribes origin of ore to deposition by ascending, originally meteoric, solutions. Original sulphides were later enriched by oxidation by superficial waters (pp. 128–132).

463 —— The geology and ore deposits of the Bisbee quadrangle, Arizona.

U. S. Geol. Surv., Professional Paper no. 21, pp. 168, 1904.

Gives a number of well sections (pp. 74–75), notes trouble with mine waters (p. 119), and discusses the relation of ground water to oxidation (pp. 145–146) and to ore deposition (pp. 134, 153–154).

463a **Ransome** (Frederick Leslie). Globe folio. Arizona.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 111, pp. 17, 1904.

Notes the relation of underground waters to ore deposition (p. 16), and describes the absorption of streams and the occurrence of springs and wells (p. 17).

464 —— **Lindgren** (Waldemar) and. Report of progress in the geological resurvey of the Cripple Creek district, Colorado.

U. S. Geol. Surv., Bull. no. 254, pp. 36, 1904.

See Lindgren (Waldemar) and Ransome (Frederick Leslie).

465 **Ransome** (Frederick Leslie) Bisbee folio. Arizona.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 112, pp. 17, 1904.

Considers ground water and its relation to alteration of ores, discusses the part of water in ore formation, and describes the artesian waters, wells, and springs of the vicinity (pp. 16–17).

466 **Reed** (W. M.). Water storage on Hondo River, New Mexico.

U. S. Geol. Surv., 2d Ann. Rept. Reclamation Service, pp. 380–387, 1904.

Notes importance of springs and artesian waters (p. 381).

467 **Richardson** (George B.). Indiana folio. Pennsylvania.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 102, pp. 7, 1904.

Gives deep-well record (p. 2), describes the occurrence of artesian waters in synclines and their use for town supplies, etc. (p. 7).

468 **Ries** (Heinrich). The clays of the United States east of the Mississippi River.

U. S. Geol. Surv., Prof. Paper no. 11, 298 pp., 1903.

Gives a number of sections of rocks, including clay shales in Pennsylvania, Ohio, West Virginia, and Virginia, some apparently being based in whole or in part on borings.

469 **Rixon** (Theodore F.), **Dodwell** (Arthur) and. Forest conditions in the Cascade Forest Reserve, Oregon; Cascade Range Forest Reserve between townships 18 and 29 south.

U. S. Geol. Surv., Prof. Paper no. 9, pp. 147–227, 1903. See Dodwell (Arthur) and Rixon (Theodore F.).

470 **Rixon** (Theodore), **Leiberg** (John B.), and **Dodwell** (Arthur). Detailed description [of timber of townships]. Forest conditions in the San Francisco Mountains Forest Reserve, Arizona.

U. S. Geol. Surv., Prof. Paper no. 22, pp. 35–91, 1904.

See Leiberg (John B.), Rixon (Theodore), and Dodwell (Arthur).

471 **Rizer** (H. C.) The United States Geological Survey; its origin, development, organization, and operations.

U. S. Geol. Surv., Bull. no. 227, 205 pp., 1904.

Notes the work of the section of chemistry on spring waters (p. 51), and gives an account of the early work of the Survey on underground waters and the organization and present work of the division of hydrology (pp. 84–88). Mention is made of work in New York, New Jersey, Georgia, Louisiana, Arkansas, Missouri, Minnesota, Wisconsin, Arizona, California, and the Dakotas. A list of survey publications is appended.

472 **Robbins** (S. B.) Reconnaissance on Musselshell River, [Montana].

U. S. Geol. Surv., 2d Ann. Rept. Reclamation Service, pp. 252–254, 1904.

Mentions the occurrence of springs, underflow, and waters available for shallow wells (p. 353).

573 **Ross** (D. W.). Investigations in Idaho.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 93, pp. 174–176, 1904.

Notes the absorption of streams by great lava flows and the breaking out of springs in canyons (p. 174).

474 **Russell** (Israel Cook). Sketch of the geological history of Lake Lahontan.

U. S. Geol. Surv., 3d Ann. Rept., pp. 189–237, 1883.

Discusses the theoretical structure of spring deposits as compared with Lake Lahonton deposits (p. 219).

475 —— A geological reconnaissance in southern Oregon.

U. S. Geol. Surv., 4th Ann. Rept., pp. 431–464, 1883.

Describes the association of hot springs and faults in the Stein Mountains at Warner and Sumner lakes, and in Surprise Valley. Regards high temperature to have resulted from the arrested motion of orographic blocks, and that hot springs outside the volcanic areas may be taken as indicating recent faults (pp. 445–452).

476 —— Geological history of Lake Lahontan, a Quaternary lake of northwestern Nevada.

U. S. Geol. Surv., Mon., vol. 11, pp. 288, 1885.

Discusses recent and extinct springs at some length (pp. 47–54), describing hillside and fissure types, hot springs and their deposits, temperature of springs, and composition (including analyses). The occurrence of springs on fault lines is noted (pp. 53, 276, 279, 283) and springs in lakes described (pp. 220–222). The chemistry of spring water and their gases, including analyses, is considered (pp. 175–178), and the tufa deposits mentioned (pp. 187, 220–222). Brines of wells and springs are also treated (pp. 232–235).

477 —— Quaternary history of Mono Valley, California.

U. S. Geol. Surv., 8th Ann. Rept., pt. 1, pp. 261–394, 1889.

Describes the numerous and copious cold and warm springs of the ordinary and of the fissure or fault type, giving analyses. The sublacustral springs forming strong eddies in the lake and building up tufa cones are of special interest. In general the waters are pure and deposits are not now forming. One spring is frequently sufficient to irrigate several acres. The hot springs are taken to indicate that the volcanic energy which resulted in the extrusion of the Mono craters is not yet entirely dissipated (pp. 285, 287, 292, 373).

478 —— Subaerial decay of rocks and origin of the red color of certain formations.

U. S. Geol. Surv., Bull. no. 52, pp. 65, 1889.

The hard and brackish quality of water in wells near trap dikes is noted (p. 17) and the action of percolating waters in the decay of rocks considered (p. 30).

479 **Russell** (Israel Cook). Correlation papers. The Newark system.
U. S. Geol. Surv., Bull. no. 85, pp. 344, 1892.
Gives shaft and boring sections at Carbon Hill and Midlothian, Virginia (p. 39).

480 —— A geological reconnoissance in central Washington.
U. S. Geol. Surv., Bull. no. 108, pp. 108, 1893.
The investigation was undertaken to determine the prospects for artesian waters. The paper describes the existing wells and the stratigraphy, structure, etc., affecting artesian prospects. The lavas beneath the clays are tilted and broken, and broad basins are impossible, although local basins in or above the basalt are described. The water beds are also tapped occasionally by drainage. Among the topics considered are flowing and deep wells (pp. 13, 39, 44), well sections (p. 56), fissures and faults in relation to springs and artesian wells (pp. 35, 40, 59), principles of artesian water (pp. 32–36), artesian prospects (pp. 39, 50, 63, 66), putrefaction by percolating waters (p. 47), location of test wells (p. 50), artesian water of Moxee Valley and its source (pp. 53–60), temperature of waters (p. 59), and waters of the John Day beds (p. 36).

481 —— A reconnoissance in southeastern Washington.
U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 4, pp. 96, 1897.
Discusses artesian principles (pp. 75–78) and local conditions (pp. 70, 78), and describes wells in basalt (pp. 49, 79–83), alluvium (p. 85), and the infiltration works at Walla Walla (p. 86). Concludes that the artesian area in Palouse region may be extended westward, but that successful wells are not likely in the uplands south of Snake River, and prospects are doubtful in the canyons. The conditions in the valley of the Walla Walla, however, are more favorable.

482 —— Water resources of a portion of southeastern Idaho.
U. S. Geol. Surv., 22d Ann. Rept., pt. 4, pp. 421–430, 1901.
Describes the physical characters of the region and notes the occurrence of large springs (p. 427). Discusses the occurrence of artesian waters between or beneath the deformed lava beds of the Snake River region (pp. 428–430).

483 —— Geology and water resources of Nez Perce County, Idaho. Part 1.
U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 53, pp. 85, 1901.
This paper is devoted mainly to the discussion of topography, geology, and soils. Wells are described on pages 15, 36, and 38, and springs on pages 20, 27, 33, 36, 38, 39, 80, and 81. The water capacity of the lava (p. 32) and the water sheets are mentioned in connection with the descriptions of the geologic formations, and the artesian areas are defined (pp. 35, 40–42). Solution basins are mentioned (pp. 83–84).

484 —— Geology and water resources of Nez Perce County, Idaho. Part 2.
U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 54, pp. 54–141, 1901.
Among the topics discussed are springs (pp. 96–97), horizontal wells (pp. 98–101), artesian well principles (pp. 101–104), artesian basins (pp. 104–115), methods of well construction (pp. 109–110, 115–119), bibliography of artesian waters (pp. 130–131), temperatures (pp. 106, 109), and regulation of flow (pp. 118–119).

485 **Russell** (Israel Cook). Geology and water resources of the Snake River plains of Idaho.

U. S. Geol. Surv., Bull. no. 199, pp. 192, 1902.

In addition to the geology the following topics are considered: (1) Springs, including spring conditions as represented by hillside, canyon, fissure, and cavern types (pp. 149–152, 162–171), together with their temperature and relation to geology (pp. 152–154); (2) artesian conditions (pp. 156–8); (3) surface, rock, and artesian wells, including records and temperature (pp. 173–178), imperfections of casing, etc. (p. 178); (4) The Lewis artesian basin (p. 178); (5) the Shoshone artesian slope (p. 180); (6) the flowing wells of the alluvium (p. 181); and the probable conditions beneath the eastern portion of the plains (p. 183). The full water supply is not yet developed, the streams not all being utilized. Wells are advised in Lewis and Shoshone basins and at "Hagerman bend," but great care should be taken to properly test each stratum and to see that the wells are properly cased (p. 184–185).

486 —— Preliminary report on artesian basins of southwestern Idaho and southeastern Oregon.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 78, pp. 53, 1903.

Discusses briefly the essential conditions (pp. 10–14) and surface indications (pp. 14–15) of artesian flows, and gives detailed descriptions of the wells and springs of the Lewis, Otis, Harney, and Whitehouse basins (pp. 24–44), and of wells in alluvium (pp. 44–45). The geology of the region (pp. 16–24), the proper size and casing of wells (pp. 45–47), and existing and proposed laws are also considered (pp. 47–49), and a bibliography of important papers on underground waters given (pp. 50–51).

487 —— Notes on the geology of southwestern Idaho and southeastern Oregon.

U. S. Geol. Surv., Bull. no. 217, pp. 83, 1903.

Describes common and hot springs and artesian wells, the waters of which are used for irrigation, baths, and heating purposes (pp. 23–24). The Lewis, Otis, Harney, and Whitehouse artesian basins are discussed, and their wells, prospects, and the relation of the water to petrology considered (pp. 25, 69–79).

488 —— Preliminary report on artesian basins in southwestern Idaho and southeastern Oregon.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 78, pp. 53, 1903.

The springs and wells, including the volume, temperature, and use of well water for irrigation are considered for the Lewis, Otis, Harney, and Whitehouse artesian basins (pp. 24–44). Special subjects discussed are artesian conditions (pp. 10–14), surface indications of water (pp. 14–15), geology of supplies (pp. 16–24), artesian wells in alluvium (pp. 44–45), well construction (pp. 45–46), necessity of records (pp. 46–47), needed laws (pp. 47–49), and literature relating to underground waters (pp. 50–51).

489 **Russell** (W. G.). Investigations in Kansas.

U. S. Geol. Surv., 2d Ann. Rept. Reclamation Service, 1902–3, pp. 326, 1904.

Describes two artesian wells at Meade, Kansas (p. 1327), and mentions springs in Cimarron River Valley.

S.

490 **Salisbury** (R. D.) **Chamberlin** (T. C.) and. Preliminary paper on the Driftless Area of the upper Mississippi Valley.

U. S. Geol. Surv., 6th Ann. Rept., pp. 199–322, 1885.

See Chamberlin (T. C.) and Salisbury (R. D.).

491. **Schmeckebier** (L. F.). Catalogue and index of the publications of the Hayden, King, Powell, and Wheeler Surveys.

U. S. Geol. Surv., Bull. no. 222, pp. 208, 1904.

The subject index includes entries of water analyses, artesian waters, artesian wells, springs, and other subjects relating to underground waters.

492. **Shaler** (Nathaniel S.). Report on the geology of Marthas Vineyard.

U. S. Geol. Surv., 7th Ann. Rept., pp. 297–363, 1888.

Mentions sulphur and chalybeate springs in the Tertiary clays at Gay Head and estimates that a flow of several thousand gallons per minute could be developed by proper methods.

493 —— The geology of Nantucket.

U. S. Geol. Surv., Bull. no. 53, pp. 55, 1889.

Mentions the springs near Polpis Harbor (p. 17) and notes the absorption of water by the gravels (pp. 14, 17, 19).

494 —— The origin and nature of soils.

U. S. Geol. Surv., 12th Ann. Rept., pt. 1, pp. 213–345, 1891.

Among the points discussed are: Relations of ground-water to soils (pp. 254–255), formation of caverns (p. 256), hot spring conditions (p. 258), rise of water by capillarity (p. 259), chemical character of ground water (pp. 260, 294), effect of variations of water level on soils (pp. 261, 341), crusts formed by the evaporation of ground water (p. 307), and contamination of well supplies (pp. 342).

495 —— The glacial brick clays of Rhode Island and southeastern Massachusetts: Origin and character of the clays.

U. S. Geol. Surv., 17th Ann. Rept., pt. 1, pp. 957–974, 1896.

Describes the mud springs or mud volcanoes in the clays and ascribes them to the escape of gases arising from the decay of buried vegetable matter (p. 971).

496 —— Geology of the Cape Cod district.

U. S. Geol. Surv., 18th Ann Rept., pt. 2, pp. 497–593, 1897.

Mentions or describes the springs near Woods Holl, and the wells of the outwash plains, especially those at Barnstable and Harwich (pp. 529–534).

497 **Shepard** (Edward M.). Missouri. [Wells and spring records.]

U. S Geol. Surv., Water Supply and Irrigation Paper no. 102, pp. 389–440, 1904.

Considers briefly the general underground water conditions (p. 389) and gives tables and notes on wells (pp. 390–416) and springs (pp. 416–440). The well data include depth, head, source, temperature, yield, quality (including analyses), records and uses; the spring data, temperature, quality (including analyses), yield, source, uses, etc.

498 **Shrader** (Frank C.). A reconnaissance of a part of Prince William Sound and the Copper River district, Alaska, in 1898.

U. S. Geol. Surv., 20th Ann. Rept., pt. 7, pp. 341–423, 1899.

Describes the occurrence at a Prince William Sound village of a spring containing sulphides of iron, cobalt, and possibly lead in solution, which caused much sickness and death and finally led to the removal of the village.

499 **Slichter** (Charles S.). Theoretical investigation of the motion of ground waters.

U. S. Geol. Surv., 19th Ann. Rept., pt. 2, pp. 295–384, 1897.

This paper is a technical discussion of the movements of ground water, including general laws (pp. 329–333), laws of rectilinear flow through soil (pp. 305–323), motion in horizontal planes (pp. 333–344), motion in vertical planes (pp. 351–358), and flow and interference of artesian wells in groups (pp. 358–380). A number of valuable tables and a bibliography are given.

500 —— The motions of underground waters.

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 67, pp. 106, 1902.

The paper is a theoretical discussion, accompanied by records of experiments and tables. The following topics are considered: Amount of underground waters (pp. 13–15), permeability and porosity of rocks (pp. 15–17), cause and method of determining flow (pp. 17–30), underground drainage basins and shape of water table (pp. 31–38), chlorine method of measuring rate of underflow (pp. 46–48), electrical apparatus for determining underflow (pp. 48–51), deep water bearing zones, including Dakota and Potsdam horizons (pp. 52–60), recovery of water by wells and springs with discussions of contamination, variation of supply and of water table (pp. 61–73), use of collecting galleries and subsurface dams (pp. 73–78), and the capacity, measurement of flow, interference, and failure of artesian wells, with descriptions of the wells at Savannah, Georgia (pp. 79–102).

501 **Smith** (Eugene A.) and **Johnson** (Lawrence C.). Tertiary and Cretaceous strata of the Tuscaloosa, Tombigbee, and Alabama rivers.

U. S. Geol. Surv., Bull. no. 43, pp. 189, 1887.

Mentions or describes artesian borings at Bladen Springs, Alabama (pp. 17, 67), Livingston, Alabama (pp. 18, 84), and at Meridian, Mississippi (p. 17).

502 **Smith** (Eugene A.). Alabama. [Well records.]

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 102, pp. 276–331, 1904.

Considers briefly the general underground water conditions and gives a large amount of well data, including records, source, head, yield, temperature, quality, analyses, uses, etc.

503 **Smith** (George Otis), **Tower** (George Warren) and. Geology and mining industry of the Tintic district, Utah.

See Tower (George Warren) and Smith (George Otis).

504 **Smith** (George Otis). Tintic Special folio, Utah. Geography and geology.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 65, pp. 1–4, 1900.

Notes the occurrence of springs and the underflow supplies of the mines and mills (p. 1).

505 —— Geology and water resources of a portion of Yakima County, Washington.

U. S. Geol. Surv., Water Supply and Irrigation Paper no. 55, pp. 68, 1901.

Gives detailed discussions of geology and geography (pp. 12–25) and considers the Atanum-Moxee, Wenas-Selah, Rye Grass Flat, Coweche Valley, and other artesian basins in more or less detail (pp. 40–48). The source (pp. 55–56) and conditions (pp. 37–39) of ground and artesian waters, their use for irrigation (pp. 53–54), the transfer movement between basins (p. 57), temperature (pp. 58–62), permanency of supply (p. 62), decrease of pressure (pp. 62–63), precautions to be observed (p. 63), and the occurrence of springs (pp. 43, 63) are also considered.

506 —— Ellensburg folio, Washington.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 86, pp. 7, 1903.

Discusses essential artesian conditions and describes the Atanum, Wide Hollow, and Moxee Valley artesian basins. Good but not unlimited supplies can probably be obtained. The deep wells, some of which are thermal, and the shallow wells, supplied by underflow from the streams, are considered, as is also the occurrence of springs throughout the quadrangle (pp. 6–7).

507 —— Mount Stuart folio, Washington.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 106, 10 pp., 1904.

Discusses the occurrence of ground water and springs (10. p).

508 **Smith** (H. L.), **Clements** (J. M.), and. Crystal Falls iron-bearing district of Michigan.

See Clements (J. M.), and Smith (H. L.)

509 **Smith** (William Sidney Tangier). A geological sketch of San Clemente Island, California.

U. S. Geol. Surv., 18th Ann. Rept., pt. 2, pp. 459–496, 1897.

Notes the occurrence of alkaline springs and mentions the penetration of sea water into wells (p. 465).

510 **Smith** (William Sidney Tangier). Lead and zinc deposits of the Joplin district, Missouri-Kansas.

U. S. Geol. Surv., Bull. no. 213, pp. 197–204, 1903.

Discusses the relation of the occurrence of ores to ground-water level and the part played by underground waters in ore deposition (pp. 200–203).

511 —— Lead, zinc, and fluorspar deposits of western Kentucky: The veins and vein minerals.

U. S. Geol. Surv., Bull. no. 213, pp. 210–213, 1903.

Notes the relation of ground water to the ores.

512 —— Hartville folio, Wyoming.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 91, p. 6, 1903.

Considers briefly the prospects for artesian wells (p. 1).

513 —— **Darton** (N. H.) and. Edgemont folio, South Dakota-Nebraska.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 108, pp. 10, 1904.

See Darton (N. H.) and Smith (W. S. Tangier).

514 **Smith** (William Sidney Tangier). Wells of Joplin [Missouri] and vicinity.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 404–408, 1904.

Gives records and analyses of waters.

515 **Smyth** (Henry Lloyd). The Marquette iron-bearing district of Michigan: The Republic trough.

U. S. Geol. Surv., Mon., vol. 28, pp. 525–553, 1897.

Ores are considered to be in part original and in part concentrated from carbonates by circulating waters with removal of silica (pp. 551–553).

516 **Spencer** (Arthur Coe). Geology of the Rico Mountains, Colorado: Erosion of Rico Dome and recent geological history.

U. S. Geol. Surv., 21st Ann. Rept., pt. 2, pp. 152–165, 1900.

Describes calcareous and ferruginous spring deposits and the occurrence of carbon dioxide and hydrogen sulphide gases (pp. 163–165).

517 —— The copper deposits of the Encampment district, Wyoming.

U. S. Geol. Surv., Prof. Paper no. 25, pp. 107, 1904.

Discusses the occurrence of ground waters in the mining district (pp. 44–45) and their relation to metamorphism (p. 36) and to ore deposition (pp. 44, 58–60, 69–70, 80–82).

518 **Spurr** (Josiah Edward). Economic geology of the Mercur mining district, Utah.

U. S. Geol. Surv., 16th Ann. Rept., pt. 2, pp. 343–455, 1896.

Discusses agency of hot waters and fumerolic gases in ore deposition (pp. 449–453, etc.).

519 **Spurr** (Josiah Edward). Geology of the Aspen mining district, Colorado, with atlas.

U. S. Geol. Surv., Mon., vol. 31, 260 pp. 1898.

Describes the solution and alteration of dolomites, etc., especially the Weber limestone, by percolating waters (pp. 24, 30–31) and discusses the action of ground water in the processes of dolomitization, silicification, and ferration (pp. 208–223). Ore deposition is ascribed to ascending heated waters (p. 232). An analysis of spring water is given (p. 213.)

520 —— Ore deposits of Monte Cristo, Utah.

U. S. Geol. Surv., 22d Ann. Rept., pt. 2, pp. 777–865, 1901.

Ascribes the ore deposition to circulating underground waters (p. 835), and describes the relation of ground-water level to ores (pp. 858–859). Many incidental references to the character of the solutions are given.

521 —— Ore deposits of Tonopah and neighboring districts, Nevada.

U. S. Geol. Surv., Bull. No. 213, pp. 81–87, 1903.

Describes hot springs near Silver Peak (p. 86).

522 —— Preliminary report on the ore deposits of Tonapah, Nevada.

U. S. Geol. Surv., Bull. no. 225, pp. 89–110, 1904.

Discusses relation of ore deposits to hot-spring action (p. 99), and notes the action of circulating ground waters on cementation (p. 105) and oxydation (p. 106).

523 **Stockton** (Fred). Timbered areas and water supply on headwaters of Henry Fork and Fall River [Idaho].

U. S. Geol. Surv., 2d Ann. Rept. Reclamation Service, 1902–3, pp. 291–295, 1904.

Describes character of springs of the district (p. 295).

524 **Stone** (George H.). The glacial gravels of Maine and their associated deposits.

U. S. Geol. Surv., Mon., vol. 34, 499 pp., 1899.

Discusses the transportation and erosion of fine material by subterranean streams and springs, the development of "gravel in till," and the erosion about springs (pp. 18–20). The method of erosion about springs is considered (pp. 64–67), and its importance in the development of valleys noted. The effect on ice sheets of springs beneath their base is discussed (pp. 305, 307).

525 **Stone** (Ralph W.). Oil and gas fields of eastern Greene County, Pennsylvania.

U. S. Geol. Surv., Bull. no. 225, pp. 396–412, 1904.

Discusses relation of water, oil, and gas (p. 407), and notes the occurrences of salt water in wells (pp. 410–412).

526 **Storrs** (H. A.). Electrical transmission of power for pumping.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 93, pp. 237–240, 1904.

Points out use of electric power for pumping from wells (p. 237).

527 **Storrs** (H. A.). Power development.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 93, pp. 311-314, 1904.

Considers ground water as a source of water for pumping for irrigation (pp. 313-314).

528 **Stout** (O. V. P.). Ground water at Kearney, Nebraska.

U. S. Geol. Surv., 21st Ann. Rept., pt. 4, pp. 216-217, 1900.

Discusses the peculiar variations of the wells, considering the influence of temperature, river level, direction of wind, barometric pressure, etc. No satisfactory explanation has been found for certain of the variations.

529 —— Reclamation and water storage in Nebraska.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 93, pp. 276-284, 1904.

Notes the extensive absorption of rain water in the sand-hill region of the North Platte (p. 283).

530 **Struthers** (Joseph). Salt [1901].

U. S. Geol. Surv., Min. Res. of U. S., 1901, pp. 853-866, 1902.

Gives production of salt from wells, springs, and other sources for the year 1901.

531 —— Bromine [1901].

U. S. Geol. Surv., Min. Res. of U. S., 1901, pp. 867-868, 1902.

Gives production of bromine as a by-product of brines, etc., for the year 1901.

532 —— Bromine.

U. S. Geol. Surv., Min. Res. of U. S., for 1902, pp. 897-898, 1904.

Describes briefly the occurrence of brines in Michigan.

533 **Sudworth** (George B.). Stanislaus and Lake Tahoe Forest Reserves, California and adjacent territory.

U. S. Geol. Surv., 21st Ann. Rept., pt. 5, pp. 499-561, 1900.

The failure of springs and wells at certain times is mentioned (p. 508).

534 **Swendsen** (G. L.). Investigations in Utah.

U. S. Geol. Surv., 2d Ann. Rept., Reclamation Service, 1902-3, pp. 450-486, 1904.

Mentions the occurrence of big springs in body of Bear Lake (p. 476).

T.

535 **Taylor** (Thomas U.). The Austin dam.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 40, pp. 52, 1900.

Notes the passage of a stream of water through the limestone beneath the dam, and quotes R. T. Hill on the local geology, including the occurrence of limestone cavities and the passage of water along the fault beneath the dam.

536 **Taylor** (Thomas U.). Irrigation systems of Texas.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 71, pp. 137, 1902.

This paper gives detailed descriptions of the Trans-Pecos, Pecos, Edwards Plateau, San Antonio, Nueces, Leona, Rio Grande and Colorado irrigation systems, with special attention to the systems used in the irrigation of rice. In connection with the discussion many large springs and deep-flowing and nonflowing wells are mentioned and described, especially those near San Antonio. Among the large springs are Tayah (p. 15), San Pedro (p. 19), Santa Rosa (p. 19), San Saba (p. 30), Connel (p. 40), and the springs of Big Bend River (pp. 19–21), Pecos Valley (p. 21), Edwards Plateau (p. 25), Del Rio (p. 25), Cienagas and Mud creeks (p. 27), Las Moras Creek (p. 29), Upper Nueces (p. 42), Kerr County (p. 42), Bailey Creek (p. 46), Kyac Creek (p. 46), South Llano River (p. 48), and vicinity of San Antonio (p. 52).

537 —— The water powers of Texas.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 105, pp. 116, 1904.

Considers the artesian wells at San Antonio (pp. 23–25) and describes in some detail with illustrations the numerous large springs giving rise to the streams. Their use for irrigation and power is also considered and measurements of flow given.

538 **Todd** (James Edward). The moraines of the Missouri Coteau and their attendant deposits.

U. S. Geol. Surv., Bull. no. 144, pp. 71, 1896.

Notes the valuable springs of the Koto Hills (p. 20), and the spring and traverture deposits of the Pierre formation (p. 56). A number of well records, mainly shallow, are given (pp. 58–61).

539 —— The moraines of southeastern South Dakota and their attendant deposits.

U. S. Geol. Surv., Bull. no. 158, pp. 171, 1899.

Describes copious springs of Jerauld County and considers the source of the water, the effect of decomposing pyrite on its character, and its association with landslides (pp. 19–21). The flowing wells from the gravels near Diana and Forrestburg and from the Dakota formation are discussed (p. 125). A considerable number of well records, mainly shallow, are given (pp. 49–51, 73, 74, 120).

540 —— Geology and water resources of a portion of southeastern South Dakota.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 34, pp. 34, 1900.

Gives a map showing depth of artesian water and describes the waters from the stream deposits, drift, and Dakota sandstone. The pressure and variations of wells through interference, barometric pressure, difference in depths of supplies, leakage, etc., are considered and hints relating to well construction and the securing of permanent supplies are given (pp. 26–31). A number of springs are noted (pp. 23, 24, 26).

541 **Todd** (James Edward). Olivet folio, South Dakota.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 96, 1903.

Gives a number of well sections (pp. 1–2) and considers surface waters, springs, and underground waters, including waters of the drift (pp. 4–5). The artesian supplies of the Niobrara and Dakota formations, artesian pressure and its fluctuation, variations due to temperature, barometric pressure, and leakage, amount of flow, future prospects, and methods of well construction are also treated (pp. 5–6). Maps showing depths of drift, flowing areas of Pleistocene formations, areas of flowing and nonflowing rock wells, contours of water surface, etc., are given.

542 —— Parker folio, South Dakota.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 97, pp. 6, 1903.

Gives well sections (pp. 1–2). Describes surface waters, including streams, springs, and lakes (p. 4), and subterranean waters (pp. 4–5). Under the latter heading shallow wells, tubular wells, wells of the drift and Dakota sandstone, and supplies of Dakota waters, including flow, quality, pressure, and decline are considered. A map showing depths of the drift and a map giving areas of Pleistocene flows, of areas of flowing and nonflowing Dakota water, and contours of water surface are included.

543 —— Mitchell folio, South Dakota.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 99, pp. 7, 1903.

Gives several well sections (pp. 2–3) and describes surface and underground waters, including those reached by shallow and tubular wells. The amount, quality, pressure, and decline of artesian water is considered, and maps showing depths of drift, depths of Sioux quartzite, areas of flows from the drift and from Benton and Dakota formations, and contours of the Sioux quartzite and of artesian head are given.

544 —— and **Hall** (C. M.). Alexandria folio, South Dakota.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 100, pp. 6, 1903.

Gives artesian well sections (p. 2). Considers surface waters, streams, springs, shallow and tubular wells, wells of Benton and Dakota formations, and flow, quality, and pressure of the waters (pp. 4–6). A drift map giving data in regard to shallow wells, a map showing depths to the Sioux quartzite, and a map showing Pleistocene, Benton, and Dakota areas of flowing wells, of Dakota pumping wells, and contours showing head of water are also given.

545 —— and **Hall** (C. M.). Geology and water resources of part of the lower James River Valley, South Dakota.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 90, pp. 47, 1904.

Describes the Dakota (pp. 14–18), Benton (pp. 18–19), and Niobrara (p. 20) water horizons, and gives a large number of well and other records (pp. 11, 15–17, pls. 8–21). Springs (pp. 35–36), shallow and pump wells (pp. 36–39), flowing wells (pp. 39–43), decline in pressure (pp. 42–43), and waste of water (p. 43), are discussed. Maps showing the geology, depth of Dakota sandstone, depth of drift, bed-rock contours, and of flowing and nonflowing areas accompany the paper.

546 **Todd** (James E.). Well records in Lyon County, Minnesota.
U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, p. 481, 1904.
Gives table of records, including depth, head, quality, and yield.

547 —— Huron folio, South Dakota.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 113, pp. 6, 1904.
Discusses occurrence of underground waters, springs, and shallow, tubular, and artesian wells (pp. 4–5). Waters are obtained from the drift, Pierre clay, and Benton and Dakota sandstones. A section showing the occurrence of artesian waters, sketch maps showing thickness of drift and depth of Sioux quartzite, and an artesian water-map showing flowing Dakota and drift areas, and the contours of the Sioux quartzite or of the granite are given.

548 **Tower** (George Warren), **Emmons** (Samuel Franklin) and. Butte special folio, Montana.
See Emmons (Samuel Franklin) and Tower (George Warren).

549 —— and **Smith** (George Otis). Geology and mining industry of the Tintic district, Utah.
U. S. Geol. Surv., 19th Ann. Rept., pt. 3, pp. 601–767, 1898.
Considers the springs of the district, the relation of the mines to ground water, and the water supply furnished by wells in alluvium. In the limestone, fissures conduct water to the syncline, mines in the higher portions of the limestone being dry. Water in monzonite does not penetrate so deeply as in limestone (p. 612). The supplies of the mills are from wells (p. 614). The ores, both in the sedimentary and igneous rock, were deposited by circulating alkaline sulphide solutions with temperatures of 200° (pp. 714–715). Alteration of ore deposits by vadose waters is considered (p. 719).

550 **Tucker** (Frederick de L. Booth). Colonization.
U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 93, pp. 122–126, 1904.
Notes utilization of underflow for irrigation in India (p. 122).

551 **Turner** (H. W.). Jackson folio, California.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 11, pp. 6, 1894.
Describes caves with stalactites (p. 3) and notes a number of deep borings (p. 4).

552 —— and **Lindgren** (Waldemar). Marysville folio, California.
See Lindgren (Waldemar) and Turner. (H. W.).

553 —— Downieville folio, California.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 37, pp. 8, 1897.
Describes the occurrence of warm springs along the fissures of the earthquake of 1876, and mentions the Sulphur Spring resort and the artesian wells of the west side of the Sierra Valley (p. 8).

554 —— and **Ransome** (F. L.). Sonora folio, California.
U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 41, pp. 7, 1897.
Notes the occurrence of solution caverns in the limestone of the Calaveras formation (p. 2).

555 **Turner** (H. W.), and **Ransome** (F. L.). Big Trees folio, California.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 51, pp. 8, 1898.

Notes the formation of salt by the evaporation of water seeping through rock into glacial pot holes (p. 7).

U.

556 **Udden** (J. A.). On account of the Paleozoic rocks explored by deep borings at Rock Island, Illinois, and vicinity.

U. S. Geol. Surv., 17th Ann. Rept., pt. 2, pp. 829–849, 1896.

Includes descriptions of wells in Devonian limestone, Niagara limestone, Hudson River shales, Galena limestone, Trenton limestone, St. Peters sandstone, Lower Magnesian limestone, and Potsdam formation.

557 **Ulrich** (Edward O.). Lead, zinc, and fluor spar deposits of western Kentucky. Geology and general relations.

U. S. Geol. Surv., Bull. no. 213, pp. 205–210, 1903.

Notes the occurrence of channels of underground waters along fracture lines (p. 210).

558 —— **Hayes** (C. Willard) and. Columbia folio, Tennessee.

See Hayes (C. Willard) and Ulrich (Edward O.).

559 **Upham** (Warren). The upper beaches and deltas of the Glacial Lake Agassiz.

U. S. Geol. Surv., Bull. no. 39, pp. 84, 1887.

Contains references to a considerable number of wells, mainly shallow, giving information relating to glacial deposits.

560 —— The Glacial Lake Agassiz.

U. S. Geol. Surv., Mon., vol. 25, 658 pp., 1895.

Discusses the common and artesian wells of the Red River Valley (pp. 523–581), considering the sources of fresh, alkaline, and saline waters, the use of water for irrigation, and the waters of the Dakota sandstone. The wells in Minnesota, North Dakota, and Manitoba are described. There are also a large number of incidental references to wells, brines, the Dakota sandstone, and springs, many of which are noted in the index. The occurrence of gases in water is mentioned (pp. 553–569)

V.

561 **Van Hise** (Charles Richard). Principles of pre-Cambrian North American geology.

U. S. Geol. Surv., 16th Ann. Rept., pt. 1, pp. 571–874, 1896.

Notes the closing of physical pores in rocks by pressure below depths of 10,000 meters, but states that rock-inclosed liquid-filled cavities can exist at an indefinite depth, or at least to a depth where the liquid and rock are miscible in all proportions (pp. 589–593).

562 —— The Marquette iron-bearing district of Michigan. Lower Marquette series.

U. S. Geol. Surv., Mon., vol. 28, pp. 221–407, 1897.

The iron ores are regarded as in part original and in part derived through secondary enrichment by downward moving waters of lean, cherty carbonate of lime, the silica being removed (pp. 401–405).

563 **Van Hise** (Charles Richard), **Leith** (C. K.), and **Clements** (J. Morgan). Iron-ore deposits of Lake Superior region.

U. S. Geol. Surv., 21st Ann. Rept., pt. 3, pp. 305–434, 1900.

The accumulation of the Lake Superior iron ores is attributed to descending underground waters (pp. 226–228, 323, 419), the action of water in the ore accumulation in the different ranges being considered, as follows: Penokee-Gogebic (pp. 348–351), Mesabe (pp. 367–369), Marquette (pp. 381–383), Menominee (pp. 396–400), and Vermilion (pp. 407–408).

564 **Van Hise** (C. R.). Preliminary report on the lead and zinc deposits of the Ozark region. Introduction.

U. S. Geol. Surv., 22d Ann. Rept., pt. 2, pp. 33–60, 1901.

Ascribes the segregation of zinc in the Silurian limestones of the Mississippi Valley and in Missouri and Arkansas to artesian circulation, deposition taking place in crevices, joints, and cavities. The nature of the solutions is discussed.

565 —— A treatise on metamorphism.

U. S. Geol. Surv., Mon., vol. 47, pp. 1286, 1904.

In this elaborate treatise, ground waters and their part in metamorphism are considered at great length. The crust is divided into two great zones according to nature of metamorphism, the first known as the zone of katamorphism and the second as the zone of anamorphism. The zone of katamorphism is further divided into an upper belt of weathering and a lower belt of cementation. Among the special points considered are (1) rock openings, including bedding planes, joints, faults, fissility, spaces in fragmental rocks, and openings in lavas; (2) waters of the belt of weathering, including a discussion of the water table, amount and source of water circulation, and fluctuations depending on barometric pressure, temperature, precipitation, seepage, evaporation, uplift, subsidence, influence of man, etc.; (3) waters of the belt of cementation, including circulation, temperature, and work; (4) waters of the zone of anamorphism, including quality, circulation, limits of depth, and work; (5) the part of water in ore formation; and (6) source of subterranean gasses associated with waters. The portions bearing on the circulation are especially pertinent.

566 **Vaughan** (Thomas Wayland) **Hill** (Robert T.) and. Nueces folio, Texas.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 42, pp. 4, 1898.

See Hill (Robert T.) and Vaughan (T. Wayland).

567 —— Geology of the Edwards Plateau and Rio Grande Plain adjacent to Austin and San Antonio, Texas, with reference to the occurrence of underground water.

See Hill (Robert T.) and Vaughan (T. Wayland).

568 **Vaughan** (Thomas Wayland). Reconnaissance in the Rio Grande coal fields of Texas.

U. S. Geol. Surv., Bull. no. 164, pp. 100, 1900.

Notes the relation of the San Felipe Spring to joints (p. 16). Describes or gives section of artesian wells or borings at Santo Tomas, Carrizo Springs, and near the Rio Grande (pp. 25, 37, 41–44, 50–51). The Carrizo sand as a source of water is mentioned (p. 37).

569 **Vaughan** (Thomas Wayland). Uvalde folio, Texas.

U. S. Geol. Surv., Geol. Atlas of U. S. folio, pp. 7, no. 64, 1900.

Mentions the caves of the Edwards limestone (p. 1) and describes the numerous springs at the base of the Leona formation. The waters are used for irrigation. The springs are not associated with faults (p. 6). There are at present no artesian wells, but artesian water may possibly be found in the Glen Rose formation, but the absence of springs makes this seem improbable. The wells in the surficial deposits, basalt, and in the sedimentary formations including the Glen Rose, Edwards, and Myrick are discussed (pp. 5–6).

570 —— **Hill** (Robert T.) and. Austin folio, Texas.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 76, pp. 8, 1902.

See Hill (Robert T.) and Vaughan (T. Wayland).

W.

571 **Walcott** (Charles Doolittle). Administrative report [1893–94].

U. S. Geol. Surv., 15th Ann. Rept., pp. 129–144, 1895.

Mentions work of G. K. Gilbert on artesian waters of Pueblo quadrangle of Colorado (p. 136).

572 —— Report of the Director [1894–95].

U. S. Geol. Surv., 16th Ann. Rept., pt. 1, pp. 1–130, 1896.

Notes the work of N. H. Darton on artesian prospects of the Atlantic Coastal Plain (p. 23); of Frank Leverett on the water supply of the drift; of R. T. Hill on the artesian waters of Texas (pp. 27, 48); of Lawson on those of San Francisco Bay, and of F. H. Newell on artesian wells in general (p. 45). Investigations of artesian waters and springs in the Nepesta and Apeshapa quadrangles, Colorado (p. 25–26) and in the deep wells of North Dakota (p. 48) are also mentioned. The laws governing artesian investigations are quoted (p. 43), and the measurement of springs in Texas mentioned (p. 48). The output of mineral waters is given as 21,569,608 gallons, with a value of $3,741,846.

573 —— Report of the Director [1895–96].

U. S. Geol. Surv., 17th Ann. Rept., pt. 1, pp. 1–200, 1896.

Notes the results of work by G. K. Gilbert on artesian waters and underflow of the Arkansas Basin and Pueblo and Apeshapa sheets in Colorado (pp. 32, 74, 80), of R. T. Hill on the underground waters of Texas (pp. 35, 36, 80), of N. H. Darton on those of North and South Dakota (pp. 37, 73, 80), of A. C. Lawson in California (p. 48), of Frank Leverett in Illinois, and of E. H. Barbour in Nebraska (p. 73). The general work of the Division of Hydrography on underground waters is described (pp. 70–71) and an analysis of a boring sample from well at Key West, Florida, made by the chemical department, noted (p. 70). The product of mineral waters is given as 21,463,543 gallons, with a value of $4,254,237.

574 —— Report of the Director [1896–97].

U. S. Geol. Surv., 18th Ann. Rept., pt. 1, pp. 1–130, 1897.

Gives allotment for artesian work (p. 20) and describes work on artesian and other underground waters by N. H. Darton in District of Columbia, Maryland, and Virginia (p. 32), in South Dakota and Nebraska (p. 73), by T. W. Vaughan in Texas (pp. 36, 75), R. T. Hill in Texas (pp. 37, 75), R. C. Hills in Colorado (p. 40), Frank Leverett in

Ohio and Indiana (pp. 55, 57, 72), A. C. Lane in Michigan (p. 72), E. J Babcock in North Dakota (p. 73), E. H. Barbour in Nebraska (p. 74), and Erasmus Haworth and W. D. Johnson in Kansas (p. 74). The work of William Hullock on temperatures of the mile-deep well near Pittsburg (p. 60) and of E. C. Murphy and O. P. Hood on windmills and pumps is also mentioned (p. 74). A summary of the work of the Division of Hydrography on artesian problems (pp. 70–71), and statistics of wells in the Mississippi Valley are given. The product of mineral waters for 1895 is stated as 25,795,312 gallons, with a value of $4,136,192.

575 **Walcott** (Charles Doolittle). Report of the Director [1897–98].

U. S. Geol. Surv., 19th Ann. Rept., pt. 1, pp. 1–143, 1898.

Describes the work of N. H. Darton and F. H. Ainsworth on well temperatures in western Nebraska; of R. T. Hill in the underground waters of Black and Grand Prairies, Edwards Plateau, and Rio Grande Plain in Texas, and of the Division of Hydrography on general underground investigations. The relation of ground water level to the oxidation of ores in the Tintic district is mentioned. The product of mineral waters for 1897 is stated as 23,255,911 gallons, with a value of $4,599,106.

576 —— Report of the Director [1898–99].

U. S. Geol. Surv., 20th Ann. Rept., pt. 1, pp. 11–209, 1899.

Describes work on underground waters by N. H. Darton in District of Columbia, Maryland, Virginia, South Dakota, and Texas; of R. C. Hills in Colorado, of Frank Leverett in Indiana, of A. C. Lane in Michigan, and of E. J. Babcock in North Dakota. The product of mineral waters for 1898 is given as 28,853,467 gallons, with a value of $8,051,833. (See index of report.)

577 —— Report of the Director [1899–1900].

U. S. Geol. Surv., 21st Ann. Rept., pt. 1, pp. 11–204, 1900.

Gives a summary of publications of the Survey relating to artesian waters, 1879–1900 (pp. 31–32), and mentions the work of the division of Hydrography on underground waters (p. 43). The allotment for such work is stated (p. 64). The work of N. H. Darton, C. C. O'Harra, and J. E. Todd on the underground waters of the Great Plains and Black Hills; of N. H. Darton in South Dakota and Wyoming; of R. T. Hill in the Black and Grand Prairies, Texas; of W. H. Weed on the Boulder Hot Springs of Montana, of W. A. Setchell on plant life of hydro-thermal waters of the Yellowstone National Park (p. 80), and of C. M. Hall in South Dakota, is reviewed. The output of mineral waters for 1899 is given as 39,562,136 gallons, with a value of $6,948,030.

578 —— Report of the Director [1900–1901].

U. S. Geol. Surv., 22nd Ann. Rept., pt. 1, pp. 3–207, 1901.

Describes work on underground waters, by Frank Leverett, in Michigan; N. H. Darton, W. S. T. Smith, J. E. Todd, C. M. Hall, E. H. Barbour, and C. C. O'Harra in the region including North Dakota, South Dakota, Colorado, Kansas, Nebraska, and Wyoming; and G. O. Smith and F. C. Calkins in Washington; I. C. Russell in Idaho; C. S. Slichter (underflow measurements) in the Mississippi Valley. Also notes work of William Hallock on the physics of geysers, and of N. H. Darton on deep wells and their relation to health. The product of mineral waters for 1900 is given as 47,558,784, with a value of $6,245,172. (See index of report).

578a **Walcott** (Charles Doolittle). Report of the Director [1901–1902].

U. S. Geol. Surv., 23rd Ann. Rept., pp. 206, 1902.

Notes the work on underground waters, by N. H. Darton, in Arizona; J. E. Todd, in the James River Valley, in South Dakota; of C. M. Hall in the Red River Valley, and of N. H. Darton on the Great Plains and Black Hills (pp. 40–41). The work of N. H. Darton on deep well records and underground temperatures (p. 41), of C. S. Slichter on movements of water in sands and gravel (p. 101), of Arnold Hague and William Hallock on geysers and hot spring phenomena of the Yellowstone National Park (p. 46), and of W. H. Weed on the Hot Springs of Arkansas (p. 62) is also mentioned. A list of survey publications of the year relating to underground and surface waters is given (pp. 118–119). The production of mineral waters for 1901 is given as 55,771,188 gallons, valued at $7,586,962.

579 —— Letter of transmittal: First Annual Report of the Reclamation Service, June 17 to December 1, 1902.

U. S. Geol. Surv., 1st. Ann. Rept. Reclamation Service, 1902, pp. 12–14, 1903.

Mentions deep well problems in western Kansas, western Nebraska, and in central Oregon (p. 13).

580 —— Report of the Director [1902–1903].

U. S. Geol. Surv., 24th Ann. Rept., pp. 302, 1904.

Gives an account of the organization of the Division of Hydrology and the scope of its work (pp. 180, 196–213), and of the Hydro-Economic Division (pp. 213–214). The production of mineral waters for 1902 is stated as 64,859,451 gallons, with a value of $8,793,761. Work in the following States is described: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Georgia, Florida, Minnesota, Wisconsin, Michigan, Iowa, Missouri, Arkansas, Louisiana, Kentucky, Tennessee, Mississippi, Alabama, Arizona, California, Colorado, Idaho, Kansas, Nebraska, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Washington, and Wyoming. Details of the work of the following men on underground waters are also given: N. H. Darton, M. L. Fuller, Arnold Hague, Waldmar Lindgren, I. C. Russell, W. C. Alden, W. S. Bayley, J. M. Boutwell, G. H. Perkins, W. O. Crosby, Laurence La Forge, H. E. Gregory, A. C. Veatch, C. S. Slichter, F. B. Weeks, G. N. Knapp, S. W. McCallie, C. W. Hall, A. R. Shultz, W. F. Cooper, W. H. Norton, E. M. Shepard, A. H. Purdue, L. C. Glenn, E. A. Smith, L. C. Johnson, G. B. Richardson, W. C. Mendenhall, W. T. Lee, C. A. Fisher, Homer Hamlin, G. E. Condra, C. M. Hall, D. E. Willard, C. N. Gould, I. C. Russell, J. E. Todd, and C. C. O'Harra. Investigations on the measurement of underflow, by C. S. Slichter, on the water supplies of Molokai, Hawaiian Islands, by W. Lindgren, and on the question of diminution of geyser action in the Yellowstone National Park, are also noted.

581 **Warman** (Philip Creveling). Bibliography and index of the publications of the United States Geological Survey, with the laws governing their printing and distribution.

U. S. Geol. Surv., Bull. no. 100, pp. 495, 1893.

Gives list of Survey publications to date of issue, with tables of contents. The index contains references to most of the more important discussions or descriptions relating to underground waters.

582 **Warman** (Philip Creveling). Catalogue and index of the publications of the United States Geological Survey, 1880–1901.

U. S. Geol. Surv., Bull. no. 177, pp. 858, 1901.

Gives lists of the Survey publications, with tables of contents of some. Has an extended index containing references to a large number of descriptions or discussions bearing on underground waters.

583 —— Catalogue and index of publications of the United States Geological Survey, 1901–1903.

U. S. Geol. Surv., Bull. no. 215, pp. 234, 1903.

Brings the list of publications and index of Survey papers to date, being supplementary to Bulletins 100 and 177.

584 **Weed** (Walter Harvey). Formation of travertine and siliceous sinter by the vegetation of hot springs.

U. S. Geol. Surv., 9th Ann. Rept., pp. 613–676, 1889.

Among the subjects discussed are the following: Vegetable growth in hot springs (pp. 620–628), the Mammoth Hot Springs and the waters of the Upper Geyser Basin of Fire Hole River, vegetable and chemical ingredients of the water, form, composition (with analyses), weathering, etc., of the travertine deposits, and analyses of hot-spring waters and of siliceous sinter. Concludes that plant life of Mammoth Hot Springs causes deposition of travertine, and that vegetation of hot alkaline waters of Geyser Basin eliminates silica from the water by the vital growth and produces deposition of siliceous sinter. The same principles probably apply to the sinters of Steamboat Springs, Nevada, in the Azores, and possibly in Iceland and New Zealand.

585 —— **Iddings** (Joseph P.) and. Livingston folio, Montana.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 1, pp. 4, 1894.

See Iddings (Joseph P.) and Weed (Walter H.).

586 —— and **Pirsson** (Louis Valentine). Geology of the Castle Mountain mining district, Montana.

U. S. Geol. Surv., Bull. no. 139, pp. 104, 1896.

Notes the occurrence of springs and the disappearance of streams into gravel and limestone (p. 20). Describes caves and abandoned subterranean channels in the carboniferous limestone (p. 40). The White Sulphur Hot Springs, temperature 125°, from the Miocene lake beds, is also discussed. The heat is supposed to be from igneous intrusions. Flow, 1,300 gallons per hour. Spring is surrounded by sulphur deposits. Hotels and a park have been built (pp. 150–151).

587 —— Yellowstone National Park folio. Sedimentary rocks.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 30, pp. 4–5, 1896.

Describes calcareous deposits of hot springs and the formation of siliceous sinter through agency of algous life. Mentions the leaching, etc., by solfataric springs giving rise to the "paint pots."

588 —— and **Pirsson** (L. V.). Geology and mineral resources of the Judith Mountains of Montana.

U. S. Geol. Surv., 18th Ann. Rept., pt. 3, pp. 437–616, 1897.

Notes the common occurrence of springs, including large and powerful ones in shale and limestones, some of which give rise to large streams at once (pp. 447, 452–454). The springs of the Benton shale (p. 513) and of the Cretaceous beds (p. 525) are described. The occurrence of underground drainage (p. 529) and of deposits of limonite formed by waters from the porphyry (p. 152) are noted. The ores, both original and replacement, are supposed to have been deposited by ascending waters and vapors through limestone or along faults (pp. 594–596).

589 **Weed** (Walter Harvey). Siliceous sinter. The educational series of rock specimens collected and distributed by the United States Geological Survey.

U. S. Geol. Surv., Bull. no. 150, pp. 91–93, 1898.

Describes character and method of formation through algous agency of siliceous sinter from the Yellowstone National Park, and gives an analysis.

590 —— Traverture. The educational series of rock specimens collected and distributed by the United States Geological Survey.

U. S. Geol. Surv., Bull. no. 150, pp. 99–101, 1898.

Explains origin and gives analysis of traverture from the Yellowstone National Park.

591 —— Geology of the Little Belt Mountains, Montana.

U. S. Geol. Surv., 20th Ann. Rept., pt. 3, pp. 257–461, 1899.

Mentions the interrupted streams of the limestone areas (p. 275), the springs of Judith region (p. 311), and notes the ascending hot carbonated and sulphide waters of the Neihart district (pp. 420–423).

592 —— **Hague**, Arnold [and]. Descriptive geology of Huckleberry Mountain and Big Game Ridge: Snake River, Hot Springs.

U. S. Geol. Surv., Mon., vol. 32, pt. 2, pp. 177–178, 1899.

See Hague (Arnold), [and Weed (W. H.)].

593 **Weed** (Walter Harvey). Fort Benton folio, Montana.

U. S. Geol. Surv., Geol. Atlas of U. S. folio no. 55, pp. 7, 1899.

Notes the passage of Belt Creek through local underground passages (p. 1). States that the rocks underlying the flat areas between the mountains would probably afford artesian waters. The surface supply is insufficient (p. 6).

594 —— Little Belt Mountains folio, Montana.

U. S. Geol. Surv., Geol. Atlas of U. S., folio no. 56, pp. 9, 1899.

Streams are reported dry in summer because of absorption into underground passages of the limestones. Describes the White Sulpnur group of 9 springs. The water is warm and has medicinal properties, being used at the near-by hotels and baths. An analysis is given (p. 8).

595 —— Mineral vein formation at Boulder Hot Springs, Montana.

U. S. Geol. Surv., 21st Ann. Rept., pt. 2, pp. 227–255, 1900.

Describes ore deposition at Steamboat Springs, Nevada, and Sulphur Bank, California. Boulder Hot Springs are now depositing both vein and surface deposits, including some gold and silver (pp. 233–235). The waters have a temperature up to 164° and have altered the adjacent granites, but although algæ are present little silica is deposited (p. 237). Surface waters penetrated to heated rhyolite intrusions and on rising the dissolved minerals were deposited by cooling and release of pressure (pp. 249–251).

596 **Weed** (Walter Harvey). Ore deposits at Butte, Montana.

U. S. Geol. Surv., Bull. no. 213, pp. 170–180, 1903.

Ascribes ore deposition to hot solutions ascending along fractures in the granite (p. 177).

597 —— Gypsum deposits in Montana.

U. S. Geol. Surv., Bull. no. 223, pp. 74–75, 1904.

Notes the presence of gypsum in hot spring waters and the deposition of gypsum and stilbite in old hot spring fissures.

598 —— Notes on the copper mines of Vermont.

U. S. Geol. Surv., Bull. no. 225, pp. 190–199, 1904.

Discusses the limits of ground waters in certain of the mines (p. 192).

599 **Weeks** (Fred Boughton). Bibliography and index of North American geology, paleontology, petrology, and mineralogy for 1802 and 1893.

U. S. Geol. Surv., Bull. no. 130, pp. 210, 1896.

Artesian wells are listed under "Economic products described."

600 —— Bibliography and index of North American geology, paleontology, petrology, and mineralogy for the year 1894.

U. S. Geol. Surv., Bull. no. 135, pp. 141, 1896.

Artesian wells are listed under "Economic products described."

601 —— Bibliography and index of North American geology, paleontology, petrology, and mineralogy for 1895.

U. S. Geol. Surv., Bull. no. 146, pp. 130, 1896.

Artesian wells and water supply are listed under "economic products described."

602 —— Bibliography and index of North American geology, paleontology, petrology, and mineralogy for 1896.

U. S. Geol. Surv., Bull. no. 149, pp. 152, 1897.

Artesian wells, mineral water, and water supply are listed under "economic products described."

603 —— Bibliography and index of North American geology, paleontology, petrology, and mineralogy for 1897.

U. S. Geol. Surv., Bull. no. 156, pp. 130, 1898.

Water analyses are listed under "chemical analyses," and artesian water, artesian wells, and water supplies under "economic products described."

604 —— Bibliography and index of North American geology, paleontology, petrology, and mineralogy for 1898.

U. S. Geol. Surv., Bull. no. 162, pp. 163, 1899.

Artesian water, artesian wells, and water supply are listed under "economic products described."

605 —— Bibliography and index of North American geology, paleontology, petrology, and mineralogy for the year 1895.

U. S. Geol. Surv., Bull. no. 172, pp. 146, 1900.

Artesian water, artesian wells, mineral waters, and water supply are listed under "economic products described," while analyses are listed under "chemical analyses."

606 **Weeks** (Fred Boughton). Bibliography of North American geology, paleontology, petrology, and mineralogy for the years 1892–1900, inclusive.

U. S. Geol. Surv., Bull. no. 188, pp. 717, 1902.

Papers relating to underground waters and springs are catalogued under authors.

607 —— Index to North American geology, paleontology, petrology, and mineralogy for the years 1892–1900, inclusive.

U. S. Geol. Surv., Bull. no. 189, pp. 337, 1902.

Artesian water, artesian wells, mineral water, and water supply are listed under "economic products described," while analyses are listed under "chemical analyses."

608 —— Bibliography and index of North American geology, paleontology, petrology, and mineralogy for the year 1901.

U. S. Geol. Surv., Bull. no. 203, pp. 144, 1902.

Artesian water, artesian wells, and water supply are listed under "economic products described."

609 —— Bibliography and index of North American geology, paleontology, petrology, and mineralogy for the year 1902.

U. S. Geol. Surv., Bull. no. 221, 200 pp., 1903.

Papers relating to underground waters are listed under "economic products described" and under "chemical analyses."

610 —— New York. [Well and spring records.]

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 102, pp. 169–206, 1904.

Discusses the general underground water conditions (pp. 169–171) and gives tables and notes relating to wells (pp. 172–198) and springs (pp. 199-206). The well data include source, temperature, yield, quality, use, records, and analyses; the spring data temperature, quality, yield, source, and uses.

611 —— Bibliography and index of North American geology, paleontology, petrology, and mineralogy for the year 1903.

U. S. Geol. Surv., Bull. no. 240, 243 pp. 1904.

Waters are more carefully indexed than in preceding volumes, being listed under "chemical analyses," "economic products described," etc.

612 **Whistler** (John T.). Investigations in Oregon.

U. S. Geol. Surv., 2d Ann. Rept. Reclamation Service, 1902–3, pp. 433–440, 1904.

Notes occurrence of large springs, some thermal, at Bonanza (p. 439).

613 **White** (Charles A.). Correlation Papers. Cretaceous.

U. S. Geol. Surv., Bull. no. 82, pp. 273, 1891.

Discusses artesian water of the Dakota formation (p. 171) and refers to wells or gives records of borings in New Jersey (p. 79) Virginia (p. 90) and elsewhere.

614 **White** (Israel C.). Stratigraphy of the bituminous coal field of Pennsylvania, Ohio, and West Virginia.

U. S. Geol. Surv., Bull. no. 65, pp. 212, 1891.

Gives several sections made up in whole or in part of well borings.

615 **Whitfield** (James Edward), **Gooch** (Frank Austin) and. Analysis of waters of the Yellowstone National Park with an account of the methods of analysis employed.

U. S. Geol. Surv., Bull. no. 47, pp. 84, 1888.

See Gooch (Frank Austin) and Whitfield (James Edward).

616 [**Williams, J. Albert**]. Salt.

U. S. Geol. Surv., Min. Res., 1882, pp. 532–553, 1883.

Gives the number, average depth, and strength of brines of wells of different States (p. 532), with more specific references on subsequent pages to the salt wells of Michigan, New York, West Virginia, Ohio, etc., and to the saline springs of New York, Montana, Dakota, Colorado, Pacific coast, Nevada, California, Oregon, Idaho, and Arizona (pp. 535–550).

617 —— Sulphur.

U. S. Geol. Surv., Min. Res., 1882, pp. 578–579, 1883.

Mentions sulphur springs of the Rocky Mountains.

618 —— Administrative report [1884–85].

U. S. Geol. Surv., 6th Ann. Rept., pp. 88–93, 1885.

In a summary of mineral products of the United States the outputs of mineral waters for 1883 and 1884 are given as 47,289,743 and 68,720,936 gallons, with values of $1,139,483 and $1,665,490, respectively.

619 —— Salt.

U. S. Geol. Surv., Min. Res., 1883–84, pp. 827–850, 1885.

Gives more or less descriptive matter relating to the salt wells or borings of Michigan, New York, Ohio, Virginia, Illinois, Indiana, Kentucky, Tennessee, Kansas, California, and Nebraska, and to saline springs of New York, Illinois, Indiana, Kentucky, Tennessee, Kansas, Nebraska, Montana, South Dakota, and Colorado.

620 —— Administrative report [1885–86].

U. S. Geol. Surv., 7th Ann. Rept., pp. 130–134, 1888.

Gives the product of mineral waters for 1885 as 9,148,401 gallons, with a value of $1,312,845. The decrease is due to the exclusion of certain Wisconsin artesian wells.

621 **Wilson** (Herbert M.). Irrigation in India.

U. S. Geol. Surv., 12th Ann. Rept., pt. 2, pp. 363–561, 1891.

Describes pump wells (p. 369) and wells for irrigation (pp. 415, 496). Underground seepage waters are sometimes valuable for irrigation where labor is cheap, but it is doubtful if they will ever be extensively used in America (p. 415). Methods of pumping, including several depending on animal power, are considered (pp. 423–425). Loss from streams by percolation and absorption is described (pp. 431–434).

622 —— American Irrigation Engineering.

U. S. Geol. Surv., 13th Ann. Rept., pt. 3, pp. 101–350, 1892.

Considers springs, ground water, artesian water, etc., as sources of supply (pp. 113–114), and discusses seepage (p. 114). Detailed descriptions of subsurface supplies and the methods of collecting by submerged dams, collecting canals, tunnels, etc., are given (pp. 327–330). The "duty" of well water in Utah (p. 157), the volume and movement of ground water (p. 328), and pumping and lifting methods (pp. 162, 332–328) are also considered.

623 **Wilson** (Herbert M.). Pumping waters for irrigation.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 1, pp. 56, 1896.

Contains a discussion of the kinds of pumps (p. 17), including animal motive powers (pp. 20–25), windmills (pp. 25–35), water wheels and hydraulic rams (pp. 35–45), hot air and gasoline pumps (pp. 45–46), steam pumps (pp. 46–50), centrifugal and rotary pumps (pp. 50–51), and mechanical and siphon elevators (pp. 51–54). The relative efficiency and cost are given (pp. 15, 16, 19, etc.). The descriptions of the methods of ancient or semicivilized peoples are of special interest.

624 —— Irrigation in India.

U. S. Geol. Surv., Water-Supply and Irrigation Paper no. 87, pp. 238, 1903.

This is a revised edition of paper on same subject appearing in the Twelfth Annual Report. Very few new facts relating to underground waters are presented.

625 **Winslow** (Arthur). The disseminated lead ores of southeastern Missouri.

U. S. Geol. Surv., Bull. no. 132, pp. 31, 1896.

Contains a number of boring records and notes on fissure and crevice systems in their relation to the deposition of the ores by circulating waters.

626 **Woodworth** (Jay Backus). The glacial brick clays of Rhode Island and southeastern Massachusetts: Geology and geography of the clays.

U. S. Geol. Surv., 17th Ann. Rept., pt. 1, pp. 975–988, 1896.

Describes the mud springs or mud volcanoes in the clays at Barrington, Rhode Island, and at Titicut, Massachusetts. They are thought to be due to water passing downward beneath the clay through the foresets of adjacent sand plains and forcing its way upward through the clay (p. 988).

627 —— Geology of the northern and eastern portions of the Narragansett Basin.

U. S. Geol. Surv., Mon., vol. 33, pp. 91–214, 1899.

Gives records of deep borings in Rhode Island (pp. 161 and 171) and in Massachusetts (pp. 170, 198).

628 **Wright** (George Frederick). The glacial boundary in western Pennsylvania, Ohio, Kentucky, Indiana, and Illinois.

U. S. Geol. Surv., Bull. no. 58, pp. 39–110, 1890.

Describes an artesian well at Oberlin, Ohio (p. 47), and mentions a number of surface wells.

CLASSIFIED KEY TO PRINCIPAL SUBJECT ENTRIES IN INDEX.

INDEX.

[The numbers refer to entries in the bibliographic review.]

O

PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 120.]

The serial publications of the United States Geological Survey consist of (1) Annual Reports, (2) monographs, (3) Professional Papers, (4) Bulletins, (5) Mineral Resources, (6) Water-Supply and Irrigation Papers, (7) Topographic Atlas of United States—folios and separate sheets thereof, (8) Geologic Atlas of the United States—folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

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SERIES O—UNDERGROUND WATERS.

WS 4. A reconnaissance in southeastern Washington, by I. C. Russell. 1897. 96 pp., 7 pls.

WS 6. Underground waters of southwestern Kansas, by E. Haworth. 1897. 65 pp., 12 pls.

WS 7. Seepage waters of northern Utah, by Samuel Fortier. 1897. 50 pp., 3 pls.

WS 12. Underground waters of southeastern Nebraska, by N. H. Darton. 1898. 56 pp., 21 pls.

WS 21. Wells of northern Indiana, by Frank Leverett. 1899. 82 pp., 2 pls.

WS 26. Wells of southern Indiana (continuation of No. 21), by Frank Leverett. 1899. 64 pp.

WS 30. Water resources of the Lower Peninsula of Michigan, by A. C. Lane. 1899. 97 pp., 7 pls.

WS 31. Lower Michigan mineral waters, by A. C. Lane. 1899. 97 pp., 4 pls.

WS 34. Geology and water resources of a portion of southeastern South Dakota, by J. E. Todd. 1900. 34 pp., 19 pls.

WS 53. Geology and water resources of Nez Perces County, Idaho, Pt. I, by I. C. Russell. 1901. 86 pp., 10 pls.

WS 54. Geology and water resources of Nez Perces County, Idaho, Pt. II, by I. C. Russell. 1901. 87–141 pp.

WS 55. Geology and water resources of a portion of Yakima County, Wash., by G. O. Smith. 1901. 68 pp., 7 pls.

WS 57. Preliminary list of deep borings in the United States, Pt. I, by N. H. Darton. 1902. 60 pp.

WS 59. Development and application of water in southern California, Pt. I, by J. B. Lippincott. 1902. 95 pp., 11 pls.

WS 60. Development and application of water in southern California, Pt. II, by J. B. Lippincott. 1902. 96–140 pp.

WS 61. Preliminary list of deep borings in the United States, Pt. II, by N. H. Darton. 1902. 67 pp.

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

B 199. Geology and water resources of the Snake River Plains of Idaho, by I. C. Russell. 1902. 192 pp., 25 pls.

WS 77. Water resources of Molokai, Hawaiian Islands, by W. Lindgren. 1903. 62 pp., 4 pls.

WS 78. Preliminary report on artesian basin in southwestern Idaho and southeastern Oregon, by I. C. Russell. 1903. 53 pp., 2 pls.

PP 17. Preliminary report on the geology and water resources of Nebraska west of the one hundred and third meridian, by N. H. Darton. 1903. 69 pp., 43 pls.

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

The following papers also relate to this subject: Underground waters of Arkansas Valley in eastern Colorado, by G. K. Gilbert, in Seventeenth Annual, Pt. II; Preliminary report on artesian waters of a portion of the Dakotas, by N. H. Darton, in Seventeenth Annual, Pt. II; Water resources of Illinois, by Frank Leverett, in Seventeenth Annual, Pt. II; Water resources of Indiana and Ohio, by Frank Leverett, in Eighteenth Annual, Pt. IV; New developments in well boring and irrigation in eastern South Dakota, by N. H. Darton, in Eighteenth Annual, Pt. IV; Rock waters of Ohio, by Edward Orton, in Nineteenth Annual, Pt. IV; Artesian well prospects in the Atlantic Coastal Plain region, by N. H. Darton, Bulletin No. 138.

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THE DIRECTOR,
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WASHINGTON, D. C.

APRIL, 1905.

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