DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

THIRTY-FIFTH ANNUAL REPORT

OF THE

DIRECTOR OF THE UNITED STATES GEOLOGICAL SURVEY

TO THE

SECRETARY OF THE INTERIOR

FOR THE FISCAL YEAR
ENDED JUNE 30

1914

WASHINGTON
GOVERNMENT PRINTING OFFICE
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THIRTY-FIFTH ANNUAL REPORT OF THE DIRECTOR OF THE UNITED STATES GEOLOGICAL SURVEY.

GEORGE OTIS SMITH, *Director.*

The appropriations for the work of the United States Geological Survey for the fiscal year 1913–14 comprised items amounting to $1,517,920. The plan of operations was approved by the Secretary of the Interior, and a detailed statement of the work of the several branches and divisions of the Survey is presented on later pages of this report.

SPECIAL FEATURES.

THE PROVINCE OF A FEDERAL SURVEY.

An amendment to the sundry civil appropriation bill was offered in the House of Representatives which, if agreed to by the Senate, would have restricted the geologic work of the Federal Survey to the public lands. As the Senate disagreed to this limitation, the only effect of the proposed legislation was to call attention afresh to the questions raised in the first years of the Survey's history and to reaffirm the policy determined by Congress 32 years ago. The organic act of the Survey, approved March 3, 1879, provided for the work of the new service and defined the duties of the Director of the Geological Survey in these words:

> That this officer shall have the direction of the Geological Survey, and the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain.

Director King saw an ambiguity in the use of the words "national domain," and in the first annual report of the new bureau he stated that "that term was supposed by the first framers of the law to cover the entire United States." He recognized the fact, however, that the term might be held to mean simply the public lands, and with only a small appropriation available to begin the vast work of the new bureau, he chose to take the conservative view and to confine field operations to the lands owned by the Nation rather than to interpret "national domain" as meaning the area within the outer boundaries of the Nation.

At the first session of the following Congress, in June, 1879, an effort was made to extend the authority of the Director of the Federal Survey, and a joint resolution, on motion of Representative Atkins, of Tennessee, chairman of the Committee on Appropriations, was promptly passed by the House amending the organic act of the Survey by providing "that the Director of the Survey may extend his examinations into the States," thus extending the field of the new organization over the whole United States. This legislation was initiated by reason of the construction placed by the law officers of the Interior Department on the words "national domain," these officers contending that the words should apply only to the Territories and States containing public lands, and the object of the legislation was to connect the geology of the national domain, so defined, with that of the States. At the following session of the same Congress the joint resolution was considered by the Senate, but although there was long debate the consideration of this measure was not completed and it thus failed of passage.

It might well have been argued whenever this matter was under debate that the framers of the act establishing the Survey had intended the words "national domain" to have a wider meaning than "public lands," because after these words in the act they wrote a provision prohibiting the Director and members of the Geological Survey from having "personal or private interests in the lands or mineral wealth of the region under survey." Obviously that provision indicates that the work contemplated under the authority given to the new organization included surveys over land in part at least under private ownership.

In 1882, however, all possible ambiguity was removed by a Senate amendment to the pending sundry civil bill whereby the authorization "to continue the preparation of a geological map of the national domain" was made to read "to continue the preparation of a geological map of the United States." After debate, the House, on August 4, concurred in the Senate amendment, which thus authorized the extension of the geologic work of the Survey over the whole country.

In 1906 and 1907 it was ruled in the House of Representatives that the topographic survey of the United States and the preparation of a geological map of the United States are both public works in progress and that legislative provisions looking to the continuance of such work in progress are not subject to a point of order.

In a broad way, the two views expressed in Congress in 1914, as well as in 1879 and 1882, relate simply to the question of the proper function of a Federal investigative service like the Geological Survey with respect to privately owned land.

The function of the Government bureau with relation to publicly owned land is unquestioned, and it has been in recognition of this special function that the land-classification work has been emphasized and expanded until it now constitutes an integral part of the Survey's activity and represents a large share of the current expenditures. Not only is the investigation of all the possible values attaching to lands belonging to the Nation in line with business principles, but the determination of what constitutes the highest use of the undeveloped lands is an allied task of even greater importance—indeed, it is nothing less than a national duty. The Survey's function on the public lands is therefore in no sense a matter for debate, and "the classification of the public lands" in the broadest sense, including the consideration of questions of highest use as well as of lawful disposition, is the special task laid upon this branch of the Government service. The investigations on the public lands directed to the determination of their value may and do go into whatever detail is demanded by the particular resources of this or that tract of land and by the questions to be answered relative to preferable utilization. The Government is the landowner and is interested as a landowner in the natural resources of its real estate.

The function of the Government and the Government bureau with relation to privately owned land must be determined by other facts. The attitude of landlord is here plainly impossible, and land classification in the sense of appraisal and inventory of individual tracts has no place. Presumably in this case the Federal Government is not the one most interested in land value, but rather the interest of the individual or corporation landowner is superior to any concern on the part of the Nation. Upon this sort of premise undoubtedly was based the prohibition in the organic act of the Survey, to the effect that the Director and members of the Survey "shall execute no surveys or examinations for private parties or corporations"—a prohibition which in administrative practice has been construed as aimed against all work done primarily for the benefit of single landowners other than the Government itself, whether such examinations are paid for by the private owners or conducted at public expense.

The prohibition just referred to has never in the history of the Survey been considered as a bar against entry upon privately owned land, or in any sense as a restriction on the extent of the surveys and investigations. Moreover, at least nine States, East as well as West, by special enactment authorize the entry upon private lands to officials of the United States Geological Survey. At the very beginning Director King planned the geologic investigation of the three more important metalliferous mining districts of that day—Lead-

ville, Eureka, and the Comstock—in all of which the lands examined in most detail, both on the surface and underground, were privately owned. But each of these examinations, helpful as it was to the individual mine owners, contributed still more to the development of the whole district as an element in national prosperity and yielded scientific results of great value to the public at large, and indeed the Leadville report as an epoch-making contribution to the study of ore deposits made the world debtor.

The distinction seems obvious. The determinative factor in the whole matter is whether the investigative work on privately owned land yields results that are merely of local and personal interest, or results that are of general and national value. The knowledge of mineral deposits can be gained in large part only by entrance to mines, and thus to private lands. If restricted to public lands, geologists would have no opportunity to advance the study of ore deposits or indeed in many cases to determine the coal value of the publicly owned lands. The detailed examination by the Government geologist of a Leadville mine in 1879, or of a mine in the Yerington district in 1914, is justified only as the facts of ore occurrence observed and the laws of ore genesis determined are found to have broad application in the winning of mineral wealth. This principle applies throughout the whole field of geologic investigation—property lines and State boundaries must be overlooked by the geologist who is attacking a large problem. Land ownership is only an incident when large questions of natural resources are considered.

This leads to another phase of the national character of the United States Geological Survey and its work. The special interest of the Government in its own land being granted, it must be added, as was suggested this year by Representative Sherley at a hearing before the House Appropriations Committee, that "so far as the development of the mineral resources of the country is concerned, it is just as important to know the resources of privately owned land as of Government-owned land."

Director King, in the first annual report of the Survey, in illustrating the need of Federal investigation, selected iron as a mineral resource of large importance and stated that with the wide distribution and variety of occurrences of iron ores, neither corporations nor individual States could adequately investigate the subject, and he added that only for a few exceptional minerals could private or State enterprise successfully prosecute such work. If it is remembered that in this same report Director King prophesied for the United States a future annual output of mineral products having a value of a billion dollars, and that the present production is two and a half times that amount, it must be conceded that the

desirableness of the Federal scientific investigation of these national resources is even greater now than in 1880.

The crux of the matter lies in the selection of subjects of investigation or of areas for survey as well as the determination of the degree of refinement with which the work should be done. In these decisions the general purpose of the work must serve as a guide, and probably few will oppose the proposition that wherever the investigation serves the general public its prosecution by the National Government is justified, and the greater the public interest in the expected results the larger the claim of that work for preference.

At this time of intensified concern in the highest utilization of every material resource the field of the varied activities of the United States Geological Survey is so broad that it has no disinclination to share the opportunities for research with State organizations of similar character. Provisions that were suggested in the Congressional debates of 30 years ago as necessary to enforce the preference right of individual States to investigate their own territory could not accomplish as much as is now accomplished by either formal or informal cooperative agreement. The cooperation existing between State and Federal geological surveys is both intimate and extensive in the conduct of topographic surveys, stream gaging, and geologic investigations, as well as in the collection of mineral statistics. A total of several hundred thousand dollars annually contributed by each party is the measure of this cooperation. In part the Federal Survey acts as the disburser of State funds in this technical work, in part the State official acts as the representative of the larger organization in local work, and again the National Survey investigates some large interstate problem in behalf of adjoining States. Each of these cooperative methods is effective and prevents duplication of effort, accomplishes standardization of results, and promotes the coordination that secures the general results for the national bureau and the more local benefits for the State organization.

Under the present plan of coordination with the State surveys, which is improved from year to year, it is believed that the United States Geological Survey can most effectively cover the national field of scientific investigations and can contribute to the Nation's advancement to a degree that would be impossible if the Federal bureau were restricted in its operations to the rapidly diminishing remnant of public lands. It is a most conservative statement that never before has the general public been in closer touch with the United States Geological Survey or made larger use of the published or unpublished results of its surveys and investigations.

SCOPE OF THE WORK.

In the following pages of this administrative report the activities of each branch of the Survey are set forth in detail, but a brief summary will serve to indicate that the United States Geological Survey is national in scope as well as in name.

Geologic investigations were conducted in 47 States, Alaska, Hawaii, and the Canal Zone; topographic surveys were made in 35 States, Alaska, and Hawaii; and stream measurements were continued in 39 States, Alaska, and Hawaii. The total area covered by the geologists in reconnaissance and detailed surveys was more than 75,000 square miles, and the area mapped by the topographers was more than 25,000 square miles, an aggregate area almost nine-tenths that of the United Kingdom. The land-classification work of the Geological Survey last year included reports on an aggregate of 45,000,000 acres, or 70,000 square miles, of public lands, an area of coal, phosphate, oil, and dry-farming lands greater than the area of all the New England States.

In the collection of the statistics of mineral production, the Geological Survey cooperates with the State geologists of 16 States and carries on correspondence with 90,000 producers.

WORK OF THE YEAR.

PUBLICATIONS.

The work of the Geological Survey is reflected chiefly in the publication and distribution of its printed reports and maps. The book publications of the year consisted of 1 annual report, 6 professional papers and 9 separate chapters from 2 professional papers, 28 bulletins and 42 separate chapters from 5 bulletins, 15 water-supply papers and 6 separate chapters from 2 water-supply papers, 1 annual report on Mineral Resources, 1912 (published also in 64 advance chapters, 18 delivered in 1912–13 and 46 in 1913–14), 16 advance chapters from the annual report on Mineral Resources for 1913, 5 geologic folios, 3 pamphlets entitled "Suggestions to authors of papers submitted for publication by the United States Geological Survey," "Service Bulletin, July, 1913," and "Plans and specifications for current-meter gaging stations," 3 charts showing mineral and clay products and coal production, 27 map index circulars and lists of publications, and 55 press bulletins. The total number of pages in these publications was 16,631.

The total of all editions received was 475,925 books, 23,070 geologic folios, and 929,446 maps, a grand total of 1,428,441. There were distributed 585,514 books, 64,543 folios, and 454,654 maps (including 197 books, 59,075 folios, and 338,253 maps sold), a total of 1,105,711, a notable increase in distribution of book publications.

The publications of the year are listed below:

THIRTY-FOURTH ANNUAL REPORT OF THE DIRECTOR of the United States Geological Survey to the Secretary of the Interior, for the fiscal year ended June 30, 1913. 1913. 183 pages, 2 plates.

A detailed account of the nature and extent of the public service performed by the Geological Survey during the fiscal year 1913, with a statement of the total appropriation made by Congress for the Survey and the allotments for each kind of work. The report contains also notes on special features of the Survey's work, abstracts of the publications of the year, and maps of the United States showing areas covered by topographic and geologic surveys.

PROFESSIONAL PAPER 76. The San Franciscan volcanic field, Arizona, by H. H. Robinson. 1913. 213 pages, 14 plates, 36 text figures.

The San Franciscan volcanic field, of which this report treats, covers about 3,000 square miles in the north-central part of Arizona, 50 miles south of the Grand Canyon of the Colorado. It takes its name from San Francisco Mountain, the largest volcano of the group.

The paper deals primarily with the volcanic phenomena of the region and discusses in detail the igneous rocks, considered both individually and as a series of genetically related members. The illustrations include geologic maps and cross sections of parts of the field, profiles of some of the peaks, photomicrographs of typical lava textures, and halftone views.

PROFESSIONAL PAPER 80. Geology and ore deposits of the San Francisco and adjacent districts, Utah, by B. S. Butler. 1913. 212 pages, 41 plates, 16 text figures.

A complete geologic report on the San Francisco mining district, in Beaver County, Utah. This district yielded rich returns in the early days of mining in Utah, but its output soon declined, and interest in it was revived only with the development of the Cactus mine in 1903. Each mine in the region is described and suggestions as to prospecting and the author's predictions as to the future of the district are given. The book contains plans and sections of some of the mines and halftone plates illustrating geologic conditions in the district and mineral specimens.

PROFESSIONAL PAPER 81. Cretaceous deposits of the eastern Gulf region and Species of Exogyra from the eastern Gulf region and the Carolinas, by L. W. Stephenson. 1914. 77 pages, 21 plates, 2 text figures.

The first paper of this book, "Cretaceous deposits of the eastern Gulf region," is a brief statement of the results of investigations made by the author during recent years in the Cretaceous areas of the region named in order to determine the lithologic units worthy of recognition as formations or as members, the lithologic and paleontologic occurrence of these units, and their stratigraphic and age relations. The major lithologic divisions present have all been recognized more or less clearly by previous investigators, but more definite knowledge has been gained of the character and the geologic and geographic boundaries of the several units recognized. The chief additions to the knowledge of the region have been those furnished by a critical study of the organic remains entombed in the deposits, for by this means much light has been thrown on the age relations of the several lithologic units.

The purpose of the second paper, "Species of Exogyra from the eastern Gulf region and the Carolinas," is to demonstrate that the representatives

of the marine fossil genus Exogyra in the regions under discussion are separable into at least three species, two of which present well-characterized varieties, and to show that these forms are so restricted in range as to give them distinct value in correlation. The author's statements as to the range, distribution, and occurrence of the species and varieties of Exogyra in the eastern Gulf region and the Carolinas are based, for the most part, on a study of the collections in the National Museum and on personal field observations.

The book contains tables giving the range of Cretaceous fossils, a geologic map of the Cretaceous deposits of the eastern Gulf region, and reproductions of some of the fossil specimens.

PROFESSIONAL PAPER 82. Geology of Long Island, New York, by M. L. Fuller. 1914. 231 pages, 27 plates, 205 text figures.

An exhaustive report on the geology of Long Island, N. Y., including physiography, stratigraphy, and geologic history. New geologic facts developed in the course of the investigations of which this paper is the outcome necessitated a complete revision of the geology of the island as it was known prior to 1903. The investigations along the New York and New England coasts have developed in this eastern region what the author regards as evidence of all but one of the five principal glacial stages recognized in central United States. The Long Island section, which exhibits more clearly than any other the formations of the Pleistocene epoch, is discussed in detail to supply a basis of comparison with similar deposits elsewhere. This systematic discussion is followed by a short tabular summary of the geographic distribution of exposures and by a chapter on correlation, in which the equivalency of the deposits of Long Island to glacial deposits elsewhere, especially to those of the New England coast, is considered. The illustrations consist of topographic and geologic maps of the island and of parts of it, halftone views showing topographic features, and text figures representing geologic sections and profiles.

PROFESSIONAL PAPER 83. The Middle Triassic marine invertebrate faunas of North America, by J. P. Smith. 1914. 254 pages, 99 plates.

The first to appear of three volumes on the marine invertebrate faunas of the Lower, Middle, and Upper Triassic of America and essentially a continuation of Professional Paper 40, "The Triassic cephalopod genera of America," which forms a synoptical introduction to the whole faunal work on American Triassic invertebrates. The descriptions of the major groups and genera given in the earlier work are not repeated in Professional Paper 83, but all figures and descriptions of species of Middle Triassic cephalopods that appear in Professional Paper 40 are repeated for convenience of reference. The book is profusely illustrated by halftone plates showing Middle Triassic invertebrates.

PROFESSIONAL PAPER 84. The Upper Cretaceous and Eocene floras of South Carolina and Georgia, by E. W. Berry. 1914. 200 pages, 29 plates, 12 text figures.

This paper presents the first systematic account of fossil plants from the Coastal Plain districts of Georgia and South Carolina. Although preliminary in nature, it describes a considerable flora, which clearly demonstrates the Upper Cretaceous age of the deposits in which it is found and which serves to correlate these deposits with the Upper Cretaceous of adjacent States. The illustrations consist mainly of halftone views of Upper Creta-

ceous specimens from the States discussed, restorations of some of the leaves found, and sketch maps showing the distribution in both hemispheres of certain Cretaceous and Recent plant forms.

PROFESSIONAL PAPER 85. Shorter contributions to general geology, 1913; advance chapters as follows:

PROFESSIONAL PAPER 85–A. The origin of colemanite deposits, by H. S. Gale. 1913. 9 pages.

This paper is the first of a new series to be published by the Survey under the title "Shorter contributions to general geology." The papers included in this series may relate to any phase of geology, such as petrology, paleontology, stratigraphy, glaciology, and structural geology, provided it possesses general interest. The volume is intended as a dignified collection of scientific contributions, each worthy in importance of subject, value of results, and quality of treatment for separate publication as a bulletin or professional paper if it were of sufficient length.

In Professional Paper 85–A the author advances the theory (which has not yet been entirely proved) that colemanite is formed from limestone in veins by replacement of carbonic acid with boric acid.

PROFESSIONAL PAPER 85–B. The mud lumps at the mouths of the Mississippi, by E. W. Shaw. 1913. 17 pages, 3 plates, 6 text figures.

In this paper the author considers the origin of the mud lumps in the Delta of the Mississippi so far as it bears on the problem of preventing their formation in places where they are objectionable. The Delta material consists mostly of interlaminated or interbedded thin layers of fine sand and dark-blue clay. According to the author's hypothesis a gentle seaward flow of the delta materials under the land and shallow water near the ends of the passes is taking place. Where this flow is opposed by the comparatively resistant parts of the sediments at the front of the Delta the soft clay is squeezed out and forms the mud lumps. The tendency to flow is assumed to be due to pressure developed by constant additions of sediment.

PROFESSIONAL PAPER 85–C. Interpretation of anomalies of gravity, by G. K. Gilbert. 1913. 9 pages, 1 plate, 1 text figure.

A geologist's statement of the possible methods of interpreting the anomalies of gravity—the differences in the observed and computed intensities of gravity at stations established for its measurement.

PROFESSIONAL PAPER 85–D. The Jurassic flora of Cape Lisburne, Alaska, by F. H. Knowlton. 1914. 26 pages, 4 plates.

A study of the fossil plants of Cape Lisburne, the bold headland which marks the northern extremity of a land mass projecting into the Arctic Ocean from the western coast of Alaska, 160 miles north of the Arctic Circle, about 300 miles directly north of Nome. The most notable and interesting fact brought out in the study of this flora, as well as that of other parts of Alaska, is that a moist, warm, and perhaps even subtropical climate prevailed in the Arctic regions up to fairly recent geologic time, in striking contrast to the frigid temperature which now makes them barren and inhospitable. The paper contains four plates showing specimens of the flora.

PROFESSIONAL PAPER 85–E. Resins in Paleozoic plants and in coals of high rank, by David White. 1914. 32 pages, 6 plates.

This paper presents evidence that anthracite and bituminous coals, as well as those of lower rank, originated as peats, and that the plants from which

the Paleozoic coals were formed were in part resin-bearing—in fact, the resin-bearing elements in the coal-forming floras of the Carboniferous period, to which the bituminous and high-rank coals of most parts of the world belong, are perhaps as numerous as in the floras from which the coals of later epochs were formed. The author points out the general prominence of resins in the Mesozoic and Tertiary coals of low bituminous and inferior ranks and contributes observations as to the disappearance of the resins in these coals in the course of carbonization under regional metamorphism, the resins disappearing at about the stage of carbonization at which the coking quality of the coals is well developed. After reviewing the evidence as to resin and gum secretion in the petrified fragments of Paleozoic plants described by several paleobotanists, he describes and illustrates, by means of selected materials, both common and unique, the abundant resinous matter in Paleozoic coals of medium bituminous or lower ranks.

PROFESSIONAL PAPER 90. Shorter contributions to general geology, 1914; advance chapters as follows:

PROFESSIONAL PAPER 90–A. Geology of the pitchblende ores of Colorado, by E. S. Bastin. 1914. 5 pages, 2 plates.

Part of Professional Paper 90, "Shorter contributions to general geology, 1914." A brief account of the mode of occurrence of pitchblende at Quartz Hill, in Gilpin County, Colo. The great interest that has recently been manifested in radium because of the apparent cures of cancer effected by certain of its emanations makes it desirable to place before the public as promptly as possible all available information in regard to the occurrence of the minerals from which radium may be derived. The present paper is therefore published in advance of a much larger report on the same region in which ore deposits of many other types will be considered.

PROFESSIONAL PAPER 90–B. Erosion and sedimentation in Chesapeake Bay around the mouth of Choptank River, by J. F. Hunter. 1914. 9 pages, 1 plate, 1 text figure.

Results of a test investigation of erosion and sedimentation in the basin of Chesapeake Bay, a region whose topography and hydrography have undergone significant change in the last half century. Although the data here set forth are chiefly of local importance, it is hoped that the study may suggest certain methods that are applicable to a complete study of the bay.

PROFESSIONAL PAPER 90–C. Dike rocks of the Apishapa quadrangle, Colorado, by Whitman Cross. 1914. 15 pages, 4 plates.

A petrographic study of the dike rocks of the Apishapa quadrangle, situated in the plains south of Arkansas River, in Colorado, about 24 miles east of the mountain front. Forty-three dikes have been observed in this quadrangle. They are mostly vertical in position and tread nearly west. According to the current system of classification, most of these rocks are alkali feldspars.

PROFESSIONAL PAPER 90–D. The composition of crinoid skeletons, by F. W. Clarke and W. C. Wheeler. 1914. 5 pages.

A study of the chemical composition of crinoid skeletons in order to determine the function of this class of organisms in the formation of certain sedimentary rocks. The two positive conclusions reached in this investigation are that the recent crinoids are distinctly magnesian and that the proportion of magnesia is dependent in some way on temperature.

BULLETIN 525. A geologic reconnaissance of the Fairbanks quadrangle, Alaska, by L. M. Prindle, with a detailed description of the Fairbanks district by L. M. Prindle and F. J. Katz and an account of lode mining near Fairbanks by P. S. Smith. 1913. 220 pages, 22 plates, 20 text figures.

Comprises a general description of the geology and mineral resources of the Fairbanks quadrangle (in the Yukon-Tanana region) and a more detailed description of the geology, mineral resources, and mining development of an area lying adjacent to the town of Fairbanks. Important data are given concerning the nature and geologic relations of the different kinds of bedrock, the character and distribution of the deposits overlying the bedrock, and the occurrence of gold.

BULLETIN 526. Coastal glaciers of Prince William Sound and Kenai Peninsula, Alaska, by U. S. Grant and D. F. Higgins. 1913. 75 pages, 40 plates, 18 text figures.

A brief account of an investigation of certain Alaskan glaciers with the intention of supplying some definite information regarding the present positions of the glaciers and the more evident facts of their fluctuations. Comparisons are made with earlier observations to show the advance or retreat of the glaciers examined. The illustrations include maps of the glaciers and the country adjacent to them and views of the glaciers, which constitute some of the most magnificent American scenery that is now accessible to the tourist and nature lover.

BULLETIN 528. Geology and ore deposits of Lemhi County, Idaho, by J. B. Umpleby. 1913. 182 pages, 23 plates, 24 text figures.

Discusses the geography, physiography, and geology of Lemhi County as a whole and gives descriptions of 19 mining districts and notes on the mines of each district. The ore deposits may be grouped as gold placers and lodes, lead-silver veins and tabular replacements, copper-bearing gold veins, cobalt-nickel deposits, and tungsten-bearing veins. The total production of the county is about $20,000,000, two-thirds of which is represented by gold. With the advent of the railroad and modern methods of mining the outlook for a steady growth in the mining industry has become bright. The bulletin contains a topographic sketch map of the county, sections of the veins, claim sheets of some of the districts, and photomicrographs of rock specimens from the deposits.

BULLETIN 531. Contributions to economic geology (short papers and preliminary reports), 1911, Part II, Mineral fuels—M. R. Campbell, geologist in charge. 1913. 361 pages, 24 plates, 10 text figures.

This bulletin includes 14 brief reports of two classes—(1) short papers giving comparatively detailed descriptions of deposits of mineral fuels that have economic interest but are not of sufficient importance to warrant a more extended description; (2) preliminary reports on economic investigations the results of which are to be published later in more detailed form. These papers are such only as have a direct economic bearing, all topics of purely scientific interest being excluded. They have been grouped according to subjects or general regions and each group has been issued as an advance chapter as soon as it was ready. A complete list of the papers included in the volume follows:

The Menifee gas field and the Ragland oil field, Kentucky, by M. J. Munn.
Oil and gas development in north-central Oklahoma, by R. H. Wood.

Geology and petroleum resources of the De Beque oil field, Colorado, by E. G. Woodruff.

Geologic structure of the Punxsutawney, Curwensville, Houtzdale, Barnesboro, and Patton quadrangles, central Pennsylvania, by G. H. Ashley and M. R. Campbell.

The Williston lignite field, Williams County, N. Dak., by F. A. Herald.

The Little Sheep Mountain coal field, Dawson, Custer, and Rosebud counties, Mont., by G. S. Rogers.

Coal in the Tertiary lake beds of southwestern Montana, by J. T. Pardee.

Coal at Horseshoe Bend and Jerusalem Valley, Boise County, Idaho, by C. F. Bowen.

Lignite in the Goose Creek district, Cassia County, Idaho, by C. F. Bowen.

The Barber coal field, Johnson County, Wyo., by C. H. Wegemann.

The Cerrillos coal field, Santa Fe County, N. Mex., by W. T. Lee.

The Coaldale coal field, Esmeralda County, Nev., by J. H. Hance.

Coal resources of Cowlitz River valley, Cowlitz and Lewis counties, Wash., by A. J. Collier.

Miscellaneous analyses of coal samples from various fields of the United States.

BULLETIN 533. Geology of the Nome and Grand Central quadrangles, Alaska, by F. H. Moffit. 1913. 140 pages, 12 plates, 13 text figures.

This bulletin describes the geology of the Nome and Grand Central quadrangles, in the south-central part of Seward Peninsula, Alaska, emphasizing especially their mineral resources. Mining for gold is the chief industry and placer deposits are more numerous than lodes. The illustrations include topographic and geologic maps of each of the quadrangles, sketch maps of certain economically important districts, and sections of gravel deposits.

BULLETIN 536. The Noatak-Kobuk region, Alaska, by P. S. Smith. 1913. 160+x pages, 15 plates, 1 text figure.

The first published account of the geology and resources of the Noatak-Kobuk region, which is adjacent to two of the largest streams of Alaska. An outline of scientific exploration in northern Alaska is given, but the report treats mainly of the economic geology and the geographic features that have important control of the development of the mining industry, which is carried on chiefly for the recovery of placer gold. The book contains also some valuable information on the extent of existing glaciers and on the former period of glaciation, and is illustrated by topographic and geologic maps, a map showing distribution of timber in the region, and halftones representing typical geologic features.

BULLETIN 538. A geologic reconnaissance of the Circle quadrangle, Alaska, by L. M. Prindle. 1913. 82 pages, 13 plates, 2 text figures.

A sketch of the geography and geology of the Yukon-Tanana region in general and of the Circle quadrangle in particular. This quadrangle covers about 17,000 square miles and includes several districts that have been productive of placer gold. The report describes especially the placers of the Birch Creek district and of the creeks tributary to the Yukon above Circle. It contains topographic and geologic maps of the quadrangle and halftone plates showing geologic and mining features.

BULLETIN 539. Some ore deposits in northwestern Custer County, Idaho, by J. B. Umpleby. 1913. 104 pages, 10 plates, 4 text figures.

This report sets forth the results of a short reconnaissance in the Loon Creek, Yankee Fork, and Bay Horse mining districts, situated in the north-

western part of Custer County, Idaho. The area includes several promising ore deposits and a few mines where large quantities of ore are blocked out, awaiting more advantageous transportation facilities.

The area is first treated as a unit in order to bring out the broader relations, and then the three districts are taken up separately, thus making the report equally valuable to the student of the general subject of ore deposits and to the person interested in a particular district.

The book is illustrated by topographic and geologic sketch maps and plates showing views of the mines and specimens of ore.

BULLETIN 540. Contributions to economic geology (short papers and preliminary reports), 1912, Part I, Metals and nonmetals except fuels—David White, chief geologist. 1914. 563 pages, 11 plates, 60 text figures.

This bulletin is made up of 30 brief reports on investigations of mineral deposits except fuels in the United States in 1912. The papers are such only as have a direct economic bearing, all topics of purely scientific interest being excluded. They have been grouped according to the subjects or localities treated, and each group has been issued as an advance chapter as soon as it was ready. A complete list of the papers included is given below. The volume contains also lists of Survey publications on the several classes of mineral deposits.

Auriferous gravels in the Weaverville quadrangle, California, by J. S. Diller.

Gold lodes of the Weaverville quadrangle, California, by H. G. Ferguson.

Mineral resources of the Inyo and White mountains, California, by Adolph Knopf.

The ore deposits of Kirwin, Wyo., by D. F. Hewett.

Copper deposits near Superior, Ariz., by F. L. Ransome.

Copper deposits of the White Mesa district, Ariz., by J. M. Hill.

Economic geology of the region around Mullan, Idaho, and Saltese, Mont., by F. C. Calkins and E. L. Jones, jr.

The lead-silver deposits of the Dome district, Idaho, by J. B. Umpleby.

The Yellow Pine mining district, Clark County, Nev., by J. M. Hill.

Preliminary report on the red iron ores of east Tennessee, northeast Alabama, and northwest Georgia, by E. F. Burchard.

Titaniferous magnetite beds on the Blackfeet Indian Reservation, Mont., by Eugene Stebinger.

Recent discoveries of "Clinton" iron ore in eastern Wisconsin, by F. T. Thwaites.

Alunite in granite porphyry near Patagonia, Ariz., by F. C. Schrader.

Alunite at Bovard, Nev., by F. C. Schrader.

The Aberdeen granite quarry, near Gunnison, Colo., by J. F. Hunter.

Ornamental marble near Barstow, Cal., by R. W. Pack.

Clay in northwestern Montana, by C. M. Bauer.

Phosphate deposits in southwestern Virginia, by G. W. Stose.

Notes on the Quaternary lakes of the Great Basin, with special reference to the deposition of potash and other salines, by H. S. Gale.

Prospecting for potash in Death Valley, Cal., by H. S. Gale.

Salt, borax, and potash in Saline Valley, Inyo County, Cal., by H. S. Gale.

Potash tests at Columbus Marsh, Nev., by H. S. Gale.

Sodium sulphate in the Carrizo Plain, San Luis Obispo County, Cal., by H. S. Gale.

Borate deposits in Ventura County, Cal., by H. S. Gale.

Potash in western saline deposits, by J. H. Hance.

Niter near Melrose, Mont., by R. W. Richards.

Sulphur deposits in Park County, Wyo., by D. F. Hewett.

Late developments of magnesite deposits in California and Nevada, by H. S. Gale.

Celestite deposits in California and Arizona, by W. C. Phalen.

New areas of diamond-bearing peridotite in Arkansas, by H. D. Miser.

BULLETIN 541. Contributions to economic geology (short papers and preliminary reports), 1912, Part II, Mineral fuels; advance chapters as follows:

BULLETIN 541–A. Oil and gas in the northern part of the Cadiz quadrangle, Ohio, by D. D. Condit; Gas from mud lumps at the mouths of the Mississippi, by E. W. Shaw. 1913. 15 pages, 1 plate.

The first paper discusses the oil and gas prospects of a part of eastern Ohio and contains a map of the region discussed showing structure contours on top of the Berea sand, whence comes practically all of the oil in this part of the State.

The second paper sets forth the principal facts bearing on the possible existence of valuable accumulations of gas in the mud lumps at the mouths of the Mississippi. These mud lumps are great swellings of soft bluish-gray clay which rise in the shallow water near the mouths of the river, commonly forming islands with a surface extent of an acre or more and a height of 5 to 10 feet.

BULLETIN 541–B. Structure of the Fort Smith-Poteau gas field, Arkansas-Oklahoma; The Glenn oil and gas pool and vicinity, Oklahoma, by C. D. Smith. 1913. 28 pages, 2 plates, 1 text figure.

These papers discuss briefly the fields named, pointing out the relation existing between accumulations of oil and gas and the geologic structure as shown by the attitude of surface strata, with a view to ascertaining some general relations that may be applicable to fields in Arkansas and Oklahoma which are yet untouched or only partly developed.

BULLETIN 541–C. The Douglas oil and gas field, Converse County, Wyo., by V. H. Barnett; The Shoshone River section, Wyoming, by D. F. Hewett. 1914. 67 pages, 2 plates, 2 text figures.

The first paper gives the results of an investigation of the Douglas oil and gas field in order to ascertain the mineral resources, especially oil, gas, and coal, for the purpose of classifying the land by legal subdivisions into mineral land and nonmineral land. A secondary object was to determine the geologic structure, the various formations involved, and the conditions which have resulted in the accumulation of oil and gas.

The second paper describes the geology of the area adjacent to Shoshone River, which rises among the ridges of the Absaroka Range in northwestern Wyoming and flows northeastward to a point near the Montana line, where it empties into Bighorn River. With a view of using it as a guide in the study and mapping of a large area south of the river in which the geologic structure is favorable for the accumulation of oil and gas, the Mesozoic section along the river east of the Rattlesnake Mountain fold has been accurately measured and examined in greater detail than is customary in such investigations.

BULLETIN 541–D. Oil and gas near Green River, Grand County, Utah, by C. T. Lupton; Petroleum near Dayton, N. Mex., by G. B. Richardson. 1913. 27 pages, 1 plate, 1 text figure.

The first paper gives the results of a detailed investigation of the oil and gas resources near Green River, Grand County, Utah. The investigation

showed that, while traces of oil and small pockets of gas have been encountered in some of the wells, there are no anticlines or domes in which large quantities of oil or gas might be expected to collect.

The second paper discusses the possible occurrence of a commercially important quantity of petroleum near Dayton, N. Mex., in the Pecos Valley.

BULLETIN 541–E. Reconnaissance of the Barstow-Kramer region, California, by R. W. Pack. 1913. 16 pages, 1 plate.

The reconnaissance survey described in this paper was made in order to determine whether or not oil might be expected to occur in the Barstow-Kramer region in commercially valuable quantities. As a result of his investigation the author concludes that the northern part of the Mohave Desert between Barstow and Mohave offers practically no promise of becoming a productive oil field and that further drilling will prove a waste of money.

BULLETIN 541–G. The Cannonball River lignite field, North Dakota, by E. R. Lloyd. 1914. 51 pages, 2 plates, 1 text figure.

A detailed account of a survey of the Cannonball River lignite field, comprising a discussion of the geography and geology of the field and the distribution, physical properties, and mining development of the lignite and descriptions, by townships, of the beds.

BULLETIN 541–H. Coal and lignite fields in Montana, papers by C. M. Bauer, G. S. Rogers, and C. F. Bowen. 88 pages, 7 plates, 3 text figures. Contains:

Lignite in the vicinity of Plentywood and Scobey, Sheridan County, Mont., by C. M. Bauer.

Geology and coal resources of the area southwest of Custer, Yellowstone and Bighorn counties, Mont., by G. S. Rogers.

Coal discovered in a reconnaissance survey between Musselshell and Judith, Mont., by C. F. Bowen.

The Cleveland coal field, Blaine County, Mont., by C. F. Bowen.

The Big Sandy coal field, Chouteau County, Mont., by C. F. Bowen.

BULLETIN 541–I. Coal fields in Idaho, Washington, and Oregon. Papers by E. G. Woodruff and C. E. Lesher. 1914. 42 pages, 4 plates, 4 text figures. Contains:

The Horseshoe Creek district of the Teton Basin coal field, Fremont County, Idaho, by E. G. Woodruff.

The Glacier coal field, Whatcom County, Wash., by E. G. Woodruff.

The Eden Ridge coal field, Coos County, Oreg., by C. E. Lesher.

BULLETIN 541–K. Analyses of coal samples from various fields in the United States. 1914. 38 pages.

Contains tables, arranged by States and counties, giving analyses and descriptions of all coal samples collected by the United States Geological Survey during the year 1913.

BULLETIN 542. Mineral resources of Alaska: report on progress of investigations in 1912, by A. H. Brooks and others. 1913. 308+x pages, 10 plates, 7 text figures.

A collection of 12 brief reports on the work of the Geological Survey in Alaska during 1912. Illustrated by a map of Alaska showing railway routes from the Pacific seaboard to the Yukon and Kuskokwim, geologic sketch maps of several of the mining regions, and hydrographs showing the daily dis-

charge of Yukon and Fortymile rivers. The titles of the papers are given below:

Administrative report, by A. H. Brooks.
The mining industry in 1912, by A. H. Brooks.
Marble resources of Ketchikan and Wrangell districts, by E. F. Burchard.
The McKinley Lake district, by Theodore Chapin.
Mining in Chitina Valley, by F. H. Moffit.
Mineral deposits of the Ellamar district, by S. R. Capps and B. L. Johnson.
Mineral deposits of Kodiak and the neighboring islands, by G. C. Martin.
Lode mining near Fairbanks, by P. S. Smith.
Placer mining in the Yukon-Tanana region, by C. E. Ellsworth and R. W. Davenport.
Water supply of the Yukon-Tanana region, 1912, by C. E. Ellsworth and R. W. Davenport.
Gold placers of the Ruby district, by H. M. Eakin.
Gold placers of the Innoko-Iditarod region, by H. M. Eakin.

BULLETIN 543. Geology and geography of a portion of Lincoln County, Wyo., by A. R. Schultz. 1914. 141 pages, 11 plates, 8 text figures.

Describes in detail the geography and geology, both historical and economic, of an area of about 2,500 square miles in Lincoln County, Wyo. This county is in the extreme western part of the State and until 1912 was a part of Uinta County. Coal, petroleum, gold, and phosphate occur in the area, but mining has not progressed far beyond the prospecting stage. The bulletin is illustrated by topographic and geologic maps of the area, sections of coal beds, and halftone plates showing views of geologic interest.

BULLETIN 545. Bibliography of North American geology for 1912, with subject index, by J. M. Nickles. 1913. 192 pages.

A list, arranged alphabetically by authors' names, of publications on the geology of the continent of North America and adjacent islands, also Panama and the Hawaiian Islands, published in 1912. The work is indexed and contains lists of chemical analyses reported and minerals, rocks, and formations described.

BULLETIN 546. Mineral resources of southwestern Oregon, by J. S. Diller. 1914. 147 pages, 11 plates, 26 text figures.

Describes briefly the geography and geology of southwestern Oregon, in the vicinity of the Klamath Mountains, which has been known since its earliest history as a region of important mineral resources. It abounds in gold and coal, and mining has progressed steadily since these resources were first discovered. The report describes the lode and placer mines and prospects in detail as well as the several coal fields and is illustrated by maps showing the location of the gold-quartz mines and geologic sections of some of the mines and coal fields.

BULLETIN 547. Reconnaissance of the Grandfield district, Oklahoma, by M. J. Munn. 1914. 85 pages, 5 plates.

This report discusses the general geologic conditions in the Grandfield district (which embraces about 360 square miles in Tillman and Cotton counties, Okla.), especially those that furnish a clue to the possible location of oil and gas pools. The district was examined in the hope that geologic work in advance of drilling might enable oil and gas prospectors to place their test wells most favorably and so avoid losses involved in drilling dry holes and at the same time obtain the best tests for the presence of oil and gas in

paying quantities. The illustrations include geologic sketch maps of the Grandfield district and of Oklahoma and northern Texas and sections of deep wells in this general region.

BULLETIN 551. Results of triangulation and primary traverse, 1911 and 1912—R. B. Marshall, chief geographer. 1914. 396 pages, 2 plates.

Gives the results of triangulation and primary traverse in the United States for the years 1911 and 1912, listing 367 triangulation stations and 7,308 primary traverse stations, nearly all on United States standard datum. Includes a map showing the condition of astronomic location and primary control to January 1, 1913, and a halftone plate showing Geological Survey station marks.

BULLETIN 552. Results of triangulation and primary traverse in Ohio, 1898 to 1911, inclusive—R. B. Marshall, chief geographer. 1914. 232 pages, 2 plates.

Lists 182 triangulation stations and 5,416 primary traverse stations in Ohio, all on United States standard datum. Illustrated by a map showing condition of primary control to January 1, 1912, and a halftone plate showing Geological Survey station marks.

BULLETIN 553. Results of spirit leveling in Illinois, 1911 to 1913, inclusive—R. B. Marshall, chief geographer. 1914. 110 pages, 1 plate.

BULLETIN 554. Results of spirit leveling in Kentucky, 1898 to 1913, inclusive—R. B. Marshall, chief geographer. 1914. 184 pages, 1 plate.

BULLETIN 555. Results of spirit leveling in Indiana, 1897 to 1911, inclusive—R. B. Marshall, chief geographer. 1913. 51 pages, 1 plate.

BULLETIN 556. Results of spirit leveling in Oregon, 1896 to 1913, inclusive—R. B. Marshall, chief geographer. 1914. 175 pages, 1 plate.

BULLETIN 557. Results of spirit leveling in the State of Washington, 1896 to 1913, inclusive—R. B. Marshall, chief geographer. 1914. 178 pages, 1 plate.

BULLETIN 558. Results of spirit leveling in Wyoming, 1896 to 1912, inclusive—R. B. Marshall, chief geographer. 1914. 148 pages, 1 plate.

BULLETIN 564. Results of spirit leveling in Oklahoma, 1895 to 1912, inclusive—R. B. Marshall, chief geographer. 1914. 119 pages, 1 plate.

BULLETIN 571. Results of spirit leveling in Kansas, 1896 to 1913, inclusive—R. B. Marshall, chief geographer. 1914. 47 pages, 1 plate.

Reports on precise and primary leveling in the States mentioned, showing the exact altitude of a great number of places. The work in Illinois and Kentucky, and part of that in Oklahoma, Oregon, and Washington was done in cooperation with the States. Each bulletin contains a halftone plate showing Geological Survey designs for bench marks.

BULLETIN 575. Geology of the Standing Rock and Cheyenne River Indian reservations, North and South Dakota, by W. R. Calvert, A. L. Beekly, V. H. Barnett, and M. A. Pishel. 1914. 49 pages, 8 plates, 1 text figure.

A compilation of the information obtained by three parties of Survey geologists sent to examine the Standing Rock and Cheyenne River Indian reservations in order to ascertain definitely the coal resources of the area. The surplus and unallotted lands in these reservations were to be sold or allotted to homesteaders, and it was necessary that their mineral value be known. The bulletin describes the geology of the area in detail and discusses its underground water and other mineral resources, which comprise a very small

amount of impure lignite, clay that might be utilized for brick, and gravel for road building. The report concludes with the statement that, as the quantity of lignite is not sufficient to justify the establishment of an extensive mining plant, mining will continue to be limited (as it now is) to a few small prospects where the fuel is taken out for local consumption. The illustrations include a geologic map of the reservations, a map showing outcrops of coal, and sections showing thickness of beds.

BULLETIN 580. Contributions to economic geology (short papers and preliminary reports), 1913, Part I, Metals and nonmetals except fuels; advance chapters as follows:

BULLETIN 580–A. The Darwin silver-lead mining district, California, by Adolph Knopf. 1914. 18 pages, 3 text figures.

Describes briefly the geologic features of the Darwin district, including the ore deposits, mines, and prospects. This district has yielded between $2,000,000 and $3,000,000 in argentiferous lead.

BULLETIN 580–B. Notes on the Unaweep copper district, Colorado, by B. S. Butler. 1914. 7 pages.

Notes the more important geologic features bearing on the ore deposits of the Unaweep district, visited in September, 1913. Copper is the main valuable metal of the district, though the ores contain some gold and silver.

BULLETIN 580–C. Some cerusite deposits in Custer County, Colo., by J. F. Hunter. 1914. 13 pages, 2 text figures.

Consists of notes based on information gained during a two-day visit in June, 1913, to the zone of cerusite deposits along Oak Creek in the vicinity of Ilse, Custer County. Includes a geologic section across the cerusite belt and a plan of the Terrible mine—the principal mine of the district.

BULLETIN 580–D. The Grand Gulch mining region, Mohave County, Ariz., by J. M. Hill. 1914. 20 pages, 5 text figures.

Discusses briefly the economic conditions, such as transportation, water, climate, timber, and labor in the Grand Gulch region, and describes the equipment, development, and ores of the Grand Gulch and Bronze L mines.

BULLETIN 580–E. A new gypsum deposit in Iowa, by G. F. Kay. 1914. 6 pages, 1 text figure.

Tells of a recently discovered gypsum deposit in the southern part of the town of Centerville, Appanoose County, Iowa. The evidence indicates that the deposit may be extensive, and the gypsum is of good quality. The deposit is well located with regard to fuel and transportation, and it is fair to assume that if gypsum products were made in this part of the State a good market for such products could soon be developed.

BULLETIN 581. Contributions to economic geology (short papers and preliminary reports), 1913, Part II, Mineral fuels; one advance chapter, namely:

BULLETIN 581–A. Oil shale of northwestern Colorado and northeastern Utah, by E. G. Woodruff and D. T. Day. 1914. 21 pages, 1 plate.

An account of a reconnaissance survey of a part of the area occupied by the Green River formation in Utah and Colorado in order to determine the geographic distribution and thickness of the oil shale which occurs there. The results of the survey indicate that the shale contains a large reserve supply of oil which sooner or later will be used to supplement the product of the well-known fields.

BULLETIN 585. Useful minerals of the United States, compiled by Samuel Sanford and R. W. Stone. 1914. 250 pages.

The material in this bulletin is arranged in two distinct parts. The first part gives concisely the location, by States, of the principal deposits of useful minerals. The States are arranged alphabetically and under each State the minerals found there are given, also in alphabetic sequence. The second part is virtually an index to the first part. It consists of a glossary of more than 425 minerals, showing the composition and character of each mineral and the location, by States, of its principal deposits.

WATER-SUPPLY PAPER 302. Surface water supply of the United States, 1911, Part II, South Atlantic coast and eastern Gulf of Mexico drainage basins, prepared under the direction of M. O. Leighton by M. R. Hall and C. H. Pierce. 1913. 90 pages, 4 plates.

WATER-SUPPLY PAPER 303. Surface water supply of the United States, 1911, Part III, The Ohio River basin, prepared under the direction of M. O. Leighton by A. H. Horton, M. R. Hall, and H. J. Jackson. 1913. 112 pages, 4 plates.

WATER-SUPPLY PAPER 306. Surface water supply of the United States, 1911, Part VI, Missouri River basin, prepared under the direction of M. O. Leighton by W. A. Lamb, W. B. Freeman, and Raymond Richards. 1914. 374 pages, 4 plates.

WATER-SUPPLY PAPER 307. Surface water supply of the United States, 1911, Part VII, Lower Mississippi River basin, prepared under the direction of M. O. Leighton by W. B. Freeman and H. J. Dean. 1913. 90 pages, 4 plates.

WATER-SUPPLY PAPER 308. Surface water supply of the United States, 1911, Part VIII, Western Gulf of Mexico, prepared under the direction of M. O. Leighton by W. W. Follett, W. B. Freeman, and G. K. Larrison. 1913. 117 pages, 4 plates.

WATER-SUPPLY PAPER 309. Surface water supply of the United States, 1911, Part IX, Colorado River basin, prepared under the direction of M. O. Leighton by Robert Follansbee, W. B. Freeman, and G. C. Baldwin. 1914. 266 pages, 4 plates.

These reports present briefly the results of measurements of flow made in streams in the drainage basins named during the calendar year 1911. Data for each gaging station are given under the following heads: Location, Records available, Drainage area of stream, Gage, Channel, Discharge measurements, Accuracy, and Cooperation. The books also contain tables giving gage heights and daily and monthly discharges at each station, lithographed maps showing the mean annual precipitation and run-off in the United States, and halftone plates representing typical gaging stations and current meters.

WATER-SUPPLY PAPER 318. Water resources of Hawaii, 1909–1911, prepared under the direction of M. O. Leighton by W. F. Martin and C. H. Pierce. 1913. 552 pages, 15 plates, 4 text figures.

This volume contains results of measurements of the flow of certain streams and ditches in the Territory of Hawaii made during the period 1909 to 1911, inclusive, an account of the factors that affect the flow, and a brief summary of the general conditions influencing the economic development and use of the surface waters. The illustrations consist of drainage maps of some of the islands, showing location of gaging stations, diagrams explaining features of discharge, and halftone plates showing typical gaging stations, waterfalls, and mountain streams. The volume contains also an appendix comprising notes

on the pronunciation and meaning of Hawaiian geographic names and a gazetteer.

WATER-SUPPLY PAPER 319. Geology and ground waters of Florida, by G. C. Matson and Samuel Sanford. 1913. 444 pages, 17 plates, 7 text figures.

A detailed report on the geography, stratigraphy, and geologic history of Florida with especial reference to its underground water. The water supply of each county, as well as of the State as a whole, is discussed with reference to its source, quality, and development, and tables giving interesting data about typical wells of the State are added to many of the county descriptions. The illustrations include a general topographic and geologic map of Florida, a map of its Pleistocene terraces, a diagram showing the importance of choosing proper locations for wells, and halftones showing features of geologic interest.

WATER-SUPPLY PAPER 320. Geology and water resources of Sulphur Spring Valley, Arizona, by O. E. Meinzer and F. C. Kelton, with a section on agriculture by R. H. Forbes. 1913. 231 pages, 15 plates, 32 text figures.

Discusses the physiography, drainage, and geology of Sulphur Spring Valley in detail, with especial reference to rainfall, artesian conditions, and the occurrence, level, and quality of ground waters. In the section on agriculture Mr. Forbes explains the several methods of farming employed in the valley and concludes that the most certain of these is dry farming supplemented by pumped water supply. The pumping plants in use are fully described. The report contains maps showing the geology and vegetation, depth to water, elevation of ground-water table, and approximate amounts of dissolved solids and certain chemicals in the ground waters in the valley, as well as diagrams showing the daily, monthly, and annual rainfall and deviations from the average rainfall.

WATER-SUPPLY PAPER 322. Surface water supply of the United States, 1912, Part II, South Atlantic coast and eastern Gulf of Mexico basins, by W. E. Hall and C. H. Pierce. 1914. 98 pages, 4 plates.

WATER-SUPPLY PAPER 323. Surface water supply of the United States, 1912, Part III, Ohio River basin, by A. H. Horton, W. E. Hall, and H. J. Jackson. 1914. 118 pages, 2 plates.

WATER-SUPPLY PAPER 324. Surface water supply of the United States, 1912, Part IV, St. Lawrence River basin, by C. C. Covert, A. H. Horton, and W. G. Hoyt. 1914. 149 pages, 3 plates.

These reports present briefly the results of measurements of stream flow made in the drainage basins named during the calendar year 1912. Data for each gaging station are given under the following heads: Location, Records available, Drainage area, Gage, Channel, Discharge measurements, Artificial control, Winter flow, Accuracy, and Cooperation. The books also contain tables giving gage heights and daily and monthly discharges at each station, and halftone plates representing typical gaging stations and current meters.

WATER-SUPPLY PAPER 333. Ground water in Boxelder and Tooele counties, Utah, by Everett Carpenter. 1913. 90 pages, 2 plates, 9 text figures.

The area covered by this report includes Boxelder County and the eastern part of Tooele County, Utah, and some small tracts in southern Idaho, comprising in all about 9,500 square miles. Insufficient rainfall and the rapid settling of the country created a demand for an investigation to determine the feasibility of irrigating by the use of underground water, in response to

which this report was prepared. The physiography, geology, climate, and vegetation are briefly described, the quality of the ground water is discussed, and a detailed account of the water supply in the several valleys of the district is given. The book also contains information regarding watering places on the routes of travel, maps of the areas investigated, and diagrams relating to rainfall.

WATER-SUPPLY PAPER 334. The Ohio Valley flood of March-April, 1913 (including comparisons with some earlier floods), by A. H. Horton and H. J. Jackson. 1913. 96 pages, 22 plates.

This paper gives a brief history of the flood in the Ohio Valley in the spring of 1913 and such data concerning this and previous floods in the same region as could be prepared with the records and funds at present available. The causes of these floods have been (1) excessive rainfall, (2) the rapid melting of accumulated snow, (3) the failure of reservoirs, (4) the forming and breaking of ice jams, and (5) the breaking of levees. The report suggests what can and should be done in collecting the hydrometric data necessary for a complete report upon the floods that menace the Ohio Valley, to the end that a definite decision may be reached as to the best and most economical means of preventing damage by floods. It contains tables showing gage heights, precipitation, and summaries of flood-flow records at stations on Ohio River; also numerous views of the flooded district at the time of the disaster.

WATER-SUPPLY PAPER 337. The effects of ice on stream flow, by W. G. Hoyt. 1913. 77 pages, 7 plates, 18 text figures.

This paper presents the available information on the methods of ascertaining the winter flow of streams in localities cold enough for the formation of ice. By discussing the factors that influence the run-off during periods of low temperature, the varieties of ice and their effect on the applicability of the laws of open-channel flow, and the collection and interpretation of winter records, the author seeks to standardize the methods of collecting records of stream flow during the ice-obstructed periods as those for open-water periods have been standardized. As the minimum flow of a stream—the flow that determines the success or failure of most hydraulic works—is most likely to occur during periods when the stream is ice covered and the temperature is low, accurate information concerning this flow is essential for any project that contemplates the continuous use of the stream. The illustrations include numerous diagrams showing the relation between temperature, gage height, and discharge on certain streams, relation between open-water curve and ice measurements, distribution of velocity under ice cover, and other problems incidental to the collection of records of winter flow.

WATER-SUPPLY PAPER 340. Stream-gaging stations and publications relating to water resources, 1885–1913, compiled by B. D. Wood; advance chapters as follows:

WATER-SUPPLY PAPER 340–A. Part I, North Atlantic coast drainage basins. 1914. 19+xii pages.

WATER-SUPPLY PAPER 340–B. Part II, South Atlantic coast and eastern Gulf of Mexico drainage basins. 1914. 10+xix pages.

The first two parts of Water-Supply Paper 340, a directory of Survey stream-gaging stations and publications relating to water resources of the United States. Each part will contain a list of all gaging stations maintained in the section named in its title and an annotated list of publications issued by the United States Geological Survey relating specifically to

that section, as well as a similar list of reports that are of general interest, covering a wide range of hydrologic subjects, and brief references to reports published by State and other organizations.

Water-Supply Paper 340–A pertains to the north Atlantic coast section, which includes the area drained by streams flowing into the Atlantic Ocean from St. John River, Me., to York River, Va.

Water-Supply Paper 340–B pertains to the south Atlantic coast and eastern Gulf of Mexico basins, which include the area drained by streams flowing into the Atlantic Ocean and Gulf of Mexico from York River, Va., to Pearl River, Miss.

WATER-SUPPLY PAPER 345. Contributions to the hydrology of the United States, 1914; advance chapters as follows:

WATER-SUPPLY PAPER 345–A. Preliminary report on ground water for irrigation in the vicinity of Wichita, Kans., by O. E. Meinzer. 1914. 9 pages.

The first paper of an annual volume to be issued in parts by the Geological Survey in order to furnish early information of the results of investigations made by its hydraulic engineers and geologists on the water supply of various sections of the country.

Water-Supply Paper 345–A gives an outline of the geology of the Wichita region with especial reference to its water resources. It contains a table of partial analyses of the ground waters in the vicinity of Wichita.

WATER-SUPPLY PAPER 345–B. Ground water for irrigation in the vicinity of Enid, Okla., by A. T. Schwennesen, with a note on ground water for irrigation in the Great Plains, by O. E. Meinzer. 1914. 23 pages, 1 plate.

The investigation of which Water-Supply Paper 345–B is the result shows that the water supply near Enid is derived chiefly by the percolation of the rain which falls in that vicinity, that although this supply is not large it is to some extent replenished by every heavy rainstorm, and that if it is withdrawn in moderate quantities for irrigation it will add materially to the agricultural production of the community. The investigation also shows the wisdom of thoroughly testing irrigation on a small scale before making heavy expenditures for large power plants. The paper is accompanied by a map of the vicinity of Enid, showing ground-water conditions.

WATER-SUPPLY PAPER 345–C. Underground water of Luna County, N. Mex., by N. H. Darton, with results of pumping tests by A. T. Schwennesen. 1914. 16 pages, 1 plate.

This paper is an abstract of part of an extended report on the geology and water resources of Luna County now in preparation by the Survey. It is issued to meet the urgent demand for information regarding wells and prospects for underground water in this district, especially as to the limits of the area in which water is available for irrigation. Results of pumping tests made at five representative plants are given at the end of the paper.

WATER-SUPPLY PAPER 345–D. Ground water for irrigation in the valley of North Fork of Canadian River near Oklahoma City, Okla., by A. T. Schwennesen. 1914. 11 pages, 1 plate.

Gives the results of a reconnaissance survey near Oklahoma City made in January, 1914, for the purpose of investigating the occurrence and quantity of available ground water. In Oklahoma the rainfall is not evenly distributed throughout the year, so that irrigation is necessary for successful farming.

MINERAL RESOURCES OF THE UNITED STATES, CALENDAR YEAR 1912. 1913. Part I, Metals, 1,079 pages, 3 plates, 13 text figures; Part II, Nonmetals, 1,218 pages, 8 plates, 11 text figures.

Statistics of the production, importation, and exportation of mineral substances in the United States, including accounts of the chief features of mining progress, comparisons of past and present production and conditions, and the application of the products in the useful arts. A consolidation of 63 advance chapters, each covering a single mining industry or group of allied industries.

MINERAL RESOURCES OF THE UNITED STATES, CALENDAR YEAR 1913; advance chapters as follows:

The production of bauxite and aluminum in 1913, by W. C. Phalen. 1914. 29 pages. Part I: 1.

The production of chromic iron ore in 1913, by J. S. Diller. 1914. 13 pages, 1 text figure. Part I: 2.

Gold, silver, copper, lead, and zinc in South Dakota and Wyoming in 1913 (mines report), by C. W. Henderson. 1914. 19 pages. Part I: 3.

The production of mica in 1913, by D. B. Sterrett. 1914. 11 pages. Part II: 1.

Fuel briquetting in 1913, by E. W. Parker. 1914. 8 pages. Part II: 2.

The production of sand-lime brick in 1913, by Jefferson Middleton. 1914. 8 pages. Part II: 3.

Sulphur, pyrite, and sulphuric acid in 1913, by W. C. Phalen. 1914. 29 pages. Part II: 4.

The production of mineral paints in 1913, by J. M. Hill. 1914. 24 pages. Part II: 5.

The production of slate in 1913, by A. T. Coons. 1914. 16 pages. Part II: 6.

Potash salts: Summary for 1913, compiled by W. C. Phalen. 1914. 23 pages. Part II: 7.

The production of fuller's earth in 1913, by Jefferson Middleton. 1914. 7 pages. Part II: 8.

The cement industry in the United States, by E. F. Burchard. 1914. 30 pages, 3 text figures. Part II: 9.

The production of feldspar in 1913, by F. J. Katz. 1914. 7 pages. Part II: 10.

The production of talc and soapstone in 1913, by J. S. Diller. 1914. 11 pages, 2 text figures. Part II: 11.

The production of silica (quartz) in 1913, by F. J. Katz. 1914. 7 pages. Part II: 13.

GEOLOGIC FOLIO 188. Tallula-Springfield (Ill.) folio, by E. W. Shaw and T. E. Savage. 1913. 12 folio pages of text, 4 maps, 14 text figures. Price, 25 cents. Published also in octavo form, 93 pages, maps in pocket. Price, 50 cents.

Description and maps of the Tallula and Springfield quadrangles, comprising about 458 square miles in Cass, Logan, Menard, Morgan, and Sangamon counties, Ill.

GEOLOGIC FOLIO 189. Barnesboro-Patton (Pa.) folio, by M. R. Campbell, F. G. Clapp, and Charles Butts. 1913. 12 folio pages of text, 6 maps, 11 text figures, 1 page of coal analyses. Price, 25 cents.

Description and maps of the Barnesboro and Patton quadrangles, comprising about 453 square miles in Blair, Cambria, Clearfield, and Indiana counties, Pa.

GEOLOGIC FOLIO 190. Niagara (N. Y.) folio, by E. M. Kindle and F. B. Taylor. 1913. 25 folio pages of text, 4 maps, 25 plates, 16 text figures. Contains a large-scale map of the Niagara River gorge. Price, 50 cents. Published also in octavo form, 184 pages, maps in pocket. Price, 50 cents.

Descriptions and maps of the Niagara quadrangle and a narrow strip along its west side, comprising 953 square miles in Niagara and Erie counties, N. Y., and in the Province of Ontario, Canada.

GEOLOGIC FOLIO 191. Raritan (N. J.) folio, by W. S. Bayley, R. D. Salisbury, and H. B. Kümmel. 1914. 32 folio pages of text, 4 maps, 1 structure-section sheet, 1 columnar-section sheet, 21 text figures. Published also in octavo form, 233 pages, maps in pocket. Price, 50 cents.

Description and maps of the Raritan quadrangle, comprising about 905 square miles in Hunterdon, Middlesex, Morris, Somerset, Sussex, and Warren counties, N. J. Price, 25 cents.

GEOLOGIC FOLIO 192. Eastport (Me.) folio, by E. S. Bastin and H. S. Williams. 1914. 15 folio pages of text, 3 maps, 1 structure-section sheet, 23 plates, 7 text figures. Price, 25 cents.

Description and maps of the Eastport quadrangle, comprising about 250 square miles in Washington County, Maine. The quadrangle occupies the easternmost extremity of Maine, and nearly half of its area is water.

TOPOGRAPHIC MAPS as follows:

Alamo National Forest, N. Mex.[1]
Alum Mountain, N. Mex.
Alvordton, Ohio-Mich.
Baxter Bayou, La.[1]
Beckley, W. Va.
Bethany, Cal.
Bethel, Maine.
Big Bend, W. Va.
Brentwood, Cal.
Brockton, Mont.
Bryan, Ohio.
Bryant Pond, Maine.
Buckhorn, Ky.
Caliente, Cal.
Capitola, Cal.
Celina, Ohio.
Centralia, Ill.
Ceredo, W. Va.-Ohio.[1]
Cherry Ridge, Mont.
Cheyenne, Wyo.
Cholame, Cal.[1]
Circleville, Ohio.
Cohutta, Ga.-Tenn.
Daingerfield, Tex.
Dannemora, N. Y.
De Queen, Ark.-Okla.
Drakesboro, Ky.
Dunmor, Ky.
Eccles, W. Va.
Era, Ohio.
Fergus Falls, Minn.
Flattop, W. Va.
Folsom, Cal.[1]
Gay Hill, Tex.
Green City, Mo.
Hamilton, Cal.
Hanna, Wyo.
Hollow Springs, Tenn.
Holt, Cal.
Homestead, Mont.
Indian Head, Md.[1]
Iuka, Miss.-Ala.-Tenn.
Jackson, Ohio.
Kentucky (State).
Kirkwood, Cal.
Leadville mining district, Colo.[2]
Lida, Cal.-Nev.
Lincoln, Ill.
Logan, W. Va.
Lolo, Idaho-Mont.
Lost Hills, Cal.[1]
Louisa, W. Va.[1]
Lyon Mountain, N. Y.
McIntosh Landing, Cal.
Madrid, Iowa.
Maryland (State).
Marysville Buttes and vicinity, Cal.
Meeker, Colo.
Meeteetse, Wyo.
Mercer, Pa.
Missouri (State).
Monticello, Ky.
Nanjemoy, Md.[1]
Navarre, Ohio.
Navasota, Tex.
Newcomerstown, Ohio.
New York (State).
Niagara Gorge, N. Y.-Canada.
Oregon Basin, Wyo.
Orland, Cal.

[1] Preliminary edition showing part of quadrangle.
[2] New edition.

Paulding, Ohio.
Pennsylvania, (State).
Phoenix, Ariz.
Pioneer, Ohio.
Raton, N. Mex.
Red Mesa, Colo.-N. Mex.
Salinas Valley, Cal., sheets Nos. 2 and 3.[1]
Sciotoville, Ohio.
Seale, Ala.-Ga.
Sidney, Ohio.
Slater, Iowa.
Slug Creek, Idaho.
Smithville, Mo.
South Carolina (State).
Stockton, Cal.
Stoneboro, Pa.
Sumner, Ill.
Swanton, Ohio-Mich.
Tintic mining district, Utah.[2]
Troublesome, Ky.
Van Wert, Ohio.
Vinita, Okla.[3]
Walcott, Wyo.
Wauseon, Ohio-Mich.
West Virginia (State).
Wicomico, Md.-Va.[3]
Willamette, Oreg., sheets Nos. 5 and 6.[1]
Winkelman, Ariz.
Woodstock, Vt.
Woodward Island, Cal.

GEOLOGIC BRANCH.

ADMINISTRATION.

The geologic branch embraces four divisions—(1) geology, David White, chief geologist in charge; (2) Alaskan mineral resources, A. H. Brooks in charge; (3) mineral resources, E. W. Parker in charge; and (4) chemical and physical researches, G. F. Becker in charge.

The scope of the work of these divisions is well established, and although each is largely autonomous, they cooperate effectively in their several lines of work. Many of the statistical reports of the division of mineral resources are prepared by geologists in the division of geology, who are specialists in the geology of the several minerals considered and whose field investigations give opportunities for close observation of the various mineral industries. During the field season members of the land-classification board are enrolled in field parties of the geologic branch engaged in the classification of the public lands.

The chief geologist plans the geologic investigations to be carried on by the Survey in the United States, and has general supervision of the field work. He gives special attention to cooperation in geology with the State surveys and is the executive officer of the branch. These duties leave him but little opportunity for systematic investigations, either in the field or in the office, the greater part of his time for field work being occupied in field inspection and conferences and the supervision of the work of the section of eastern fuels.

PUBLICATIONS.

The publications of the fiscal year 1914 prepared in the geologic branch consisted of 24 professional papers, bulletins, etc., as well as 51 chapters of reports later published as annual volumes and 5 geo-

[1] Preliminary photolithograph.
[2] Revised and reengraved.
[3] New edition.

logic folios. Titles and brief notices of these publications are given on pages 13–31.

Besides these publications 48 papers were, with the permission of the Director, published in scientific journals and in the transactions of scientific societies. In view of the scientific importance of many of these shorter papers, some of which represent the by-product of investigations that are primarily economic, provision was made at the close of the year 1913 for the publication of such of these scientific papers as are complete in form, are of general interest, and do not require elaborate illustration, in a set of short professional papers to be known as "Shorter contributions to general geology." The expectation that the publication of these papers would greatly stimulate the scientific work of the Survey by encouraging broader and more thorough observation and deduction on the part of the geologist is being realized. The papers submitted and published in Professional Papers 85 and 90 have been of high merit and varied scope.

The areas in the United States covered by geologic maps published by the Survey and the general nature of the work are indicated on Plate I. It should be borne in mind that a number of reports and maps prepared by geologists of this Survey have been transmitted for publication by cooperating State surveys. The work in Alaska is given in the section on the division of Alaskan mineral resources.

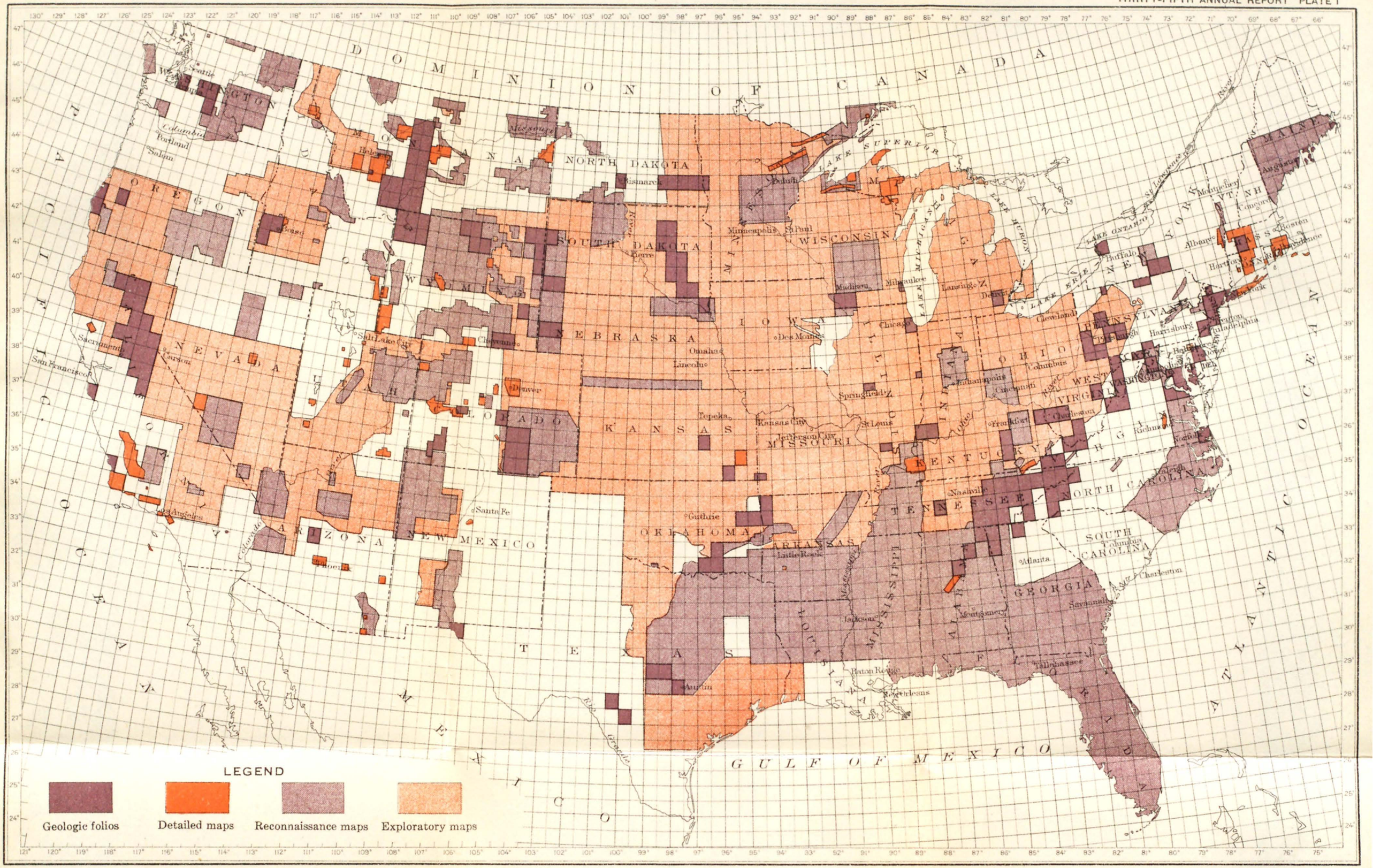
DIVISION OF GEOLOGY.

ORGANIZATION.

The scientific force at the beginning of the year consisted of 62 geologists, 36 associate geologists, 27 assistant geologists, and 15 junior geologists. During the year 5 members of the scientific staff resigned to take places elsewhere at higher salaries and 11 members were appointed. The total number of geologists of various grades on the staff at the end of the year was 146. Of this number 83 were employed continuously, 23 were carried on the per diem roll, giving only part of their time to the Survey work, and 40 were not employed during the year. In addition to this force, 16 geologic aids were employed as field assistants for a part of the year.

The division of geology is organized in nine sections, as follow

1. Section of eastern areal geology (east of the one hundredth meridian).
2. Section of western areal geology (west of the one hundredth meridian). Subsection, investigations in petrology.
3. Section of Coastal Plain investigations.
4. Section of glacial geology.
5. Section of paleontology and stratigraphy.



LEGEND

Geologic folios | Detailed maps | Reconnaissance maps | Exploratory maps

MAP OF THE UNITED STATES, SHOWING AREAS COVERED BY GEOLOGIC MAPS PUBLISHED PRIOR TO JULY 1, 1914

Scale 1/14,000,000

100 0 100 200 300 400 500 Miles

SNYDER & BLACK N.Y.

6. Section of metalliferous deposits.
7. Section of nonmetalliferous deposits.
8. Section of eastern mineral fuels (east of the one hundredth meridian).
9. Section of western mineral fuels (west of the one hundredth meridian).

ALLOTMENTS.

The total funds from the appropriations for the year 1913–14 available for geologic work of the Survey in the United States were:

Geologic surveys	$300,000
Statutory salaries	13,700
Search for potash deposits (part of the appropriation for chemistry and physics)	17,000
	330,700

The allotments of the appropriations were as follows:

Section of eastern areal geology	$23,320
Section of western areal geology	34,660
Section of Coastal Plain investigations	13,050
Section of glacial geology	6,930
Section of paleontology and stratigraphy	20,580
Section of metalliferous deposits	41,760
Section of nonmetalliferous deposits (including potash)	31,700
Section of eastern fuels	19,800
Section of western fuels	34,000
Débris investigation and inspection	2,900
Geologic map editing	7,020
Supervision, administration, salaries of clerical, technical, and skilled-labor forces, instruments, supplies, and contingent fund	72,980
	308,700
Land-classification board	22,000

Of the amounts allotted to the geologic branch, $249,000 was expended directly for geologic work, including the search for potash. Of this amount $94,000, or 37.8 per cent, was expended east of the one hundredth meridian and $155,000 west of it. The allotment for supervision, etc., was divided in the same proportion between the eastern and the western work. As the work of the land-classification board relates only to the Western States the total amount expended on account of work in the region west of the one hundredth meridian, nearly all of which was expended in the public-land States, approximates 67 per cent of the total appropriation.

COOPERATION WITH FEDERAL BUREAUS AND STATE SURVEYS.

The cooperative funds expended during the fiscal years 1913–14 were as follows:

General Land Office, for coal-land classification	$35,000.00
General Land Office, for surveys at Caddo Lake, La.-Tex.	286.90
Indian Office, classification of land in Indian reservations, Montana, Washington, Oklahoma, California, and Idaho	13,047.28
Department of Justice	1,307.83
Bureau of Mines	261.21
Cooperation with States and official organizations	13,066.65

The money allotted by the General Land Office ($35,000) was expended west of the one hundredth meridian, being assigned to the section of western fuels for use in the classification of public coal and oil lands.

Since last year agreements for cooperation in geologic investigations have been entered into by the State geological surveys of Iowa, Wisconsin, Michigan, and Kentucky. Geologic investigations have been carried on under cooperative agreement in 14 States—Illinois, Iowa, Kentucky, Maine, Maryland, Michigan, Minnesota, Missouri, Oklahoma, Oregon, Pennsylvania, Tennessee, Virginia, and Wisconsin.

Cooperation is effective with the Bureau of Mines in the metallographic study of ores and in the investigation of the invasion of California oil wells by salt water. The Survey has also engaged with the Bureau of Standards, the Bureau of Mines, and the Office of Public Roads in a thorough and systematic investigation of the building stones of the United States. The survey also cooperates with the Smithsonian Institution and the Isthmian Canal Commission, and in several lines of research has informal cooperation with the Carnegie Geophysical Laboratory and the marine biological station at Tortugas.

GENERAL FEATURES OF THE WORK.

The primary function of the division of geology is to prepare a geologic map of the United States, to classify public lands, to make investigative and quantitative surveys of mineral deposits and to make all geologic, paleontologic, and petrologic researches necessary to this work. The scientific investigations of geologic problems are of kinds directly contributive to economic geology as well as to knowledge of geologic principles and phenomena. Thus the observations regarding temperatures in deep bore holes and mines will incidentally put to test the hypothesis maintained by some geologists that oil and gas bearing geologic formations have higher temperatures and offer steeper temperature gradients than formations not contain-

ing these hydrocarbons. The study of the sedimentation of the lower Mississippi River, and of the Delta in particular, bears not only on the problems of detrital transportation and filling, but also on the abatement of flood disasters, on the formation of obstructions to navigation in the Delta, and, through observations of the chemical changes in the waters and sediments, on the formation of disseminated ores from solutions in the mud and water. The analysis of crinoid stems or other invertebrate shells and tests representing molluscan types now living in different parts of the oceans promises to contribute important information as to the conditions under which dolomites and dolomitic limestones were deposited. On the other hand, the studies of the mutual relations of water, oil, and gas in rocks of varying degree of porosity and of different compositions, and of their movements under various structural conditions, which the Survey has recently felt justified in undertaking in connection with the investigation of the enormous damage occasioned in a number of oil fields by the invasion of the oil sands by water, not only promise valuable scientific results, including a better understanding of the mutual relations and the modes of occurrence of water, oil, and gas in rocks and in structures of different kinds, but assure data which will make possible far more accurate and certain prediction as to the occurrence or absence of oil and gas in commercial quantities in rocks of different textures occurring in different structural relations. These investigations have only recently been begun in the Survey. It is hoped that they may be as successful and beneficial as the longer established researches relating to the origin and modes of occurrence of the various types of ore deposits.

All these various researches, as well as the paleontologic researches, which are indispensable to the geologic mapping of the country, yield educational by-products of the highest value.

The geologic work of the division, both in the field and in the office, is under the immediate supervision of the chiefs of the respective sections, who are directly responsible for maintaining efficiency and a high standard of work. Exceptions are made of the studies of detrital deposition in California, carried on by G. K. Gilbert under the joint auspices of the geologic and water-resources branches, and the general monographic description of the geology of the Yellowstone National Park, in progress by Arnold Hague. The work of these distinguished senior geologists of the Survey is reported directly to the chief geologist.

Services varying in extent have, during the year, been rendered by this division to the Office of Indian Affairs in the classification of Indian lands; to the General Land Office in the classification of withdrawn coal, oil, and phosphate lands; to the commission having in

charge the purchase of lands for Appalachian forest reserves in accordance with the provision of the Weeks Act; and to the Isthmian Canal Commission with respect to the geologic structure, the stability of foundation rocks, and the resources of the Canal Zone. The Department of Justice has made frequent demands on the services of the Geological Survey in connection with the prosecution of suits concerning the public lands.

SCOPE OF THE WORK OF THE SECTIONS.

The work of each of the several sections of the division of geology is briefly outlined in the following synopsis:

1. The section of eastern areal geology—Arthur Keith, geologist in charge—conducts reconnaissance and detailed work in areal or general geology in regions east of the one hundredth meridian, the primary object of which is to make known, mainly through folios of the geologic atlas, the general geology of the region studied, or to prepare scientific and educational descriptions of it, rather than to examine and describe or map the area especially on account of some geologic problem or some particular economic resource. The work of this section is carried on in close cooperation with several State surveys and university departments of geology, an effort being made to coordinate the work of all participants.

During the year the operations of the section have covered projects in Alabama, Arkansas, Kentucky, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Vermont, and Virginia.

2. The work of the section of western areal geology (west of the one hundredth meridian)—F. L. Ransome, geologist in charge—corresponds to that of the section of eastern areal geology and is similar in scope, these sections being especially charged with the preparation of the folios of the geologic atlas of the United States. The activities of the section have concerned the States of Arizona, California, Colorado, Idaho, Kansas, New Mexico, Oregon, and South Dakota.

3. The section of Coastal Plain investigations—T. Wayland Vaughan, geologist in charge—is occupied primarily with the study of the numerous geologic formations of the Atlantic and Gulf Coastal Plain, their character, extent, general structure, correlations, conditions of deposition, and history, and especially of the underground water and other mineral resources of the region. Most of the areal work of this section during the last year has been of the reconnaissance type. Its office investigations are comprehensive and broadly scientific as well as economic. The National Museum, the Bureau

of Fisheries, the Carnegie Institution, and a number of specialists in biology or paleontology, as well as the division of underground waters of the water-resources branch, have cooperated with or contributed to the work of this section.

4. The section of glacial geology—W. C. Alden, geologist in charge—is engaged in the study of the work of the great glaciers, the glacial and interglacial deposits and the contemporary deposits of the bordering regions, and the geologic history of the continent during the Pleistocene epoch. The geologists occupied with these varied and specialized problems are charged with the classification and mapping of the Pleistocene deposits of the glaciated regions. The work of this section during the year has comprised field studies and mapping and the preparation of reports covering areas in Arkansas, Illinois, Iowa, Louisiana, Maine, Massachusetts, Minnesota, Missouri, Montana, New York, Ohio, Vermont, and Wisconsin.

5. The section of paleontology and stratigraphy—T. W. Stanton, geologist in charge—is responsible for the determination of the relative ages and equivalences of the strata in different areas and for the reference of the formations to a geologic time scale. The geologists who specialize in paleontology are engaged also in working out the sequence and character of the continental changes, the physiographic and climatic conditions of the various periods, and the history of the animal and plant life of the geologic epochs. The field study of the stratigraphic distribution of the fossil floras and faunas gives the most complete key to the correlation of the beds; hence the paleontologists can most efficiently accomplish their work by close cooperation with the areal and economic geologists.

The work of this section is practically coextensive with that of the divisions of geology and of Alaskan mineral resources and is indispensable to the geologic mapping of the areas surveyed and the satisfactory determination of the structure.

6. The section of metalliferous deposits—F. L. Ransome, geologist in charge—not only studies metalliferous deposits and mines and investigates the conditions and methods of ore deposition, but also carries on reconnaissance geologic examination of many new districts and makes complete detailed areal surveys, for folio publication, of quadrangles in which metalliferous deposits are of special importance, the folios being subject to the inspection and approval of the geologists in charge of areal geology.

The geologists of the section have been engaged on projects that will be referred to in the detailed description of the work of the division in the States of Arizona, Arkansas, California, Colorado, Idaho, Missouri, Montana, Nevada, Oklahoma, Oregon, Tennessee, Utah, Washington, and Wyoming.

7. The section of nonmetalliferous deposits—H. S. Gale, geologist in charge—is concerned with the examination of the deposits of nonmetallic ores and minerals, exclusive of fuels, and with the geologic investigation and mapping of regions in which such minerals are of paramount importance. Among the mineral resources with which the section is especially concerned are clay, cement rock, limestone, salt, borax, phosphate, sand, and building stone. During the year the great part of the work of the section has been divided between the search for potash in commercial quantities in the salts of the old evaporation basins or dried-up ancient lakes of the Southwest and the classification of the phosphate-bearing lands withdrawn from entry in Idaho, Wyoming, and Montana. The field work in this section has been performed in the States of California, Idaho, Minnesota, Montana, Nevada, New Mexico, Pennsylvania, and Wyoming.

8. The section of eastern fuels—David White, geologist in charge—conducts examinations of coal, oil, and gas bearing areas in regions east of the one hundredth meridian. It not only investigates and describes the economic geology, but in some regions also works out the detailed areal geology for folio publication, the folios being subject to the inspection and approval of the geologist in charge of the section of eastern areal geology. The work of this section during the year has been confined mainly to the study of coal, oil, and gas areas in cooperation with the State surveys of Pennsylvania, Virginia, Illinois, Missouri, and Oklahoma. The noncooperative work of the section was done in Ohio, Kentucky, Kansas, Alabama, West Virginia, Maryland, Louisiana, Rhode Island, and Texas.

9. The section of western fuels—M. R. Campbell, geologist in charge—conducts examinations and surveys in the fuel-bearing areas west of the one hundredth meridian similar to those carried on by the section of eastern fuels. The greater part of the work of the western section has consisted in classifying and mapping coal or oil bearing lands of the public domain in North Dakota, South Dakota, Montana, Wyoming, Colorado, New Mexico, Utah, Washington, Oregon, Idaho, and California, but a part of the work in this section was done on the quadrangle basis for folio publication, subject to the approval of the geologist in charge of the section of western areal geology.

10. The subsection of geologic map editing—G. W. Stose, geologist in charge—though really a part of the publication branch of the Survey, is conducted as a part of the geologic branch, in which the chief of the subsection is an active geologist.

ASSISTANCE TO OTHER DIVISIONS.

In addition to the work done in the respective sections, a considerable number of the geologists in the sections of metalliferous and nonmetalliferous deposits and several geologists in the sections of

eastern and western areal geology and western fuels have prepared for publication in the annual volumes of Mineral Resources reports of the production and statements of the industrial conditions relating to a large number of mineral resources with which they are especially familiar. Parts of the salaries of some of these geologists are paid from the funds of the division of mineral resources, and the traveling and field expenses incurred by others in the collection of data are also met from the funds of that division. As a result of this cooperation between the two divisions the value of the reports which will be enumerated under the division of mineral resources has been greatly increased, while the contributing geologists have at the same time acquired a wider commercial knowledge of the particular mineral deposits and industries.

A number of economic geologists of this division serve as members of the special committees of the land-classification board. The paleontologists of the division of geology report on all fossils collected for the division of Alaskan mineral resources and are called upon to classify fossils for the National Museum and, through courtesy, occasionally for foreign governments and other scientific institutions.

A close cooperation, with constant interchange of information, exists between the geologic branch and the water-resources branch.

COMMITTEE ON GEOLOGIC NAMES.

There has been no change in the personnel of the committee on geologic names, a standing committee of the geologic branch consisting of T. W. Stanton (chairman), M. R. Campbell (vice chairman), W. C. Alden, G. H. Ashley, Arthur Keith, F. L. Ransome, G. W. Stose, and David White. The minutes and other records are kept by the secretary, Miss M. G. Wilmarth, who also scrutinizes the geologic nomenclature and classification used in all manuscripts submitted for publication and prepares data on them for consideration by the committee. An account of the general objects of this committee and of the reference materials compiled in its records was given in the administrative report for last year. During the year this committee has considered 196 manuscripts, comprising 24,305 pages and involving about 4,187 geologic names. This is an increase of 15 manuscripts, about 9,100 pages, and more than 1,500 names over the record for the year 1912–13.

WORK OF THE DIVISION BY STATES AND COUNTRIES.

The work of the division of geology during the year was done in the States listed below, the Canal Zone, the Hawaiian Islands, and the West Indies:

Alabama.
Arizona.
Arkansas.
California.
Colorado.
Delaware.
Florida.
Georgia.
Idaho.
Illinois.
Indiana.
Iowa.
Kansas
Kentucky.
Louisiana.
Maine.
Maryland.
Massachusetts.
Michigan.
Minnesota.
Mississippi.
Missouri.
Montana.
Nebraska.
Nevada.
New Hampshire.
New Jersey.
New Mexico.
New York.
North Carolina.
North Dakota.
Ohio.
Oklahoma.
Oregon.
Pennsylvania.
Rhode Island.
South Carolina.
South Dakota.
Tennessee.
Texas.
Utah.
Vermont.
Virginia.
Washington.
West Virginia.
Wisconsin.
Wyoming.

ALABAMA.

The mapping of the areal geology of the Montevallo, Columbiana, Bessemer, and Vandiver quadrangles, Alabama, was revised and completed by Charles Butts, and the manuscripts for the two folios covering these areas have been submitted for publication.

A proposed forest reserve in Winston and Lawrence counties was examined by Mr. Butts, and a report thereon was prepared for the Forest Reservation Commission.

Stratigraphic and paleontologic materials were gathered by E. O. Ulrich at a number of points in the Bessemer quadrangle for use in the correlation of the formations of Alabama with those of other States.

Similar investigations of the deposits of Vicksburg age in the southern part of the State, covering an estimated area of 3,500 square miles, were made by C. Wythe Cooke, who has also identified Tertiary mollusks from Alabama in connection with his correlation work.

The offshore deposits of the Alabama coast were briefly examined by E. W. Shaw with aid from the Bureau of Fisheries.

A report on "Cretaceous deposits of the eastern Gulf region" by L. W. Stephenson, recently published as Professional Paper 81, contains descriptions of the Cretaceous deposits of Alabama.

The sandstones and clays of lower Oligocene age in portions of this State are described in a paper in preparation by George C. Matson.

ARIZONA.

Some detailed mapping, with stratigraphic and petrologic studies, was done by L. F. Noble in and near the Grand Canyon of the Colorado. Important information was procured on the unconformity at the base of the Carboniferous, the stratigraphy of the Cambrian, and the character of the crystalline pre-Cambrian rocks. A report by Mr. Noble on the geology of the Shinumo quadrangle (Bulletin 549) is in press.

An economic reconnaissance of the Grand Gulch mining district was made by J. M. Hill, whose report appears as part D of Bulletin 580, "Contributions to economic geology, 1913, Part I." The Colorado River Indian Reservation was examined in detail by E. L. Jones, jr., for the purpose of land classification for the Office of Indian Affairs.

ARKANSAS.

The Quaternary deposits and physiography of eastern Arkansas were briefly studied by E. W. Shaw, who also made a similar study covering an area of 40 square miles in the Moon Lake region for the Department of Justice.

A study of the Recent and Pleistocene geology and physiography of southwestern Arkansas was begun by Frank Leverett and George C. Matson.

A water-supply paper, "Geology and ground waters of eastern and northeastern Arkansas," by L. W. Stephenson and A. F. Crider, with a chapter on the chemistry of the waters by R. B. Dole, is in the hands of the editor.

The geologic mapping of the Hot Springs and Caddo Gap quadrangles was inspected in the field by Arthur Keith in conference with A. H. Purdue and H. D. Miser.

Extended studies of the pre-Mississippian faunas of northern Arkansas and southern Missouri, for use in the stratigraphic descriptions of the Eureka Springs-Harrison and Yellville folios, were made by E. O. Ulrich.

Stratigraphic observations were made and fossils collected by R. D. Mesler, from the Izard, Polk Bayou, and St. Clair limestones, in the valley of White River above Batesville, and Carboniferous invertebrates were collected by P. V. Roundy in the Eureka Springs and Harrison areas.

A summary report on the coal fields of this State has been submitted by Carl D. Smith for inclusion in a general report on the coal fields of the United States, which is now in preparation.

Reported occurrences of gold ore in Yell County were investigated by G. S. Rogers, and a brief announcement of his conclusions was contributed by the Survey to the public press.

The deposits furnishing precious stones in the State have been examined by D. B. Sterrett, who has described them briefly in a chapter in Mineral Resources for 1913.

CALIFORNIA.

The detailed survey of the Weaverville quadrangle, California, was completed by J. S. Diller and H. G. Ferguson for folio publication.

In June the reported volcanic eruption in Lassen County was investigated by Mr. Diller, whose report was immediately communicated to the public in the form of a press bulletin.

The study of the Yosemite region in detail was prosecuted by F. C. Calkins and F. E. Matthes for the purpose of publishing a descriptive and educational bulletin prior to the Panama-Pacific Exposition in 1915.

Some detailed mapping in the Rock Creek quadrangle was done by L. F. Noble.

The Allegheny district was studied by H. G. Ferguson, who prepared a report on its rich gold lodes. Mr. Ferguson also completed for publication a brief report on the pocket gold deposits of the Klamath Mountains.

A reconnaissance survey of the chromite and asbestos deposits in Shasta County and of the talc deposits in San Bernardino and Inyo counties was made by J. S. Diller. Reports on these subjects have been issued as parts of Mineral Resources for 1913.

A geologic survey of the east slope of the Sierra Nevada overlooking Owens Valley was made by Adolph Knopf, assisted by F. H. Lahee. A reconnaissance examination of the Bodie mining district, in Mono County, was also made by Mr. Knopf, and a report on the Darwin silver-lead mining district by him has been issued as Bulletin 580–A. A report on the stratigraphy of the Inyo Range is in preparation by Edwin Kirk.

A reconnaissance of the California portion of the Colorado River Indian Reservation and of the Yuma Indian Reservation for purposes of land classification was made at the request of the Office of Indian Affairs, by E. L. Jones, jr.

The areal mapping of the Priest Valley quadrangle was carried on during the months of August to November, 1913, by R. W. Pack, assisted by W. A. English and J. D. Northrop. During December Mr. Pack made a reconnaissance examination of the Marysville region to investigate the reported occurrence of oil there, and also made a trip through the San Joaquin Valley oil fields to obtain data on recent developments. Mr. Pack has submitted land-classification data on most of the areas examined, and, with Mr. English,

has prepared for publication a report on oil and coal in the Priest Valley quadrangle. A short report on the Marysville district was submitted.

In April, 1914, Mr. Pack resumed work in the Temblor Range oil fields, collecting data for a detailed report on the structure and the occurrence of oil in the Midway and Sunset fields. During the same period G. S. Rogers studied the inflow of water which has caused considerable damage in portions of the California oil fields.

Monographs on the marine Triassic invertebrate faunas of California and neighboring States are in preparation by Prof. J. P. Smith.

Brief visits to and reviews of a number of desert saline or playa areas in the southern part of the State were made by H. S. Gale and W. B. Hicks in connection with the search for potash. The general reconnaissance of the desert basins from Owens Valley through Indian Wells Valley, Salt Wells Valley, and Panamint Valley has resulted in further observations and conclusions of an interesting character, referring particularly to the Quaternary lake history of these basins and the valuable saline deposits they may contain. A paper discussing the potash and salt in the Searles Lake basin has been submitted for publication by Mr. Gale.

The salt resources of the State and the methods of production are described by W. C. Phalen in a bulletin on the salt deposits of the United States, submitted for publication. On account of the urgent demand from those interested in the mineral wealth of the gold belt, the maps showing the economic geology of the Placerville, Sacramento, and Jackson quadrangles as originally printed in the folios for these quadrangles have, together with the descriptions of the mining geology and ore deposits, been republished under a single cover (Folio Reprint 3, 5, and 11).

COLORADO.

A reconnaissance in the Cretaceous and Tertiary areas east of the Front Range, Colorado, was made by F. H. Knowlton and E. W. Berry, who gave special attention to the plant-bearing formations near Trinidad, Florissant, and Denver, and at Colorado Springs, where they were joined by C. W. Gilmore and T. W. Stanton in an examination of the Dawson arkose.

The Cretaceous section south of Fort Collins, from the Dakota hogback in the foothills to a point on Cache la Poudre River near New Windsor, was studied by T. W. Stanton, who thus completed a section the upper part of which was studied in 1909.

In Moffat County areal mapping for folio and economic work was continued by E. T. Hancock in the Lay, Axial, and Monument Butte quadrangles. Mr. Hancock mapped in detail an area of 283 square

miles. Land-classification data have been submitted for the Axial and Monument Butte quadrangles and are almost completed for the Lay quadrangle. Folios and detailed economic reports have been in preparation for these quadrangles, and also a detailed economic report covering 189 square miles in the Lay quadrangle.

Detailed areal mapping and economic investigations were carried on in the Red Mesa and Soda Canyon quadrangles, in La Plata and Montezuma counties, by M. A. Pishel. The work was completed over an area of 389 square miles. Mr. Pishel has submitted classification data for 376 square miles, and has in preparation an economic report on the Red Mesa quadrangle, which will appear in the bulletin entitled "Contributions to economic geology, 1915."

In July, 1913, E. G. Woodruff began a detailed examination of the oil shales of the Uinta Basin of Colorado and Utah, attention being first directed to the area lying within the State of Colorado. In addition to determining the areal distribution of the shales and their stratigraphic and lithologic character from place to place, Mr. Woodruff made field experiments to determine the percentage of oil in the shales. After July this work was continued in Utah.

The survey of the San Juan region was continued by Whitman Cross and E. S. Larsen, jr., assisted by J. F. Hunter. The work consisted in the completion of the areal survey of the Uncompahgre quadrangle and the beginning of a detailed reconnaissance survey of an area east of the region. During the winter the geologists named have been engaged on reports and special papers dealing mainly with the geology of the San Juan region. Mr. Cross transmitted for publication a paper on "The dike rocks of the Apishapa quadrangle," and, with Mr. Larsen, another entitled "Contributions to the stratigraphy of southwestern Colorado." A paper on some of the minerals of the Uncompahgre quadrangle was prepared by Messrs. Larsen and Hunter for publication in one of the scientific journals, and Mr. Hunter practically completed his report on the pre-Cambrian rocks of the Gunnison Canyon.

The Quaternary formations in the San Juan Mountains were, during July, August, and part of September, surveyed in detail by W. W. Atwood and Kirtley Mather. They completed their work in the San Cristobal quadrangle and made considerable progress in the Uncompahgre and Montrose quadrangles. A portion of October was spent by Mr. Atwood, in association with Mr. Cross, in a reconnaissance survey of the northeastern portion of the San Juan area.

The preparation of the report on the economic geology of the Central City district, by E. S. Bastin, has required more time than was expected, because of the large number of detailed mine descriptions involved. This study is practically completed. The ores of this district have been studied by Mr. Bastin and Chase Palmer in con-

nection with a series of important researches on the precipitative action of metallic minerals upon silver in solution. Specimens of enriched ores were collected and mine waters were tested.

As a part of the metallographic studies carried on by F. B. Laney, in cooperation with the Bureau of Mines, a month was spent in the field by Mr. Laney in the collection of ores from the Leadville district. The results of these studies, which are as yet incomplete, constitute a valuable contribution to the knowledge of the origin and deposition of the Leadville ores and of the formation of similar ores in general. The oxidized zinc ores at Leadville were studied by G. F. Loughlin, whose report on them, now completed, will be included in the monograph on the Leadville district which is in preparation by J. D. Irving.

A reconnaissance of the Unaweep copper district in Mesa County was made by B. S. Butler, whose report is issued as part B of Bulletin 580. A similar examination of the Hardscrabble district in Custer County was made by J. F. Hunter, whose report has been published as Bulletin 580–C.

The principal mica deposits of the State were studied by D. B. Sterrett, who has described them in a bulletin submitted for publication.

A paper on the coal measures of Raton Mesa and other coal fields in Colorado and New Mexico, by W. T. Lee, with a report on the fossil floras of the Vermejo and Raton formations, by F. H. Knowlton, was submitted for publication. Mr. Knowlton also prepared a paper on the Cretaceous-Tertiary boundary in the Rocky Mountains, which will be published outside of the Survey.

DELAWARE.

A folio describing and mapping the geology of the Wilmington quadrangle, in Delaware and New Jersey, has been submitted for publication by Florence Bascom and B. L. Miller, the work having been done in connection with the Geological Survey of Maryland.

FLORIDA.

Investigations of the geology of the Florida Keys were continued by T. W. Vaughan, who has prepared and published a number of scientific papers on the geology of this region. Mr. Vaughan, assisted by C. Wythe Cooke, studied the stratigraphy of the upper Oligocene formations in the northern and central parts of the State. Stratigraphic and paleontologic investigations in this area of approximately 2,500 square miles have been made by Mr. Cooke, who has also identified Tertiary mollusks from the State in connection with his correlation work.

The offshore deposits along the west coast of Florida and the shores of the Gulf States were briefly examined by E. W. Shaw through the courtesy of the Bureau of Fisheries, which permitted him to take advantage of a cruise of the steamer *Fish Hawk*.

A report on the phosphate deposits of Florida, by George C. Matson, was revised and transmitted for publication.

The Pliocene Foraminifera of Florida have been described in a report by Joseph A. Cushman, and another report by him on the Miocene Foraminifera is nearing completion.

A report on the geology and ground waters of Florida, by George C. Matson and Samuel Sanford, was published as Water-Supply Paper 319. The demand for this paper is so great that the edition has already been exhausted.

GEORGIA.

A report on "Underground-water resources of the Coastal Plain of Georgia," prepared in cooperation between the Geological Survey of Georgia and the Federal Survey, by L. W. Stephenson and Otto Veatch, with a chapter on the chemistry of the waters by R. B. Dole, is in press as Water-Supply Paper 341.

The Upper Cretaceous and Eocene floras of South Carolina and Georgia have been described by E. W. Berry in an instructive and valuable paleontologic paper, published as Professional Paper 84.

The Cretaceous deposits of the State are discussed and mapped in a paper on "Cretaceous deposits of the eastern Gulf region," by L. W. Stephenson, published as Professional Paper 81.

IDAHO.

The studies of the ore deposits of Idaho, which since 1910 have been in progress by J. B. Umpleby, were continued during the present year. Some mining districts in the central part of the State were reviewed by Mr. Umpleby, who later examined in detail the ore deposits in the Hailey quadrangle. His work in Idaho is expected to result in a comprehensive summary report on the ore deposits of the State. In the meantime, areas examined by him have been separately treated in shorter papers, four of which have been printed (Bulletins 528, 530–G, 539, and 540–E), and two others, on the Mackay and Sawtooth districts, are practically completed. This work has also supplied material for five articles, three of which have appeared in scientific journals during the year. These are "Custerite, a new contact-metamorphic mineral"; "Crystallized chrysocolla from Mackay, Idaho"; and "The genesis of the Mackay copper deposits."

The geology of the Hailey quadrangle has been almost completely mapped for folio publication by L. G. Westgate, who also gave some

time to the compilation of a geologic map of Idaho, in which he was assisted by R. V. Mills.

A brief examination of the lead-silver mines and prospects of the Mineral Hill district, which adjoins the Hailey quadrangle, was made by D. F. Hewett, whose report on this district is now in preparation.

The further classifications of Northern Pacific Railroad grant lands were made by E. L. Jones, jr., assisted by R. V. Mills, the selections lying in 10 townships situated chiefly in the drainage basin of the North Fork of Coeur d'Alene River; also similar lands in 9 townships situated in the drainage basins of St. Joe River and the North Fork of the Clearwater. The total area of the listed lands probably did not exceed 50 square miles, but in the course of the examination approximately 350 square miles were necessarily mapped in a reconnaissance way.

An area of about 100 square miles along Clearwater River and Orofino Creek was examined for land classification by C. T. Lupton.

At the request of the Office of Indian Affairs an examination for classification of the Fort Hall Indian Reservation was made and completed during the season by G. R. Mansfield, who was assisted in the field by J. W. Merritt and, for a short time toward the close of the season, by C. A. Bonine and Wallace Lee. Classification data for the entire reservation have been prepared and submitted, and a general report and geologic map covering the geology and phosphate deposits is well advanced in preparation. For a large part of the area the topography as well as the geology was mapped by the geologic party to facilitate the geologic mapping.

Paleontologic studies for the classification and correlation of the Carboniferous geologic formations in the Fort Hall Indian Reservation, the Hailey quadrangle, and the vicinity of Mackay, under examination respectively by G. R. Mansfield, J. B. Umpleby, and L. G. Westgate, were carried on by G. H. Girty, and a brief study of the pre-Carboniferous rocks was made by Edwin Kirk.

ILLINOIS.

The geologic investigations carried on by this Survey in Illinois are conducted in cooperation with the Illinois Geological Survey under an agreement which provides that approximately equal areas are to be mapped and described by the State and Federal surveys, though to some extent both organizations work in the same areas. In the Baldwin, Chester, Renault, Kimmswick, and Crystal City quadrangles, the Paleozoic strata and the economic geology are treated by the State survey, and the Pleistocene formations and physiography are described by E. W. Shaw, of the Federal Survey.

A folio describing and mapping the Colchester and Macomb quadrangles, in which certain Pleistocene deposits had been examined by Frank Leverett, was submitted by Henry Hinds. A folio covering the Paleozoic rocks in the West Frankfort and Galatia quadrangles was submitted by G. H. Cady for the State. The Galena-Elizabeth folio, prepared by E. W. Shaw and A. C. Trowbridge, is now in process of publication.

The text of the Belleville-Breese folio, by J. A. Udden and E. W. Shaw, has received final revision by Mr. Shaw and is now in the hands of the editor. Progress has been made by Mr. Shaw in the preparation of a folio for the Carlisle and Centralia quadrangles.

The field examination of the Gillespie and Mount Olive quadrangles was begun by Wallace Lee in June.

A field conference on the late Mississippian rocks of Illinois and adjacent parts of Missouri and Kentucky was held by E. O. Ulrich, Stuart Weller, and the State geologists of Illinois and Missouri.

INDIANA.

A reconnaissance study of the Richmond group was made by E. O. Ulrich.

IOWA.

A review of the evidence of an Iowan stage of glaciation and of its relations to the deposits of other Pleistocene stages in eastern Iowa and adjoining States was begun in June by W. C. Alden. This work is being done in cooperation with the State Geological Survey, which furnished an assistant, Morris M. Leighton.

KANSAS.

Detailed field work in the Syracuse and Lakin quadrangles, Kansas, was done by N. H. Darton, whose text and maps, for folio publication, are practically completed, except for the acquisition of certain information as to the structure of the Dakota sandstone given in well records.

An examination of the zinc deposits in the southeastern corner of the State was made by C. E. Siebenthal, the results of which will be incorporated in a report on the ores of the region.

A folio describing and mapping the geology of the Leavenworth quadrangle was submitted by Henry Hinds and F. C. Greene, the latter being the representative of the cooperating State of Missouri in the studies of the Missouri coal field, in which the greater part of the Leavenworth quadrangle lies.

KENTUCKY.

The coal resources of the Kentucky portion of the Pound quadrangle have been described by Charles Butts in a paper to be published in part F of Bulletin 541.

A small area near Pine Mountain, in the southeast corner of the Regina quadrangle, was mapped by Henry Hinds in the summer of 1913, in connection with the examination of the Bucu quadrangle, in the southwestern Virginia coal field.

In cooperation with the Kentucky Geological Survey the detailed study and mapping of Jefferson County was begun in June by Charles Butts, assisted by T. C. Brown. The results of the comprehensive studies thus begun are to be embodied in a general report on the geology and mineral resources of the county, to be published by the State, and in folios to be issued by this Survey.

The Ordovician rocks of central Kentucky were examined by E. O. Ulrich in association with A. M. Miller for the purpose of procuring information necessary to the interpretation of the stratigraphy of the Cincinnati quadrangle.

The Pleistocene age of the Columbus and Hickman bluffs, in western Kentucky, has been demonstrated through paleobotanic evidence by E. W. Berry, who has also submitted a report on the fossil flora of the Wilcox formation.

A paper on "Cretaceous deposits of the eastern Gulf region," by L. W. Stephenson (Professional Paper 81), contains descriptions of the Cretaceous deposits of the Coastal Plain area of the State.

LOUISIANA.

A study of the origin and history of Caddo Lake, La., was made by the Survey, under order from the Secretary of the Interior, in cooperation with representatives of the General Land Office, and a report by Frank Leverett has been submitted. During a part of the investigations Mr. Leverett was associated with George C. Matson, who had also examined the stratigraphy and geologic structure of the region including the Caddo oil field, with special reference to the mode of occurrence of oil and natural gas. A report on this field by Mr. Matson is now ready for submission.

A study of the Pleistocene deposits, the Recent offshore deposits, and the physiography of eastern and southern Louisiana was made by E. W. Shaw, who spent several weeks in a reconnaissance study of the Mississippi Delta, extending over an area of 100 square miles. A paper on "The mud lumps at the mouths of the Mississippi," by Mr. Shaw, was published as Professional Paper 85–B.

A report on the lower Oligocene floras of Mississippi, Louisiana, and Texas, by E. W. Berry, was completed last year, and will be

published in conjunction with a report by George C. Matson on the Catahoula sandstone in Mississippi, Louisiana and Texas, which is in preparation.

MAINE.

A review, with field conference and inspection by Arthur Keith, of the areal and economic geology of the Portland and Casco Bay quadrangles, Maine, was completed by F. J. Katz, for folio publication, in cooperation with the Maine State Water Storage Commission. The final map covering these quadrangles has been finished by Mr. Katz and the text nearly completed.

A brief reconnaissance in the Bath and Boothbay quadrangles, covering about 50 square miles, was made by Arthur Keith. Prof. C. W. Brown has continued the preparation of the folio on the Frenchmans Bay quadrangle.

The study and description of the faunas of the Silurian formations in the Eastport quadrangle have been prosecuted by H. S. Williams.

MARYLAND.

A detailed reconnaissance in the Williamsport and Hagerstown quadrangles, in Maryland, West Virginia, and Pennsylvania, was carried on by G. W. Stose, in association with R. S. Bassler. The maps and descriptions of these areas have been completed as far as the field work has gone.

The manuscript of the folio on the Elkton and Wilmington quadrangles, including portions of Pennsylvania and Delaware, has been submitted by Florence Bascom and B. L. Miller. This work was done in cooperation with the Geological Survey of Maryland.

A brief investigation of the underground-water conditions at Silver Spring and vicinity was made by George C. Matson in October, 1913, and a report of his conclusions was transmitted to a committee of citizens interested in the establishment of water and sewerage systems in the town.

A cooperative report on the underground waters of Maryland, Delaware, and the District of Columbia has been taken over by the Maryland Geological Survey and will be completed and published by it.

MASSACHUSETTS.

The description of the Boston and Boston Bay quadrangles, Massachusetts, for the Boston folio has been advanced, and the survey of the Framingham quadrangle, also for the Boston folio, has been almost completed by Laurence La Forge, who also made a reconnaissance in the Franklin and Lowell quadrangles.

Certain portions of the areal geology of the Warwick quadrangle were reviewed by Prof. B. K. Emerson, about 50 square miles having been covered in detail.

A manuscript of the "Geology of Massachusetts and Rhode Island" was carefully revised by Prof. Emerson and transmitted for publication.

A field conference in the Framingham and Franklin quadrangles was held by Arthur Keith with Prof. Emerson and Laurence La Forge. Mr. Keith also made a brief reconnaissance in the Salem quadrangle.

The Quaternary geology of the Sheffield, Sandisfield, Pittsfield, and Becket quadrangles was described for folio publication by F. B. Taylor, who in June completed the field mapping of the Quaternary deposits of the Berlin, Greylock, Hoosick, and Bennington quadrangles.

MICHIGAN.

A brief reconnaissance in the Carboniferous area of Michigan, particularly of the Marshall sandstone, was made by G. H. Girty for the purpose of studying the stratigraphy and collecting the fossil fauna. The report embodying the results of these studies is in preparation in cooperation with the Geological Survey of Michigan, to which it will be submitted for publication.

The salt resources of the State and the methods of production will be described by W. C. Phalen in a bulletin on the salt deposits of the United States

MINNESOTA.

The field examination of the clay deposits of Minnesota was finished by F. F. Grout, and a report containing descriptions of the deposits and of the results of burning tests of the clays is in preparation.

An examination of the granite area in Benton and Sherburne counties was made by Mr. Grout for description in a report by Mr. Grout and Oliver Bowles on the building and ornamental stones of Minnesota. This report is now nearly completed.

Preliminary to the preparation of a general report on the stratigraphy and economic geology of the Cuyuna iron range a large number of logs of drill holes and samples were collected by A. W. Johnston.

The work of mapping the glacial deposits of the State, with special reference to the origin of the soils, was continued by Frank Leverett, with the assistance, at different times, on the part of the State survey, of E. R. Preston, F. W. Sardeson, C. S. Corbett, and G. R. McDowell. A report covering the northwest quarter of the State was prepared by Mr. Leverett and transmitted to the director of the

Minnesota Geological Survey for publication. A paper entitled "Earth movements in the Minnesota portion of Lake Agassiz during and since the lake's occupancy" was submitted by Mr. Leverett for publication by the Geological Society of America.

The surveys of this State as described above are carried on in cooperation with the State Geological Survey of Minnesota.

The manuscripts for the Herman-Morris and St. Paul-Minneapolis folios have been revised by Mr. Sardeson, who, in company with E. O. Ulrich, reviewed the stratigraphy of the Cambrian and Ordovician formations in the St. Paul and Minneapolis quadrangles.

MISSISSIPPI.

A description of the Cretaceous deposits of Mississippi is contained in a paper on "Cretaceous deposits of the eastern Gulf region," by L. W. Stephenson, published as Professional Paper 81.

A brief study of the Quaternary deposits and physiography of the State was made by E. W. Shaw.

A monograph on the lower Oligocene floras of Mississippi, Louisiana, and Texas, by E. W. Berry, was completed and will be published in conjunction with a report by George C. Matson on the Catahoula sandstone in Mississippi, Louisiana, and Texas, which is in preparation.

A professional paper on "The lower Eocene flora of southeastern North America," by E. W. Berry, an exhaustive paleobotanic study of the floras as developed in the Mississippi Embayment, was transmitted for publication.

Stratigraphic and paleontologic investigations covering an area of approximately 400 square miles were made by C. W. Cooke, who has also identified Tertiary mollusks from Mississippi and prepared lists of fossils for incorporation in a report on the Coastal Plain of Mississippi to be issued by the State Survey.

One week was devoted to a conference and review of field work in Mississippi by T. W. Vaughan, G. C. Matson, and E. W. Shaw, of the United States Geological Survey, in company with E. N. Lowe, State geologist of Mississippi, and E. A. Smith, State geologist of Alabama.

MISSOURI.

As a part of the cooperative geologic work in Missouri the Pleistocene area of the Missouri portions of the Crystal City, Renault, Kimmswick, and Chester quadrangles were examined and mapped by E. W. Shaw for description in folios for which the Paleozoic formations and economic geology will be described by Stuart Weller and other geologists of the Missouri Bureau of Geology and Mines.

A folio covering the Leavenworth and Smithville quadrangles, also surveyed in cooperation, was completed by Henry Hinds and F. C. Greene, and a draft of the text with maps for the Queen City and Green City quadrangles was submitted by F. C. Greene, assistant geologist of the State Survey, for examination.

The report of Messrs. Hinds and Greene on the stratigraphy of the Pennsylvanian formations in the northwestern part of the State has been prepared for submission to the State for publication.

Recent developments in the Spring City mining camp were examined by C. E. Siebenthal, who completed and submitted a report on the "Genesis of the Joplin lead and zinc ores."

The first edition of the Joplin folio of the geologic atlas having been exhausted, a reprint of this folio, in view of the urgent public demand, was ordered.

Field conferences concerning the stratigraphy and classification of the upper Paleozoic rocks of the Missouri were held by G. H. Girty, E. O. Ulrich, and David White with the State geologists of Missouri, Iowa, and Illinois, and the States of the Mississippi Valley.

The Carboniferous formations and faunas of the Rolla quadrangle and of the Joplin district were studied by G. H. Girty.

The Pleistocene deposits at several points in northern Missouri were examined by Frank Leverett in connection with the work on the Queen City, Green City, Leavenworth, and Smithville quadrangles.

MONTANA.

The classification of the lands in the former Flathead Indian Reservation, Mont., begun at the request of the Office of Indian Affairs in 1912, was completed in 1913, the examination and report being made by R. W. Stone. A reconnaissance trip to South Fork of Flathead River resulted in brief reports on "Coal on South Fork of Flathead River, Mont.," and on the "Felix Basin copper deposits." The former will appear in the bulletin entitled "Contributions to economic geology, 1915," and the latter was given to the daily press.

Certain lands near Anaconda were examined and classified by J. M. Hill for the Department of Justice.

A reconnaissance for land classification as to the mineral or nonmineral character of Northern Pacific Railroad grant lands lying in Tps. 6 and 7 S., R. 6 W., comprising about 2 square miles, was made by E. L. Jones, jr.

E. S. Larsen and J. T. Pardee made an examination of a small district east of Libby, in which occur veins containing silicate minerals notably rich in vanadium. The vanadiferous ægirite from this district was described by Mr. Larsen and W. F. Hunt in one of the scientific journals.

The microscopic study of the Butte copper ores, which was begun by F. B. Laney before he was detailed to other work in cooperation with the Bureau of Mines, has been advanced somewhat during the year.

After completing the examination of the lands of Fort Berthold Indian Reservation of North Dakota, C. M. Bauer, assisted by C. A. Bonine, made a detailed reconnaissance survey of a part of the Ekalaka coal field, in Chester County, Mont., embracing an area of about 650 square miles. Mr. Bauer has submitted land-classification data for the area examined and has prepared for publication an economic report which will appear in the bulletin "Contributions to economic geology, 1915." He has also submitted for publication two other short papers, one on the clays of Montana and one on the late Tertiary history of upper Missouri River.

The examination of the Tullock coal field, Rosebud County, which was begun the preceding year, was continued by G. S. Rogers, assisted by Wallace Lee, who together mapped an area 435 miles in extent. Land-classification data have been submitted for this area, and an economic report is now ready for publication.

Mr. Rogers also mapped an area of 125 square miles in the vicinity of Pine Ridge, between Bighorn and Yellowstone rivers. The land has been classified and a report thereon published in Bulletin 541–H.

An area of 65 square miles in Dawson County, 20 to 35 miles northwest of Glendive, and an area of about 110 square miles south of Maudlow were mapped by C. T. Lupton, who also made a detailed reconnaissance examination of an area 30 square miles in extent near Lombard, and another 40 square miles in extent 10 miles northwest of Musselshell. The land has been classified and a report for publication is partly prepared. Mr. Lupton and E. R. Lloyd have also submitted for publication as a bulletin a final report on the Bull Mountain coal field.

The areal mapping of the Cut Bank and Blackfoot quadrangles was completed by Eugene Stebinger, who also made a reconnaissance, for classification purposes, of an area of 1,500 square miles in the vicinity of the Sweetgrass Hills. All the land has been classified, and an economic report on the coal resources of the Blackfeet Indian Reservation and a folio on the Blackfoot and Cut Bank quadrangles are in hand.

Mr. Stebinger also prepared papers on the coal fields of Montana and on the stratigraphy of the Montana group in north-central Montana.

A paper on the stratigraphy of the Montana group, with special reference to the stratigraphic position and age of the Judith River formation, has been submitted by C. F. Bowen. The two papers

last named will appear in the professional paper entitled "Shorter contributions to general geology, 1914."

Carboniferous sections on Yellowstone River above Livingston were studied by G. H. Girty, and a field study of the paleontology and stratigraphic relations of the Jefferson limestone in southwestern Montana was made by Edwin Kirk, who also examined some points in the Phillipsburg quadrangle.

Collections of vertebrate fossils from the Two Medicine formation in the Blackfeet Indian Reservation was made by C. W. Gilmore, temporarily transferred from the National Museum to the Geological Survey. The results of Mr. Gilmore's researches will be published by the Geological Survey and the National Museum.

Field studies were made and fossils were collected in the Livingston formation west of the Crazy Mountains by F. H. Knowlton, E. W. Berry, and T. W. Stanton. Mr. Stanton examined the Pierre shale and Lance formation in the neighborhood of Glendive.

The examination of the Garrison-Drummond phosphate withdrawals, embracing an area of about 640 square miles, a part of which included lands in which some work had been done the preceding year, was concluded by J. T. Pardee, and classification plats and reports concerning these lands have been filed with the land-classification board. Phosphate withdrawals, about 50 square miles in extent, near Elliston and Helena were examined in August and September by R. W. Stone, assisted by C. A. Bonine. A joint report on the Elliston phosphate field by Messrs. Stone and Bonine has been submitted for publication as Bulletin 580–N.

The Quaternary geology of Glacier National Park was studied by W. C. Alden, in company with C. S. Corbett and a party under the direction of M. R. Campbell. This work included sounding of lakes and study of existing glaciers and of the physiography and Pleistocene deposits of the region. A paper by Mr. Alden on the glaciers of the park was published by the Department of the Interior as one of its series of pamphlets descriptive of the national parks.

NEBRASKA.

Studies of the early Pleistocene in the vicinity of Omaha, Nebr., were made by W. C. Alden in association with W. T. Lee.

In the Pennsylvanian formations near Missouri River correlations have been made and the continuity of the members in Missouri and Kansas has been determined and is described in a report on the stratigraphy of the Pennsylvanian in northern Missouri, by Henry Hinds and F. C. Greene, prepared in cooperation with the Missouri Survey, to which it is to be transmitted for publication.

NEVADA.

Reconnaissance examinations of mining districts in eastern Nevada were continued by J. M. Hill, who visited 26 localities in Elko, White Pine, Lincoln, and Clark counties and the Ravenswood district, in Lander County. His report is in preparation.

A report on the National district by Waldemar Lindgren has been completed.

The Rawhide, Eagleville, Terrell, Denway, Cox Canyon, I. X. L. Canyon, Bernice, and Alpine mining districts were examined by F. C. Schrader, who also studied and prepared a report on the Rochester mining district.

The report on the geology and ore deposits of the Ely district has been completed by A. C. Spencer.

Drilling was prosecuted in Columbus Marsh, and the playa and the outline of the Quaternary lake that occupied this basin were mapped in detail. The chemical study of the samples obtained from the drillings at this locality has been continued, chiefly for the bearing they have on the general study of the salines in the desert-basin region. High potash tests obtained from some of the muds in the Columbus basin are now shown to be the result of absorbed or loosely combined potassium held by these colloidal sediments, and it is believed that this example may illustrate and help to explain the apparent disappearance of much of the potassium content of original drainage waters that must have collected and concentrated in this and other basins.

The drilling of a series of shallow wells in the Black Rock Desert as a part of potash investigation was intended to be supplemented by the sinking of at least one deep hole, but a period of unusually stormy weather for this desert region made operations impossible in the spring of 1914. This work was under the supervision of Hoyt S. Gale, with whom W. B. Hicks, R. K. Bailey, and Charles E. Watson were associated in the field work and Messrs. Hicks and Bailey in the laboratory chemical investigations.

NEW HAMPSHIRE.

The areal survey of the Milford quadrangle, New Hampshire, was continued by Prof. B. K. Emerson for folio publication, the work relating largely to the Pleistocene deposits. A field conference in the Peterboro quadrangle was held by Arthur Keith with Prof. Emerson.

The pyrite deposits in the vicinity of Milan, in Coos County, were examined by W. C. Phalen.

NEW JERSEY.

The areal survey of the Easton quadrangle, in New Jersey and Pennsylvania, was continued, in cooperation, by Dr. H. B. Kümmel, State geologist. A field conference was held by Arthur Keith with Dr. Kümmel in this quadrangle.

The pre-Cambrian portion of the Ramapo-Greenwood Lake folio has been revised by Prof. W. S. Bayley.

NEW MEXICO.

At the request of the Office of Indian Affairs, about 5,000 acres of irrigable land lying under the Hogback Canal in the Navajo Indian Reservation, N. Mex., was examined for purposes of land classification, which was made by M. A. Pishel.

A detailed examination for land classification of an area of 75 square miles in the vicinity of Gallup, McKinley County, was made by C. T. Lupton.

Under instructions of the Secretary of the Interior a commission consisting of C. T. Lupton, geologist, chairman, and C. B. Barker and A. G. Jaffa, mineral inspectors of the General Land Office, examined an area of 60 square miles west and south of Gallup, for the purpose of determining the coal content of the land. A report thereon has been submitted to the Secretary of the Interior.

The detailed mapping of the Raton and Brilliant quadrangles, in the Raton coal field, was completed by W. T. Lee, assisted by K. C. Heald. A folio and an economic report on the coal resources of these two quadrangles are in preparation.

The Datil Mountain coal field, in Socorro and Valencia counties, about 730 square miles in extent, was surveyed in detailed reconnaissance by D. E. Winchester, who has classified the lands and is preparing a report. A review of the Cretaceous section in this coal field was made by Mr. Winchester and T. W. Stanton, and Mr. Stanton also made a brief study of the section of the Rio Grande on Elephant Butte.

An area of about 1,800 square miles, mainly in central New Mexico, in Rio Arriba, Sandoval, Valencia, Bernalillo, San Miguel, Socorro, Lincoln, Guadalupe, Gallina, and Otero counties, was examined in reconnaissance by N. H. Darton, in a study of the stratigraphy and conditions of sedimentation and chemical deposition in the "Red Beds" in the Southwestern States. Brief visits were also made to salt deposits near Salina, Utah, and St. Thomas, Nev. It is hoped that the study of the "Red Beds" and their great gypsum deposits may reveal a relation of the gypsum beds to the more soluble salts of desiccated saline water deposits and result in the discovery of potash-bearing salts.

A portion of the coal lands in the Zuni Indian Reservation, which were examined in 1912, has been classified and reported on by D. E. Winchester.

The deposits furnishing precious stones have been examined by D. B. Sterrett, who has described them briefly in a manuscript submitted for publication as a part of Mineral Resources for 1913.

A paper on the coal measures of Raton Mesa and other coal fields in Colorado and New Mexico, by W. T. Lee, with a report on the fossil floras of the Vermejo and Raton formations, by F. H. Knowlton, was submitted for publication. Mr. Knowlton also prepared a paper on the Cretaceous-Tertiary boundary in the Rocky Mountains.

NEW YORK.

The areal survey of the Hoosick quadrangle, New York, was completed by L. M. Prindle, who also continued the areal mapping of the Berlin quadrangle, including a portion of Massachusetts. A field conference was held by Arthur Keith with Mr. Prindle in the Berlin quadrangle.

For the Sheffield and Pittsfield quadrangles manuscripts descriptive of the Quaternary geology were prepared and transmitted for folio publication by F. B. Taylor, who, in June, completed the field mapping of the Quaternary deposits in the Berlin and Hoosick quadrangles, which, like those already mentioned, lie partly in this State.

A report on the geology of Long Island, by M. L. Fuller, has been issued as Professional Paper 82.

A folio by E. M. Kindle and F. B. Taylor, describing in detail the geology of the Niagara Falls quadrangle and written with special reference to the educational features of the region, was issued in August. A part of this material was prepared with the cooperation of the Geological Survey of Canada.

The Cambrian and early Ordovician formations of the Ogdensburg quadrangle were examined by E. O. Ulrich and H. P. Cushing, and the study of the late Ordovician formations of western and central New York with special reference to their bearing on the Ordovician-Silurian boundary was made by Mr. Ulrich in association with C. A. Hartnagel, of the New York State Survey.

The salt resources of the State and the methods of production are described by W. C. Phalen in a bulletin on the salt deposits of the United States.

The pyrite deposits in St. Lawrence County were examined by Mr. Phalen for discussion in a chapter in Mineral Resources for 1913.

NORTH CAROLINA.

The areal and economic survey of the Lincolnton quadrangle was completed by D. B. Sterrett, who also made a reconnaissance of about 100 square miles adjoining this quadrangle.

The survey of the portions of the Kings Mountain and Gaffney quadrangles lying in North Carolina was reviewed by Mr. Sterrett in conference with Arthur Keith.

A description of the principal mica deposits of the State, prepared by Mr. Sterrett, was submitted for publication as a bulletin. The deposits furnishing precious stones in the State have also been examined by Mr. Sterrett, who has treated them briefly in a chapter in Mineral Resources for 1913.

A monograph on the Cretaceous Mollusca of North Carolina, by L. W. Stephenson, to be published as a cooperative report by the North Carolina Geological and Economic Survey, is nearly completed. A report entitled "Cretaceous deposits of the eastern Gulf region and Species of Exogyra from the eastern Gulf region and the Carolinas," by L. W. Stephenson, was published as Professional Paper 81.

The Pliocene Foraminifera of the State are described in a report by Joseph A. Cushman, and a paper by him on the Foraminifera of Miocene age is nearing completion.

NORTH DAKOTA.

An area of approximately 216 square miles in the Fort Berthold Indian Reservation, N. Dak., was examined for land classification by C. M. Bauer, assisted by C. A. Bonine, and they have classified the lands and prepared a report on the area for publication.

Work on the Cannonball River lignite field was continued during the year by E. R. Lloyd, who made a detailed reconnaissance of an area about 1,200 square miles in extent in the valleys of Cannonball and Heart rivers. Much time was given to the Cannonball marine member of the Lance formation, concerning which a joint report by Mr. Lloyd and C. J. Hares has been submitted for publication. The land was classified, and a report on the coals by Mr. Lloyd has been published as Bulletin 541–G.

A field conference on the stratigraphy and relations of the Cannonball marine member in Morton County was held by E. R. Lloyd, E. W. Berry, F. H. Knowlton, and T. W. Stanton; and Mr. Stanton has discussed the formation and its invertebrate fauna in a paper on "The boundary between Cretaceous and Tertiary in North America."

A reconnaissance survey of an area of about 100 square miles in the vicinity of Devils Lake was made by Eugene Stebinger, who classified the lands.

OHIO.

The Paleozoic formations in the Hamilton and Mason quadrangles, Ohio, were mapped in detail by R. S. Bassler for folio publication, about 220 square miles having been covered. The manuscript for the folio for these quadrangles, by Dr. Bassler, in association with N. M. Fenneman, who will describe the Pleistocene formations and the economic geology, is well advanced.

A part of Ashland County, reported to contain tilted shore lines, was examined by Frank Leverett.

The preparation of a folio text for the Steubenville and Cadiz quadrangles was resumed by D. D. Condit, who during the greater part of the year was occupied with the classification of withdrawn phosphate lands in Wyoming.

OKLAHOMA.

Field work in the Hominy quadrangle, Oklahoma, has been completed by Robert H. Wood, assisted by C. C. Turnbull, in cooperation with the Oklahoma Geological Survey. Field conferences in this work were held between Mr. Wood and Arthur Keith and with C. W. Shannon, State geologist. A folio and an economic report on the Hominy quadrangle, by Mr. Wood, are nearly completed.

A reconnaissance in the western half of the Osage Indian Reservation was made by Mr. Wood.

The economic report on the Vinita and Nowata quadrangles, prepared by D. W. Ohern in cooperation with the State, has been submitted.

A reconnaissance covering about 100 square miles in the Pawhuska quadrangle was made by Carl D. Smith, whose reports on the Pawhuska quadrangle have been well advanced. The report on the Claremore quadrangle is prepared in cooperation with the Oklahoma Geological Survey.

The preparation of the manuscript for the folio on the Sallisaw and Sanbois quadrangles has also been well advanced by Mr. Smith.

A report on the coal fields of Oklahoma, designed for inclusion in a general report on the coal fields of the United States, has been begun by Mr. Smith.

The preparation of the folio for the McAlester quadrangle has been resumed by J. A. Taff under a contract. The long suspension of this work was caused by the resignation of Mr. Taff, several years ago, from the Survey.

The area along Red River in Cotton, Jefferson, and Carter counties, lying east of that described by M. J. Munn in Bulletin 547 and extending eastward to the Chicago, Rock Island & Pacific Railroad, was examined and mapped in detailed structural reconnaissance by

Carroll H. Wegemann, assisted by A. E. Fath and R. W. Howell, and a report describing the structure, with special reference to oil and gas possibilities, was prepared. In connection with this field work preliminary examination of the Healdton and Loco oil fields were made, and brief reports on the structure of these pools are nearly completed. The work by Mr. Wegemann's party was conducted in cooperation with the State Geological Survey, which defrayed a part of the expense.

Further examinations of the geology in the Wyandotte quadrangle, in the northeast corner of the State, were made by C. E. Siebenthal, who was joined for a time by G. H. Girty for the purpose of obtaining paleontologic material adequate for the correlation and classification of the formations. Special attention was given by Mr. Siebenthal to the recent developments in the Miami camp, which it is expected will be the subject of an economic report.

Extensive collections of fossil invertebrates were obtained by P. V. Roundy for use in connection with the stratigraphic study of the Carboniferous formations in the Pryor and Muskogee quadrangles.

OREGON.

Mapping of the geology of the Sumpter quadrangle, Oregon, for folio publication, was begun in 1908 by J. T. Pardee. After November 1, 1909, no further work was done in this area until the fall of 1913, when, under a cooperative agreement between the Federal Survey and the Oregon Bureau of Mines and Geology, 50 square miles was mapped by F. J. Katz. Under this agreement, which includes the preparation of an economic bulletin to be published by the Oregon Bureau and the publication of a geologic folio by the Federal Survey, field work was resumed June 1, 1914, by J. T. Pardee and D. F. Hewett, and is now being carried to completion.

A reconnaissance of the Klamath Indian Reservation for the purpose of mineral-land classification was made in the fall of 1913 by H. G. Ferguson, whose report has been submitted.

A report on the mineral resources of southwestern Oregon, by J. S. Diller, was published as Bulletin 546.

A detailed examination of 10 square miles in the Eden Ridge coal field, Coos County, was made by C. E. Lesher, for the purpose of classifying the land as coal or noncoal. Float and sink tests of 26 samples of the coal and ash determinations of 80 samples were made. The land examined has been classified and a report published.

PENNSYLVANIA.

The folios and economic bulletins covering the Punxsutawney, Houtzdale, and Curwensville quadrangles, Pennsylvania, have been brought nearly to completion by G. H. Ashley, under whose direc-

tion additional field observations of the coals and fire clays were made during July and August by J. H. Hance, who sampled the clays for tests in the Pittsburgh laboratories of the Bureau of Standards. In connection with this work Mr. Hance sampled the clay mines at a number of points in Blair and Cambria counties.

The Newcastle quadrangle, which was examined some years ago by F. W. De Wolf, prior to his appointment as State geologist of Illinois, will be described in both a folio and an economic bulletin by Mr. De Wolf, who, in order to bring the economic developments to date, made in June additional examinations in the field, where he was for a few days assisted by A. E. Fath and R. V. Mills. The above-mentioned work by Mr. Ashley and Mr. De Wolf is done in cooperation with the Topographic and Geologic Survey Commission of Pennsylvania.

The final revision of the areal-geology map of the Gettysburg quadrangle has been made by George W. Stose, who has partly prepared the descriptive text for the folio covering the Fairfield and Gettysburg quadrangles.

A special examination and brief report were made by Mr. Stose on the water resources of a small area around Monterey.

The manuscript for the folio on the Bellefonte quadrangle has been revised and transmitted by Prof. E. S. Moore for publication.

The survey of the Huntingdon quadrangle was completed for folio publication by Charles Butts, who has reviewed his former work in the Hollidaysburg quadrangle. The maps and descriptions for a Hollidaysburg-Huntingdon folio are three-fourths completed.

A detailed reconnaissance covering about 100 square miles in the Elkton quadrangle in review of former work was made by Florence Bascom, who has transmitted the manuscript maps and text for the Elkton-Wilmington folio.

The detailed mapping of the crystalline rocks of the Reading area has been completed by Eleanora F. Bliss, and the sedimentary formations in the same quadrangle have been mapped in detail by E. T. Wherry.

The mapping of the Allentown quadrangle for publication in the Allentown-Easton folio was continued and nearly completed by Prof. B. L. Miller.

The Somerset quadrangle was examined and mapped in detail by G. C. Richardson, who has nearly completed the text for the folio covering this quadrangle.

RHODE ISLAND.

Field examinations in the Narragansett Basin, R. I., were made and a full report on the coals and their adaptabilities has been submitted by G. H. Ashley. A preliminary summary of Mr. Ashley's results was published in Bulletin 541–F.

SOUTH CAROLINA.

A reconnaissance in the Gaffney and Kings Mountain quadrangles, South Carolina, was made by D. B. Sterrett, in company with Arthur Keith, in review of previous work in those areas. The geologic folio in preparation by Mr. Sterrett for these quadrangles is well advanced.

A brief examination of the phosphate developments in the State was made early in the summer by G. S. Rogers, whose report is in press as Bulletin 580–J.

A study of the principal mica deposits of the State was made by D. B. Sterrett and the report submitted.

The deposits furnishing precious stones in the State have been examined and described by Mr. Sterrett.

A report on "The Upper Cretaceous and Eocene floras of South Carolina and Georgia," by E. W. Berry, was published as Professional Paper 84, and papers on the "Cretaceous deposits of the eastern Gulf region, and Species of Exogyra from the eastern Gulf region and the Carolinas," by L. W. Stephenson, was issued as Professional Paper 81.

A report on "A deep well at Charleston, S. C.," by L. W. Stephenson, including a report on the Foraminifera, by Joseph A. Cushman, and a discussion of the chemistry of the water, by Chase Palmer, was completed.

A monograph on the Pliocene Foraminifera was transmitted by Joseph A. Cushman, and a report on the Foraminifera of the Miocene, by the same author, is now nearly written.

SOUTH DAKOTA.

An area of about 700 square miles of pre-Cambrian rocks within the Deadwood, Rapid, Hermona, and Harney Peak quadrangles, in the Black Hills, S. Dak., was mapped for folio publication by Sidney Paige and two assistants. During the winter Mr. Paige continued the preparation of folios covering these quadrangles. A short field season in 1914 will complete this work. N. H. Darton, who mapped the younger formations in these quadrangles, spent some time in preparing the text for the Deadwood-Rapid folio and nearly completed the text for the Newell folio. For the latter, however, a small amount of field work is still necessary to determine the Lance and Fox Hills boundary.

Field work on the lignite area of South Dakota was completed in 1912. The reports of all the geologists who have been engaged in this work were consolidated into a joint report under the caption "The lignite field of northwestern South Dakota," by D. E. Winchester, C. J. Hares, E. R. Lloyd, and E. M. Parks, which will be published as a bulletin.

TENNESSEE.

A report by Charles Butts on the geology and coal resources of the Crossville quadrangle, Tennessee, which was surveyed in cooperation with the State, has been submitted and will be published by the State Geological Survey.

The section of the report on the Ducktown district for which Prof. W. H. Emmons is responsible has been submitted and the manuscript is now in the hands of F. B. Laney, the author of another section of the report.

The deposits of iron ore in eastern Tennessee will be described in detail by E. F. Burchard in a bulletin now nearly completed. The preparation of Mr. Burchard's manuscript has been seriously interrupted by his work in Alaska and other areas. The stratigraphy of the formations associated with the iron-ore deposits was briefly studied in the field by E. O. Ulrich.

Under cooperative auspices the areal geology and mineral resources of the Waynesboro quadrangle were surveyed in detail by H. D. Miser, assisted on the part of the State by N. F. Drake, Bruce Wade, and O. P. Jenkins. An additional area, embracing 100 square miles, west of this quadrangle was examined in reconnaissance by Mr. Miser, who has begun the compilation of notes and maps for the folio on the Waynesboro quadrangle. A preliminary report, "The resources of the Waynesboro quadrangle," by Mr. Drake, with contributions by Mr. Miser, has been submitted for publication by the State Geological Survey.

The bauxite deposits near Keenburg, Carter County, were studied by W. C. Phalen and are discussed in the appropriate chapter in Mineral Resources for 1913.

An examination of the Chickasaw Bluffs, in the western part of the State, was made by E. W. Berry, who by means of paleobotanic evidence has found beds of Claiborne age at that point. Fossil plants of Wilcox age from Tennessee are described in a report submitted by Mr. Berry.

The Cretaceous formations of the State are described by L. W. Stephenson in a report published as Professional Paper 81.

Unpublished geologic map data were furnished to the State Survey for use in the publication of a new geologic map of the State.

TEXAS.

Field investigations in southwestern Texas, particularly in the section in the Nueces Valley of Zavalla, Dimmit, La Salle, and McMullen counties, were made by Alexander Deussen, and some reconnaissance work done in Duval, Jim Wells, Brooks, and Willacy counties, an area of 6,000 square miles being covered by the field

work. Numerous samples from deep wells in the Texas Coastal Plain were studied and a complete set of drill samples and accurate data concerning a well at Fowlerton were obtained, as also were samples from well drillings at Marion, Maxwell, Crystal City, and other points. Logs of wells bored in the Paleozoic formations of the State were collected and geologically interpreted by J. A. Udden, geologist of the State Bureau of Economic Geology and Technology.

A brief examination of the offshore deposits was made by E. W. Shaw during a cruise of the Bureau of Fisheries steamer *Fish Hawk*.

Fossil plants were collected from the Catahoula and Yegua formations of eastern Texas by E. W. Berry in the course of his paleobotanic studies.

A report on the "Geology and underground water resources of Texas east of Brazos River," by Alexander Deussen, will soon be published as Water-Supply Paper 335.

A report on the underground water supply of La Salle and McMullen counties, with notes on the oil, gas, and lignite occurrences in McMullen County and a detailed description of the Tertiary formations in the Nueces drainage basin of southwestern Texas, by Alexander Deussen, including a chapter on the ground waters of Dimmit, La Salle, and McMullen counties, by R. B. Dole, has been transmitted for publication.

Portions of the Brackett quadrangle were examined by T. Wayland Vaughan, whose folio covering this quadrangle is nearly completed.

The structure of the Caddo oil field, which embraces a small area in eastern Texas, has been described and mapped by G. C. Matson in a report nearly ready for submission.

The geologic section in the Franklin Mountains near El Paso was studied by Edwin Kirk.

The cooperation of this Survey has been extended to the State Bureau of Economic Geology and Technology, under the direction of William B. Phillips, in the preparation of the geologic map of the State, now in progress by J. A. Udden.

The principal mica deposits of the State and the deposits furnishing precious stones have been examined by D. B. Sterrett.

A report on the lower Oligocene floras of Mississippi, Louisiana, and Texas, by E. W. Berry, was completed last year and will probably be published in conjunction with a report by George C. Matson on the Catahoula sandstone in Mississippi, Louisiana, and Texas now in preparation.

A report, with maps, on the "Geology and underground waters of the central Coastal Plain region of Texas," by Alexander Deussen, is nearing completion.

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UTAH.

The detailed report on the geology and ore deposits of the Tintic district, whose completion has been delayed through the resignation from continuous service of its senior author, Waldemar Lindgren, is practically finished, and the part of the report by C. F. Loughlin has been brought up to date. A paper on the oxidized zinc ores of the district was published by Mr. Loughlin in the journal Economic Geology. He also prepared a paper on a reconnaissance in the Canyon Range, west-central Utah, to be published by the Survey in "Shorter contributions to general geology, 1914" (Professional Paper 90). During the field season Mr. Loughlin completed reconnaissance surveys of the Blue Bells, West Tintic, Leamington, Saline Creek, Provo, American Fork, Farmington, Sierra Madre, Willard, Argenta, and Morgan districts. Reports on these districts will form a part of a general work on the ore deposits of Utah which is being prepared by B. S. Butler, in collaboration with Mr. Loughlin.

A reconnaissance of the uranium, vanadium, and copper deposits of the eastern part of the State was made by Mr. Butler and F. L. Hess.

In the Sunnyside and Wellington quadrangles an area of about 35 square miles was resurveyed in detail by F. R. Clark, who also examined two other small areas, one north of Thompson, the other south of Wales, for purposes of land classification. A folio and economic reports by Mr. Clark on these quadrangles are in preparation.

The investigation of the oil-bearing shales of the Uinta Basin, in western Colorado and northeastern Utah, was begun by E. G. Woodruff in August. The study of the stratigraphy and the mapping of these shales was supplemented by practical distillation tests in the field of the shales in the vicinity of Dragon, Watson, and White River in Utah, the results of which have been described by Mr. Woodruff and David T. Day in Bulletin 581–A. Office work was continued in the preparation of a more detailed report on the shales and a report on the geology of the Vernal quadrangle. In February Mr. Woodruff resigned from the service to accept a position in private work. The investigation of the oil shales of this region and of their commercial possibilities was continued by D. E. Winchester in June.

The pre-Carboniferous sections in northern Utah, chiefly in the Randolph quadrangle, were studied by Edwin Kirk.

The salt resources of the State and the methods of production will be described by W. C. Phalen in a report now in preparation.

VERMONT.

Detailed geologic mapping of the Bennington quadrangle, Vermont, was continued and practically completed by L. M. Prindle,

with whom a field conference was held by Arthur Keith. Mr. Prindle has continued the preparation of the Hoosick-Bennington folio.

A reconnaissance covering about 165 square miles in the Londonderry, Wilmington, and Townsend quadrangles and a detailed reconnaissance of 5 square miles in the Wilmington quadrangle were made by T. Nelson Dale, who has submitted the results of this work for publication.

Arthur Keith continued his special investigation of the stratigraphy and faulted structure of the Taconic Mountains in the Brandon and Castleton quadrangles and has made a detailed examination of the Cambrian and pre-Cambrian rocks in the northern part of the Rutland quadrangle. A paper embodying some of the results of Mr. Keith's studies in the Brandon quadrangle was presented at the December meeting of the Geological Society of America.

VIRGINIA.

In continuance of the detailed survey of the southwestern Virginia coal field in cooperation with the Virginia Geological Survey the Virginia portion of the Regina quadrangle and the greater part of the Bucu quadrangle were mapped by Henry Hinds, assisted on the part of the State, in 1913, by T. K. Harnesberger, and in June, 1914, by C. M. Bauer.

A report on the geology and coal resources of the Pound quadrangle, geologically mapped in 1912 by Charles Butts, appears in Bulletin 541–F.

The mapping of small areas in the Abingdon quadrangle was revised by G. W. Stose, who also studied the gypsum mines in this quadrangle. A brief study of certain stratigraphic points in the quadrangle was made by E. O. Ulrich.

An examination of the proposed national forest in the Lexington and Natural Bridge quadrangles, including a geologic reconnaissance, was made by Mr. Stose, who also studied the gypsum mines in this quadrangle and reported on the question of acquiring an extension of the Natural Bridge National Forest under the Weeks law. A brief study of certain stratigraphic points in the quadrangles was made by E. O. Ulrich.

The rutile deposits of Virginia are given prominence in a report by T. L. Watson on "The rutile deposits of the eastern United States," which will be published as Bulletin 580–O.

A quantitative and qualitative examination of the semianthracite coals in the Pocono formation (basal Mississippian) of the State was begun in the spring and nearly completed by R. W. Howell, the work being done in cooperation with the Virginia Geological Survey. The purpose of the investigation is to acquire information as to the

amount, distribution, accessibility, and characters of this reserve of semianthracite coal in Virginia.

A study of the principal mica deposits of the State was made by D. B. Sterrett.

WASHINGTON.

A rapid reconnaissance for the classification of coal land withdrawn from entry, embracing 700 square miles in Skagit and Whatcom counties, Wash., was made by C. E. Lesher, who classified the larger part of the area.

A reconnaissance for oil and gas was made in Chehalis, Jefferson, and Clallam counties, northwestern Washington, by C. T. Lupton, who examined an area of 1,300 square miles in detailed reconnaissance and 350 square miles in rapid reconnaissance and submitted his report.

The field examination of lands in the diminished Colville Reservation by J. T. Pardee, begun in 1912, was carried to completion in 1913, and maps and reports for the classification of these lands have been submitted.

Bulletin 550, on the ore deposits of northeastern Washington, by Howland Bancroft, with a report on the Republic district by Waldemar Lindgren and Mr. Bancroft, was issued during the fiscal year.

WEST VIRGINIA.

Portions of the Steubenville, Frostburg, Flintstone, and Williamsport quadrangles, in West Virginia, have been under examination for description with the object of folio publication, the folio covering the Steubenville quadrangle being in preparation by D. D. Condit, and folios for the remaining quadrangles, which were surveyed in cooperation with the Maryland Geological Survey, being prepared by G. W. Stose, together with R. S. Bassler, G. K. Swartz, and other members of the Maryland Geological Survey.

The coals of the Pocono formation in Virginia and West Virginia were, in June, examined by R. W. Howell for description in a brief report on the semianthracite coal resources of the Pocono formation in the Virginian region.

WISCONSIN.

A report on the Quaternary geology of southeastern Wisconsin, with a chapter on the older rock formations, received final revision from W. C. Alden and was transmitted for publication.

At the request of the Wisconsin Geological and Natural History Survey the Federal Survey, through E. O. Ulrich, made a somewhat brief field study, in company with W. O. Hotchkiss and Samuel

Weidman, of the pre-Ordovician rocks of the western part of the State. Assistance has been extended by the State in the paleontologic determinations of invertebrate fossils from Wisconsin in the collections of the Federal Survey.

WYOMING.

The examination for more definite delimitation of the extensive phosphate withdrawals in Wyoming was continued and nearly completed during the season by parties under the direction of Eliot Blackwelder and D. Dale Condit, with Hyrum Schneider as assistant during the first half of the field season. Mr. Blackwelder's work was chiefly on the north slope of the Owl Creek Mountains, and Mr. Condit's examinations covered the south slope of the Owl Creek Mountains, the western extension of the phosphate outcrop along the south slope of the Absaroka Mountains and the northeast slope of the Wind River Mountains. During the last half of the season Mr. Condit was associated in the field work with A. R. Schultz. The total area covered by the two parties in reconnaissance and detailed work was about 1,000 square miles, of which about 540 square miles was mapped in detail. The classification data submitted to the land-classification board cover parts of 48 townships in the Owl Creek and Absaroka mountains and 55 townships on the northeast slope of the Wind River Mountains.

A field examination of the gold placers on the Wind River or Shoshone Indian Reservation along nearly 200 miles of Wind and Bighorn rivers and their tributaries was made by F. C. Schrader in September and October. Classification data were submitted and a report was prepared for the bulletin entitled "Contributions to economic geology, 1913, Part I" (Bulletin 580).

The Moorcroft oil field, embracing a small area near Moorcroft, Crook County, was examined in July by V. H. Barnett, who classified the land and prepared a report on the oil field for "Contributions to economic geology, 1913, Part II" (Bulletin 581).

In the later part of the season the Glenrock coal field, approximately 1,300 square miles in area, in Converse and Natrona counties, was studied in detail by Mr. Barnett, who submitted data for the classification of the land and prepared reports on the coal field and on the prospects for oil in the Big Muddy dome of the Glenrock field.

Detailed folio work in the Hanna and Walcott quadrangles, in Carbon County, was carried on by C. F. Bowen, assisted by F. A. Herald. An area of about 300 square miles was mapped, leaving one-half of the Hanna quadrangle to be covered. Land-classification data have been partly prepared, and a geologic folio and an economic

report on the quadrangles are in preparation and will be finished as soon as the field work is completed.

An area embracing about 100 square miles in the Shirley Basin, Carbon and Natrona counties, was examined in rapid reconnaissance for land classification by Mr. Bowen. Part of this land has been classified, but no report for publication is contemplated.

An investigation of the prospects for oil and gas in the structural domes occurring between Casper and Lander, Natrona and Fremont counties, in central Wyoming, was undertaken by C. J. Hares, assisted by Max W. Ball and Stuart St. Clair. A total of 2,330 square miles was examined, of which 1,180 square miles was covered in detail, 970 in detailed reconnaissance, and 180 in rapid reconnaissance. The work is to be continued for another season, after which a final report covering the entire area is to be prepared.

The detailed areal survey of the Ilo quadrangle, in the Bighorn basin, was continued by D. F. Hewett, who mapped the remaining 130 square miles in detail with respect to the coal, oil, and gas resources. The land has been classified, and a preliminary report on the chances for finding oil and gas in the quadrangle is in preparation.

A report by Mr. Hewett on the prospects for oil and gas in the Oregon Basin and Meeteetse quadrangles has been submitted, and a report on the coal resources of the quadrangles is in process of preparation.

The Cretaceous sections at Kemmerer and Cumberland were studied by T. W. Stanton, who joined C. F. Bowen in a review of the stratigraphy in part of the Walcott quadrangle. The stratigraphic relations of the Bighorn dolomite and Jefferson limestone were described in a manuscript by Edwin Kirk.

A popular description of the fossil forest of the Yellowstone National Park was prepared by F. H. Knowlton for publication by the Department of the Interior.

CANAL ZONE.

In order to procure data for the determination and correlation of some of the formations on the Canal Zone, collections of Tertiary fossils were forwarded by the Isthmian Canal Commission to the Geological Survey. These fossils have been determined and reported on by W. H. Dall.

In continuance of the geologic and paleontologic investigations carried on in cooperation with the Isthmian Canal Commission the fossil calcareous algæ have been reported on by Dr. Marshall A. Howe, who has in preparation other scientific contributions based on the materials from the isthmian region.

HAWAIIAN ISLANDS.

The manuscript of a report by Whitman Cross on the lavas of the Hawaiian Islands and their relations has been revised and enlarged by the author and is in press as Professional Paper 88.

Collections of Tertiary or Quaternary invertebrates from the islands have been examined and reported on by W. H. Dall.

INVESTIGATIONS OF A GENERAL NATURE.

In addition to projects relating to specific or restricted areas, the geologic work of the Survey embraces many kinds of research concerning broad provinces or problems, in which the criteria originate in a number of States and the solution of which may have important economic application in many States, though the immediate results are classed as purely scientific. Mention can be made of but a few among the more important or general of these broad researches. Most of the investigations carried on by the Survey are either directly contributory to or are by-products of such studies.

Among the best known of these general studies are those relating to paleontology. The work of the geologists who are specialists in paleontology has a purely scientific side that is biologic and deals with the history of life on the earth and the classification and description of the forms of animals and plants that have been preserved in the rocks. In its geologic aspect, on the other hand, it is indirectly utilitarian, for it is indispensable to the geologic mapping of the country. This side of the work, which is necessarily emphasized by the Survey, touches the classification and correlation of practically all the sedimentary formations mapped by the geologists. From either point of view it involves the comparison of fossils and living faunas and floras in all parts of the world. The areas that must be considered are therefore coextensive with and stretch beyond the field of operations of the Survey as a whole. In illustrating this it may be noted, in passing, that one of the Survey geologists, distinguished for his paleontologic knowledge, has during the year been officially called upon to examine and report on collections of fossils from 18 States, Alaska, the Canal Zone, the Hawaiian Islands, and 10 foreign countries. The examinations of the history and work of the great Pleistocene ice sheets in North America, by Chamberlin and others; the skillful unraveling of the sequence of formations and of the geologic history of the metamorphic belt in the Appalachian region, by Keith and his associates; the working out of the geologic history and physiography of the San Juan region of Colorado, by the Cross and Atwood parties; and the geophysical investigations carried on in the physical laboratory, as noted on pages 82–85, are familiar examples.

The final publications, some of them monographic in scope, may embrace the scientific results of years of study.

Among the more important scientific studies to which special attention has recently been given by the Survey the following may be mentioned:

1. Studies of the precipitative action of metallic minerals on silver in solution. The field investigations carried on by E. S. Bastin and Chase Palmer in Colorado mining districts, and the laboratory experiments by Mr. Palmer, who has made a series of quantitative studies of the action of solutions of silver salts on metallic minerals that are common in silver ores, clearly demonstrate the importance of downward enrichment in the development of rich silver ores. These studies show also that many mineral substances which appear homogeneous and have been described as single mineral species are in reality microscopic mixtures of two or more minerals.

2. The metallographic study of certain ores, which, in accordance with a cooperative arrangement with the Bureau of Mines, was undertaken by one of the geologists of the Survey, F. B. Laney, the material used being drawn mostly from Leadville and other points in Colorado. It has already been shown that much of the banding so characteristic of the Leadville ores was developed by diffusion, during their deposition. It has also been demonstrated that eutectic structures similar in all respects to those characteristic of melts are equally characteristic of certain Leadville ores which are replacement deposits and were formed by precipitation from aqueous solutions; further, that a number of lead-silver-bismuth sulphides, previously regarded as definite minerals, are in reality merely mechanical mixtures of two or more definite, well-known minerals. These facts all have an important bearing on the physics and chemistry of ore deposits, and as soon as further chemical work can be done they will be discussed for publication.

3. Observations of temperatures in deep wells and deep mines. This work is timely by reason of the very deep borings that are now in progress in different parts of the United States and is done not only to ascertain actual temperature gradients in different regions and geologic formations and to obtain criteria for use in studies of isostasy, but also to test a theory, which has gained much credence, that the temperature gradient is steepest in areas underlain by deposits of oil or coal.

4. The study of marine rock deposition in the Florida region, prosecuted by Mr. Vaughan, the extension of whose investigations to the Bahama Islands has been made possible through the cooperation of the Carnegie Institution. Incidental to these studies, which are intended to aid in writing the last chapter in the geologic history of the Coastal Plain, mention may be made of a by-product of the

investigation, the study of the formation of oolites. Verifying and continuing the observations of Drew, Mr. Karl F. Kellerman, of the Bureau of Plant Industry, Department of Agriculture, informally cooperating with Mr. Vaughan, has shown that oolites may be formed in pure cultures through the action of two determined species of bacteria.

5. Chemical analyses, made under the direction of F. W. Clarke, of the carbonates contained in the skeletons, or hard parts, of a number of types of echinoderms. These analyses, which show a relatively high proportion of magnesium carbonate in the organisms examined, especially in those found in warm waters, may ultimately shed light upon the origin of some magnesian limestones, but any definite conclusions on this subject will be premature. This investigation is being continued.

6. The study of the Pleistocene deposits and terraces of the lower Mississippi Valley, begun in 1912 by E. W. Shaw for the purpose of correlating these terraces with the Pleistocene deposits of the glaciated regions to the north and in order to unravel the Pleistocene history of the Coastal Plain. Connected with these investigations is the study of the depositing sediment in the Delta of Mississippi River, a study that relates to the filling of the channels and the flooding of the lowlands, to the chemical changes in the suspended mineral matter and to the deposition of metals and other substances in solution on encountering brackish or salt waters, to the origin of the mud lumps and mud geysers in the delta, and to other interesting matters.

7. The investigation of the movement of water in oil sands and of the great damage caused in some of the California oil fields by the invasion of water, undertaken in informal cooperation with the Bureau of Mines. This investigation made practicable in April the initiation of a long-contemplated inquiry into the general subject of the mutual relations of oil, gas, and water in rocks of different texture and composition and of their movements under varying conditions of structure, etc. This problem, which is likely to prove long and difficult, should afford results of great economic importance as to the practical location of oil and gas pools, as well as to the conservation of these most valuable fuel resources. The problem is inseparably connected also with the question of the origin of petroleum and natural gas.

8. The investigation of the question whether portions of the Atlantic coast of the United States are now slowly subsiding beneath the ocean, by Charles A. Davis, who has several times been transferred from the Bureau of Mines to the Survey for the purpose of prosecuting examinations pertaining mainly to this subject. The presence of deposits both of fresh-water peat and of brackish or salt-

water peat, each kind being clearly distinguished by its component vegetal species in many of the peat bogs along the coast, and the relations of these deposits to the present tide level afford convincing and interesting evidence bearing directly upon this problem.

9. The examination, in cooperation with the Geological Survey of Iowa, of the so-called Iowan drift in the upper Mississippi Valley, undertaken in June by W. C. Alden for the purpose of determining the validity of the so-called Iowan glacial stage and the relations of the Iowan to other Pleistocene deposits in the region.

AREA GEOLOGICALLY SURVEYED IN THE UNITED STATES DURING THE YEAR.

On account of differences in the nature of the work performed, it is difficult to estimate areas covered by all the geologists in square miles of detailed areal, detailed reconnaissance, and reconnaissance mapping. However, calculations, omitting examinations for inspection, revision, local studies, etc., furnish the following results for the fiscal year ended June 30, 1914:

Areas covered by geologic surveys, fiscal year 1913–14.

	Square miles.
States east of the one hundredth meridian:	
Detailed areal	4,100
Detailed reconnaissance	1,200
Reconnaissance	39,900
States west of the one hundredth meridian:	
Detailed areal	7,783
Detailed reconnaissance	8,135
Reconnaissance	7,940
Total in the United States:	
Detailed areal	11,883
Detailed reconnaissance	9,335
Reconnaissance	47,840

A statement of the areas surveyed by the division of Alaskan mineral resources will be found in the account of the work of that division.

DIVISION OF ALASKAN MINERAL RESOURCES.

CLASSES OF WORK.

The fact that the appropriation for the continuation of the investigation of the mineral resources of Alaska was not made until June 23, 1913, much curtailed the field season of several of the parties and thereby greatly increased the cost of the work. Out of 14 field parties only 5 performed a full season's work. The loss in time due to the delay in the appropriation amounted to an average of one month, or 29 per cent, for each of 9 field parties. A careful estimate, based on the allotments to these parties and the cost of the additional month of field work, shows that the actual monetary

loss occasioned by the delay—that is, expenditure for which there was no return—was $7,120, or over 7 per cent of the total fund. The delay of the field work and consequent change of plans also caused a loss of efficiency which can not be expressed in figures. It can be stated, however, that the delay in appropriation for two successive years[1] has put the Alaska field work nearly one year behind. This is indicated by the table showing progress of surveys (p. 77).

Under the appropriation of $100,000 made for the continuation of the investigation of the mineral resources of Alaska, as in previous years, the following classes of work were carried on: Reconnaissance and detailed geologic surveys, special investigations of mineral resources, reconnaissances and detailed topographic surveys, investigation of water resources with reference to their use in mining, and collection of statistics on mineral production.

PERSONNEL.

The personnel of the division varied somewhat during the year on account of transfers of employees to and from other divisions and temporary employment of technical assistants. On July 1, 1913, the division included 1 geologist in charge, 9 geologists, 4 topographers, 2 engineers, 3 clerks, and 1 draftsman on annual salaries, and 2 field assistants and 13 camp hands and recorders. On June 30, 1914, the personnel of the division included 1 geologist in charge, 11 geologists, 4 topographers, 1 draftsman, and 3 clerks on annual salaries, and 2 field assistants and 22 camp hands and recorders. One geologist employed for three months and one employed for six weeks during the year were not included in the above enumeration.

FIELD OPERATIONS IN SEASON OF 1913.

Areas covered and allotments.—Fourteen parties in all were engaged in surveys and investigations during 1913. Two of these started field work in May, three in June, seven in July, and two in August. The average length of the Alaskan field season is 110 days; the average time of all the parties in 1913 was 73 days.

The areas covered by geologic exploratory surveys on a scale of 1:500,000 (8 miles to the inch) amount to 3,500 square miles; by geologic reconnaissance surveys, scale 1:250,000 (4 miles to the inch), 2,950 square miles; by detailed geologic surveys, scale 1:62,500 (1 mile to the inch), 180 square miles. Much of the time of the geologists was devoted to special field problems, the result of which can not be expressed areally. Topographic exploratory surveys on a scale of 1:500,000 covered about 3,400 square miles; topographic reconnaissance surveys, 2,535 square miles; detailed topographic sur-

[1] The full appropriation for 1912–13 was not available until Aug. 24, 1912.

veys, 287 square miles. Twenty-five stream-gaging stations were maintained for an average of 12 weeks each in south-central Alaska.

The following table shows the allotment, including both field and office expenses, to the different regions investigated. The results are expressed in round numbers. "General investigations" include, among other things, the cost of collecting mineral statistics and of office work relating to the field investigations of previous seasons:

Approximate geographic distribution of appropriation for Alaskan work, 1913.

Southeastern Alaska	$7,000
Yakataga region	6,000
Copper River	10,500
Prince William Sound	7,000
Kenai Peninsula	1,500
Susitna basin	25,500
Matanuska basin	23,500
Yukon basin	8,500
General investigations	4,500
Unallotted	6,000
	100,000

In the following tables the approximate amount of money devoted to each class of investigations and surveys is indicated. It is not possible to give the exact figures, as the same man may have carried on different kinds of work, but these tables will serve to elucidate a later table, which will summarize the complete areal surveys.

Approximate allotments to different kinds of surveys and investigations, 1913.

Geologic and topographic exploration	$4,650
Reconnaissance geologic surveys	17,450
Detailed geologic surveys	5,350
Special geologic investigations	11,100
Reconnaissance topographic surveys	7,400
Detailed topographic surveys	20,700
Investigation of water resources	6,300
Collection of statistics of mineral production	1,250
Miscellaneous, including administration, inspection, clerical salaries, office supplies, and equipment	19,800
Unallotted	6,000
	100,000

Allotments for salaries and field expenses, 1913.

Scientific and technical salaries	$38,800
Field expenses	38,930
Clerical and other office and miscellaneous expenses	16,270
Unallotted	6,000
	100,000

Progress of the work.—The following table exhibits the progress of investigations in Alaska and the annual appropriations since systematic surveys were begun in 1898. A varying amount is expended each year on special investigations, yielding results which can not be expressed in terms of area.

Progress of surveys in Alaska, 1898–1913.

Year.	Appropriation.	Areas covered by geologic surveys.			Areas covered by topographic surveys.[a]					Investigations of water resources.	
		Exploratory (scale 1:500,000, 1:625,000, or 1:1,000,000).	Reconnaissance (scale 1:250,000).	Detailed (scale 1:62,500).	Exploratory (scale 1:500,000, 1:625,000, or 1:1,000,000).	Reconnaissance (scale 200-foot contours; 1:250,000).	Detailed (scale 1:62,500; 25, 50, or 100 foot contours).	Lines of levels.	Bench marks set.	Gaging stations maintained part of year.	Measurements of stream volume.
		Sq. m.	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Miles.*			
1898	$46,189	9,500	.....	.....	12,840	2,070	.....	.....	....	.....	.....
1899	25,000	6,000	.....	.....	8,690	.....	.....	.....	....	.....	.....
1900	60,000	3,300	6,700	.....	630	11,150	.....	.....	....	.....	.....
1901	60,000	6,200	5,800	.....	10,200	5,420	.....	.....	....	.....	.....
1902	60,000	6,950	10,050	.....	8,330	11,970	96	.....	....	.....	.....
1903	60,000	5,000	8,000	96	.....	15,000	.....	.....	....	.....	.....
1904	60,000	4,050	3,500	.....	800	6,480	480	86	19	.....	.....
1905	80,000	4,000	4,100	536	.....	4,880	787	202	28	.....	.....
1906	80,000	5,000	4,000	421	.....	13,500	40	.....	....	14	286
1907	80,000	2,600	1,400	442	.....	6,120	501	95	16	48	457
1908	80,000	2,000	2,850	604	.....	3,980	427	76	9	53	556
1909	90,000	6,100	5,500	450	6,190	5,170	444	.....	....	81	703
1910	90,000	.....	8,635	321	.....	13,815	36	.....	....	69	429
1911	100,000	8,000	10,550	496	.....	14,460	246	.....	....	68	309
1912	90,000	.....	2,000	525	.....	.....	298	.....	....	69	381
1913	100,000	3,500	2,950	180	3,400	2,535	287	.....	....	24	185
	1,161,189	72,200	76,035	4,071	51,080	116,580	3,642	459	72	.....	.....
Percentage of total area of Alaska	.....	12.31	12.97	0.69	8.71	19.88	0.62	.....	....	.....	.....

[a] The Coast and Geodetic and International Boundary surveys have also made topographic surveys in Alaska. The areas covered by these surveys are, of course, not included in these totals.

General work.—Alfred H. Brooks, geologist in charge, spent the month of July in Alaska. He visited several points on Cook Inlet and spent about 10 days with B. L. Johnson in reviewing the geology of the Ellamar district and adjacent regions. Mr. Brooks attended the Thirteenth International Geological Congress at Toronto, August 7 to 14, as an official delegate, and later made an excursion through the Canadian Cordillera, visiting a number of mining camps in British Columbia.

Of the 222 days spent by Mr. Brooks in office work during the fiscal year, 38 were devoted to scientific investigations, 24 to writing articles for the progress report, 10 to preparing the annual press bulletin on the mining industry of Alaska, 8 to compiling statistics on mineral production, 12 to preparing field plans, 16 to matters

relating to Alaska railroads and to coal-land leasing, and 8 to preparations for the Panama-Pacific Exposition. The rest of his time was devoted to routine and miscellaneous matters.

R. H. Sargent continued the general supervision of the topographic surveys and map compilation, in addition to carrying on his own field work. E. M. Aten continued to serve as office assistant and during the absence of the geologist in charge and of the three senior geologists acted as administrative head of the division. He also continued to assist in collecting statistics of production of precious metals in Alaska. Arthur Hollick was employed for about six weeks, and continued the study of the coal measures of Alaska.

Southeastern Alaska.—Field work in the Ketchikan district was carried on by P. S. Smith from May 12 to July 25, when he returned to Washington to take charge of the Alaska division. Much new information on the areal geology and stratigraphy was gained, but further field studies will be made before the results are published.

Mr. E. F. Burchard completed the reconnaissance of most of the marble deposits of the Juneau and Sitka districts. He was in the field from August 28 to October 3.

Yakataga region.—A fairly complete reconnaissance of the gold and oil bearing district of the Yakataga region was made and some of the coal beds were examined. The reconnaissance surveys covered an area of about 1,000 square miles.

A. G. Maddren, assisted by E. O. Blades and one boatman, reached Yakataga on July 13 and continued field work until September 13. Mr. Blades did some work in this region until October 14. In the Yakataga district the party traveled chiefly on foot, carrying their supplies on their backs. In spite of this arduous work and the obstacles of heavy vegetation and glacial streams, reconnaissance surveys were in places carried inland for some 15 miles.

Copper River region.—The detailed topographic survey of the Kuskulana district was completed by D. C. Witherspoon. The map of this district will be published on a scale of 1 mile to the inch, with 100-foot contours. In 1913 about 95 square miles was mapped, in spite of the fact that field work was not begun until July 18. Work was continued, so far as weather permitted, until October 19.

In connection with the work in the Susitna basin (p. 81), J. W. Bagley surveyed a belt adjacent to the Government wagon road extending from Beaver Dam to Gulkana. C. E. Giffin, while waiting for the appropriation bill to be passed, made a similar survey along the wagon road from Beaver Dam to Valdez. The investigation of the water resources of the Copper River basin below Copper Center is described under "Prince William Sound," below.

Prince William Sound.—Field work in the Prince William Sound region was begun on July 13 by B. L. Johnson, and included a re-

examination of some localities in the Ellamar district. Mr. Johnson also spent about two months in making a reconnaissance of the gold deposits of the Port Wells district and some further studies of the Port Valdez district and of Latouche Island, finishing his field work October 27.

C. E. Giffin utilized a part of the time while waiting at Valdez for the appropriation bill to be passed in making a hurried topographic reconnaissance from the head of Passage Canal to Turnagain Arm.

A preliminary study of the possibilities of developing water power in the Prince William Sound region and adjacent portions of the Copper River and Bering River areas, Kenai Peninsula, and the Willow Creek district was undertaken in 1913 by C. E. Ellsworth and R. W. Davenport. Work was begun on May 5 and continued until November 25. In the Bering River region only four days was spent in actual work, and six measurements of stream flow were made. The work in the Copper River basin was extended northward as far as Copper Center and eastward on the Chitina as far as the Nizina placer district. Four gaging stations were maintained for an average of 17 weeks each and 46 measurements of stream flow were made. One rainfall station was established. In the Prince William Sound region 10 gaging stations were maintained for an average of 12 weeks each and 82 measurements of stream flow were made. In Kenai Peninsula and the Willow Creek district 10 gaging stations were maintained for an average of 10 weeks each and 51 measurements of stream flow were made.

Willow Creek district.—A detailed topographic and geologic survey of Willow Creek district was undertaken in 1913. The base map was made by C. E. Giffin, who began work on July 14 and completed the survey on August 27. In this time an area of 90 square miles was surveyed for publication on a scale of 1 mile to the inch, with 100-foot contours. The geology of the same area was mapped on the same scale by S. R. Capps, who began work on July 14 and finished on September 16. His work included also a detailed study of the ore deposits.

Broad Pass region.—Topographic surveys of the Broad Pass region were made by J. W. Bagley, by phototopographic methods. After a long journey from the coast Mr. Bagley began field work on July 9 and continued it until August 23. Some 2,500 square miles was surveyed for publication on a scale of 4 miles to the inch, with 200-foot contours. F. H. Moffit and J. E. Pogue made a geologic reconnaissance survey of a part of the same area. They began field work on June 29 and continued until August 28, covering an area of 800 square miles.

Matanuska basin.—A base map of 102 square miles in the upper Matanuska basin was made by R. H. Sargent for publication on a scale of 1 mile to the inch, with 50-foot contours. He was assisted by R. W. Chaney and began field work on July 22 and finished on September 26. The geologic work was done by G. C. Martin, assisted by J. B. Mertie, jr., and R. M. Overbeck. This party began field work on July 14 and finished on October 9. It was originally planned that a detailed geologic survey of the entire Matanuska coal field should be made, but as the party was necessarily a month late in reaching the field, this plan proved impracticable and therefore only the areas of actual coal outcrops were studied in detail. At the same time a reconnaissance was extended over a large area to determine the general distribution of the coal measures as well as of the other formations.

Yukon-Koyukuk region.—A geologic and topographic exploration was carried on by H. M. Eakin from a point near the mouth of Dall River southwestward to the Koyukuk, passing through the Indian River placer district. On his return Mr. Eakin traveled in a southerly direction, reaching the Yukon near the mouth of Melozi River. This survey was carried on from June 19 to August 20, and covered an area of about 2,400 square miles, for publication on a scale of 8 miles to the inch.

Fairbanks district and Seward Peninsula.—The progress in quartz mining at Fairbanks led to further studies of this field by Theodore Chapin. He arrived at Fairbanks on August 12 and continued his work until August 31. He then proceeded to Nome and made an investigation of the mining developments on Seward Peninsula. This work occupied him until October 8.

FIELD OPERATIONS FOR SEASON OF 1914.

Alfred H. Brooks will continue investigations of placer deposits in different parts of Alaska.

G. C. Martin, assisted by R. M. Overbeck, is continuing his studies of Mesozoic stratigraphy in many parts of Alaska.

Further investigations of Alaska tin deposits, of the auriferous lodes of Seward Peninsula, and of the Fairbanks and Juneau districts will be made by H. M. Eakin.

A new topographic base map of the region adjacent to Juneau, on a scale of 1:24,000, is in progress by D. C. Witherspoon.

A geologic and topographic reconnaissance survey is being carried on by Stephen R. Capps and C. E. Giffin across Skolai Pass to the newly discovered Chisana placer district. The previous surveys in this field will be extended and supplemented.

Detailed geologic surveys and studies of the ore deposits of the copper-bearing area adjacent to Kuskulana River are being made by F. H. Moffit, assisted by J. B. Mertie.

Detailed geologic surveys and investigations of the mineral resources of the Port Valdez mining district, by B. L. Johnson, assisted by G. L. Harrington, are under way.

Geologic and topographic reconnaissance surveys, by J. W. Bagley and Theodore Chapin, are in progress in the headwater regions of Talkeetna and Susitna rivers.

A geologic and topographic reconnaissance survey from Lake Clark to the Iditarod district is being made by R. H. Sargent and P. S. Smith, and A. G. Maddren is on the way to the lower Kuskokwim Valley, where he will investigate the gold-placer districts.

COLLECTION OF STATISTICS.

The work of collecting statistics of the annual production of gold, silver, and copper in Alaska, begun in 1906, was continued during the year. The progress report for 1913 was completed in June and is in press as Bulletin 592. This report contains figures on mineral production which were also included in a report transmitted in June for inclusion in the Survey's annual volume, "Mineral Resources of the United States," for the calendar year 1913.

OFFICE WORK.

During the year six bulletins (Nos. 525, 526, 533, 536, 538, and 542) were issued relating to Alaska. One professional paper (No. 87), four bulletins (Nos. 576, 578, 587, and 592), and one water-supply paper (No. 342) are in press. All these publications contain maps. A detailed topographic map (Port Valdez district, scale 1:62,500) is in press. Manuscripts of the following reports have been completed:

The Ellamar district, Alaska, by S. R. Capps and B. L. Johnson, including detailed geologic and topographic maps.

The Willow Creek district, Alaska, by S. R. Capps, including detailed geologic and topographic maps.

The Broad Pass region, Alaska, by F. H. Moffit and J. E. Pogue, including geologic and topographic reconnaissance maps.

A water-power reconnaissance in south-central Alaska, by C. E. Ellsworth and R. E. Davenport.

The following reports are in hand:

Geology of the Glacier Bay and Lituya region, Alaska, by F. E. Wright and C. W. Wright, including geologic reconnaissance map.

Geology of the region along the international boundary from Porcupine River to the Arctic Ocean, by A. G. Maddren, including detailed geologic map.

The upper Matanuska basin, by G. C. Martin and J. B. Mertie, including geologic and topographic reconnaissance and detailed maps.

The Yukon-Koyukuk region, by H. M. Eakin, including geologic and topographic reconnaissance maps.

The office work on eight topographic maps was completed during the year, as follows:

Port Valdez and vicinity, by J. W. Bagley, scale 1:62,500, contour interval 100 feet.

Yukon-Tanana region (compiled map), scale 1:500,000 (drainage map).

Yukon-Koyukuk region, by H. M. Eakin, scale 1:500,000, contour interval 200 feet.

Yakataga region, by A. G. Maddren, scale 1:500,000, contour interval 200 feet.

Upper Matanuska basin, by R. H. Sargent, scale 1:62,500, contour interval 100 feet.

Ellamar and vicinity, by R. H. Sargent and C. E. Giffin, scale 1:62,500, contour interval 100 feet.

Willow Creek district, by C. E. Giffin, scale 1:62,500, contour interval 100 feet.

Passage Canal to Turnagain Arm, by C. E. Giffin, scale 1:62,500, contour interval 100 feet.

General map of Alaska (new edition), scale 1:500,000.

The following maps are in hand:

Broad Pass region, by J. W. Bagley, scale 1:250,000, contour interval 200 feet.

Kuskulana district, by D. C. Witherspoon, scale 1:62,500, contour interval 100 feet.

General map of Alaska, scale 1:250,000.

SCIENTIFIC RESULTS.

Mr. Johnson obtained evidence that some of the sediments in the Port Wells district of Prince William Sound are of Mesozoic age. Mr. Moffit and Mr. Pogue found Middle Devonian limestones in the Broad Pass region. They also brought definite proof of the Eocene age of the Cantwell formation, which had previously been provisionally assigned to the Carboniferous. Some evidence was also found of the presence of post-Eocene lignite-bearing sediments in the same field. Mr. Maddren observed in the Yakataga region the occurrence of phyllite of Pleistocene age which had been involved in the folding of the front range of the St. Elias chain. Mr. Eakin found that a large amount of granite had been intruded into the Mesozoic sediments of the Yukon-Koyukuk region, thus furnishing additional proof that the massive intrusive rocks of the Yukon basin are chiefly of Mesozoic age.

DIVISION OF CHEMICAL AND PHYSICAL RESEARCH.

This division is in charge of George F. Becker, geologist, who has immediate direction of geophysical researches. The force in the chemical laboratory forms essentially a section in charge of F. W. Clarke, chief chemist.

The routine and administrative work of the division has largely occupied the time of Mr. Clarke, who nevertheless has been able to prepare a new edition of Bulletin 419 on rock and mineral analyses, now in the printer's hands, and, in collaboration with W. C. Wheeler, a paper on the composition of crinoid skeletons. This paper is printed in "Shorter contributions to general geology, 1914" (Professional Paper 90).

A paper on the relative abundance of certain metallic elements, especially copper, lead, zinc, arsenic, and cadmium, by Mr. Clarke and George Steiger, has been published in the Journal of the Washington Academy of Sciences.

The greater part of Mr. Steiger's time has been taken up with routine analyses, notable among which are those of a composite of 235 samples of Mississippi River mud; of water from a deep well at McDonald, Pa., and of a composite of 329 samples of igneous rocks for the determination of traces of lead, copper, nickel, and zinc. Mr. Steiger also made experiments to show the relative solubility of the various kinds of glass used in the chemical laboratory.

Researches involving the application of physico-chemical methods of investigation were prosecuted by R. C. Wells. Mr. Wells completed determinations of the solubility of galena and sphalerite in solutions resembling natural waters in order to assist in elucidating the origin of the Joplin ores. He made determinations of radioactivity of uranium ores by the electroscopic method, partly for geologists and partly for persons outside of the Survey requesting qualitative determinations. He completed the revision of Bulletin 548, "Electric activity in ore deposits," and published short papers entitled: "A new occurrence of cuprodescloizite," "Electrochemical activity between minerals and solutions," and "Electromotive behavior of soluble sulphides."

The relation of certain minerals to the deposition of silver ores and to their enrichment was investigated by Chase Palmer. In connection with these studies Mr. Palmer found an efficient solvent for use in the analysis of arsenides, with which he investigated nickel arsenides from Germany and Canada and harmonized conflicting statements concerning their chemical nature. A paper by Mr. Palmer on tetranickel triarsenide, with respect to its capacity as a precipitant of silver, has been submitted for publication in the journal Economic Geology. The chemical association of gold and silver in the ore of the Republic mine, Washington, is the subject of a manuscript contributed by Mr. Palmer for publication in Bulletin 550; and a report on the qualities of underground waters at Charleston, S. C., has been submitted for publication in Professional Paper 90.

Strictly mineralogic investigations occupied only a part of the attention of Waldemar T. Schaller, much of his time being consumed

in routine work in miscellaneous qualitative mineral and chemical determinations and in quantitative analyses of rocks and minerals. His report "The gem tourmaline field of southern California" was revised, and a report entitled "Mineralogical notes, series 3," was prepared and submitted for publication. This report contains many original papers and descriptions of a number of new mineral species and also establishes better the precise character of other known minerals. Mr. Schaller also analyzed a new zinc manganese silicate from Franklin Furnace, N. J., and several minerals from Colorado, namely, melilite, cebollite (a new mineral, an alteration product of melilite), blue anatase, and a titaniferous garnet.

Phosphate rocks from numerous sources were analyzed by W. C. Wheeler, who also made the analyses of the crinoids which formed the basis of the paper by F. W. Clarke and himself, published in Professional Paper 90.

Investigations connected with the search for potash deposits in the United States occupied the time of W. B. Hicks and R. K. Bailey. Mr. Hicks was for three months engaged with Mr. Gale in the study of the deposits in Columbus Marsh and Black Rock Desert, Nev., and Searles Lake, Cal. A chemical study was made by him of the muds of Columbus Marsh. The following papers have been prepared by Mr. Hicks: "The action between clay filters and certain salt solutions," "Octahedral sulphohalite" (with H. S. Gale), "Searlesite, a new mineral," and "The muds of Columbus Marsh."

R. K. Bailey assisted Mr. Hicks in analytical investigations, his work consisting mainly of analyses of suspected potash salts, nitrates, and phosphates. He also made some field investigations in the Black Rock Desert region and examined some nitrate deposits in southern California.

In the physical laboratory C. E. Van Orstrand has been assisted by A. F. Melcher and R. Weinstein in investigations of the elasticity of metals and in the construction of mathematical tables. In addition to these investigations, which are to a certain extent routine in character, special apparatus has been designed and constructed for the purpose of determining the temperatures of deep wells by means of maximum thermometers and electrical resistance thermometers. Tests made in the field show that an accuracy of 0.1° C. can be obtained, and the time required for taking the necessary measurements for a single well of 3,000 feet depth has been reduced from about four days to five or six hours.

Mr. Becker, chief of the division, continued his investigations in the mechanics of earth slides in the Culebra Cut. He also prepared a short paper on a feature of the nebular hypothesis, and, with A. L. Day, made an investigation of the linear force of growing crystals.

confirming an investigation made several years ago. Progress has also been made in the preparation of two papers, one on isostasy and the other on "Queries on radioactive geology."

DIVISION OF MINERAL RESOURCES.

The scope of the work of the division of mineral resources has not been changed during the year, the Survey having continued the policy of making the annual report, "Mineral Resources of the United States," more than a statistical compilation by treating in full the sources from which the mineral products of the country are obtained. This report thus becomes in fact, as well as in name, an annual inventory of the Nation's mineral resources.

During the last 11 years the reports have been prepared in large part by geologists of the Survey who have specialized in the subjects treated by them, with a view to carrying out the provision of the organic act of the Survey which directs the examination of the mineral resources and products of the national domain.

Cooperation between the Geological Survey and the State surveys in collecting most of the mineral statistics continued in force in the preparation of the report for 1913. The 18 States which cooperated were Alabama, Florida, Georgia, Illinois, Iowa, Kansas, Maryland, Michigan, Missouri, New Jersey, New Mexico, North Carolina, Oklahoma, Oregon, Pennsylvania, Virginia, Washington, and Wisconsin. The results of this cooperation for 1913 have been the most satisfactory yet obtained. The method employed obviates the duplication of a considerable amount of work and, so far as applied, saves the producers the annoyance of preparing two sets of statistical returns.

During the fiscal year the work of the division consisted of the preparation of the reports on the mineral production of the United States in the calendar years 1912 and 1913. The report for 1912 was published in two parts. Part II (Nonmetals) was issued in December, 1913, and Part I (Metals) in January, 1914. Work on the report for 1913 was well advanced at the close of the fiscal year. The energies of the entire force of the division have been directed to the prompter publication of the reports, as well as to obtaining more complete information regarding the mineral industries, especially the sources of production. At the close of the fiscal year 1913 the manuscripts of 34 chapters from the report for the calendar year 1912 had been completed and transmitted to the printer. On June 30, 1914, 33 chapters for the report for 1913 had been completed and transmitted to the printer.

Preliminary estimates of the production of the following minerals in 1913, with reviews of the conditions that prevailed during the year, were given to the press in the form of special press bulletins during the later part of December, 1913, and in January, 1914:

Arsenic, cement, coal, copper, gold and silver mining, iron ores, lead, petroleum, quicksilver, radium ores, rutile, tin, tungsten ores, uranium ores, vanadium ores, western metal mining, and zinc. Advance statements giving the final figures covering the production of copper, lead, and zinc in 1913 have also been published. Separate chapters from the report for 1913 on the following subjects (33 in all) have been published or are in press: Abrasives; anthracite; asbestos; barytes; bauxite and aluminum, cement; chromic iron ore; feldspar; fluorspar and cryolite; fuel briquetting; fuller's earth; gold, silver, copper, and lead in South Dakota and Wyoming; gold, silver, copper, lead, and zinc in the Eastern States; graphite; gypsum; lime; manganese; mica; mineral paints; mineral waters; phosphate rock; potash salts; pottery; quicksilver; salt and bromine; sand and gravel; sand-lime brick; secondary metals; silica; silver, lead, copper, and zinc in the Central States; slate; sulphur and pyrite; and talc and soapstone.

The number of permanent employees in Washington who devote their entire time to the work of the division of mineral resources is 31, and 8 persons are employed in the offices of the division outside of Washington—at Salt Lake City, Denver, and San Francisco. In addition to these employees, 21 members of other divisions of the Survey, chiefly geologists; devote a part of their time to the work of the division of mineral resources, making a total of 60 persons employed in the work.

During the year 189,122 pieces of first-class mail matter (chiefly statistical inquiries) were sent out by the division, an increase of 20 per cent over 1913, and 69,368 pieces were received.

E. W. Parker continued as administrative head of the division and chief of the section of nonmetallic resources. H. D. McCaskey continued as geologist in charge of the section of metallic resources, and on January 15 was placed temporarily in charge of the division to permit Mr. Parker to devote half of his time (on leave without pay) during the remainder of the fiscal year to work on a history of the mining industry, prepared for the department of economics and sociology of the Carnegie Institution of Washington. During the part of this period that Mr. Parker was on official duty he prepared for publication by the Survey the reports on the production of coal, the manufacture of coke, and the fuel-briquetting industry. The reports on the several mineral products were in charge of the persons indicated below: E. S. Bastin, graphite; E. F. Burchard, cement, fluorspar and cryolite, stone, iron ore, pig iron, and steel; B. S. Butler, copper (general report), copper and silver in Michigan (mines report); A. T. Coons, slate; C. A. Davis (of the Bureau of Mines), peat; D. T. Day, asphalt and bituminous rock, natural gas, petroleum, platinum and allied metals; J. S. Diller, asbestos, chro-

mite, talc and soapstone; R. B. Dole, mineral waters; J. P. Dunlop, silver, copper, lead, and zinc in the Central States (mines report), secondary metals, metals and ores (summary report); H. S. Gale, borax, magnesite, nitrates; F. L. Hess, antimony, arsenic, bismuth, cobalt, molybdenum, nickel, selenium, tantalum, tungsten, titanium, vanadium, uranium, tin; D. F. Hewett, manganese; J. M. Hill, barytes, mineral paints, strontium ore; F. J. Katz, abrasives, feldspar, silica (quartz); H. D. McCaskey, gold and silver (general report), gold, silver, copper, lead, and zinc in the Eastern States (mines report), quicksilver; Jefferson Middleton, clay, clay-working industries, fuller's earth, sand-lime brick; W. C. Phalen, bauxite and aluminum, phosphate rock, potash salts, salt and bromine, sodium salts, sulphur and pyrite; C. E. Siebenthal, lead, zinc, and cadmium (general report); D. B. Sterrett, gems and precious stones, mica; R. W. Stone, glass sand, other sand, and gravel, gypsum, lime; W. T. Thom, summary of the mineral production; C. G. Yale (with H. S. Gale), borax, magnesite.

In addition to preparing his reports and performing supervisory work in Washington, Mr. McCaskey exercises general supervision of the offices of the division in the Western States. The offices at Denver, Salt Lake City, and San Francisco are under the direct charge of C. W. Henderson, V. C. Heikes, and C. G. Yale, respectively, who prepare the various mines reports on gold, silver, copper, lead, and zinc in the Western States.

TOPOGRAPHIC BRANCH.

ORGANIZATION.

The organization of the topographic branch remained the same as at the close of the last fiscal year and is as follows:

Chief geographer, R. B. Marshall.
Atlantic division, Frank Sutton, geographer in charge.
Central division, W. H. Herron, geographer in charge.
Rocky Mountain division, Sledge Tatum, geographer in charge.
Northwestern division, T. G. Gerdine, geographer in charge.
Pacific division, George R. Davis, geographer in charge.
Inspectors of topography, J. H. Renshawe, geographer; W. M. Beaman, topographic engineer.

PERSONNEL.

The technical corps of the topographic branch was increased during the year by the appointment of 9 junior topographers and the reinstatement of 1 topographic engineer, 2 assistant topographers, and 1 junior topographer. It was reduced 13 by transfers and resignations. With these changes the technical force now includes 1 chief geographer, 11 geographers, 23 topographic engineers, 31 topographers, 37 assistant topographers, 55 junior topographers, and 8 drafts-

men—a total of 166. In addition, 47 technical field assistants were employed during the whole or a part of the field season. One geographer, 1 topographic engineer, and 1 assistant topographer are on leave without pay; and 2 topographers, 3 assistant topographers, and 6 junior topographers were furloughed.

PUBLICATIONS.

The published work of the topographic branch for the fiscal year consists of 102 maps and 10 book publications, namely, "Results of triangulation and primary traverse, 1911 and 1912"; "Results of triangulation and primary traverse in Ohio, 1898 to 1911, inclusive"; and bulletins giving results of spirit leveling in Illinois, Kentucky, Indiana, Oregon, Washington, Wyoming, Oklahoma, and Kansas. Brief summaries of these publications (Bulletins 551–558, 564, and 571) are given on page 23. Manuscript for level results in Arizona from 1899 to 1913, inclusive, was transmitted for publication, and level results for 1913 work were added to the manuscripts for bulletins previously transmitted for the following States: Colorado, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Michigan, Minnesota, Missouri, Nebraska, Oklahoma, Oregon, Utah, Virginia, Washington, Wisconsin, Wyoming, and the Territory of Hawaii.

ALLOTMENTS.

The total appropriations for topographic surveys for the fiscal year 1914 were:

Topographic surveys	$350,000
Surveying national forests	75,000
Statutory salaries	9,200
	434,200

The allotments of the appropriations, which were adhered to so far as practicable, were as follows:

Allotments from funds appropriated for topographic work, fiscal year 1914.

	Topographic surveys.	Surveying national forests.
Administrative expenses of Survey	$22,896	$4,500
Clerical assistance and supervision	16,542	3,388
Map editing	6,225	1,275
Purchase and repair of instruments, stationery, etc.	12,242	2,508
Millionth scale map	20,000	.....
Atlantic division, field work in Alabama, Maine, New York, North Carolina, Pennsylvania, Vermont, Virginia, and West Virginia	61,725	.....
Central division, field work in Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio, and Wisconsin	60,000	.....
Rocky Mountain division, field work in Colorado, Montana, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming	31,543	26,200
Northwestern division, field work in Idaho, Oregon, and Washington	50,872	20,329
Pacific division, field work in Arizona, California, Nevada, Utah, and Hawaii	65,955	14,000
Work by land-classification board	11,000	3,000
	359,000	75,200

COOPERATION.

Cooperation has been maintained with several States, as described in previous reports. The States and the amounts allotted by them are as follows:

Allotments for cooperative topographic work.

California	$16,500.00	Oklahoma	$1,000.00
Illinois	11,500.00	Oregon	18,000.00
Iowa	1,750.00	Pennsylvania	6,816.55
Kentucky	10,000.00	Vermont	2,000.00
Maine	4,900.00	Virginia	4,250.00
Michigan	2,500.00	Washington	12,500.00
Minnesota	10,000.00	West Virginia	14,331.41
Missouri	10,000.00	Hawaii	16,000.00
Nebraska	2,000.00		179,047.96
New York	10,000.00		
Ohio	25,000.00		

Additional allotments of $500 and $550 were also made by the States of Missouri and Washington, respectively, for cooperation in the compilation of the Missouri and Washington portions of the 1:1,000,000 scale map of the United States. These funds were met by Federal allotments of equal amounts.

GENERAL OFFICE WORK.

Progress maps were kept up to date and new ones were compiled when necessary; the new 1:1,000,000 State maps were used when available; results of computations for vertical and horizontal control work were copied and catalogued, and 128 examination papers for the junior topographer and topographic aid civil-service examinations were rated.

The computations of control data were made principally by D. H. Baldwin, T. M. Bannon, L. F. Biggs, R. H. Chapman, J. R. Ellis, G. T. Hawkins, Oscar Jones, C. B. Kendall, F. J. McMaugh, A. C. Roberts, C. F. Urquhart, and J. H. Wilson under the immediate supervision of E. M. Douglas, geographer. S. S. Gannett, geographer, spent most of his time in preparing manuscript and compiling data for the bulletins submitted for publication.

J. H. Renshawe was engaged in preparing colored relief maps of national parks for the Secretary of the Interior. Such maps have already been prepared for the Crater Lake, Yosemite, Glacier, and Yellowstone national parks, and that for the Mount Rainier National Park is in progress.

SUMMARY OF RESULTS.

The condition of topographic surveys to June 30, 1914, distinguished as to scale, etc., is shown on Plate II.

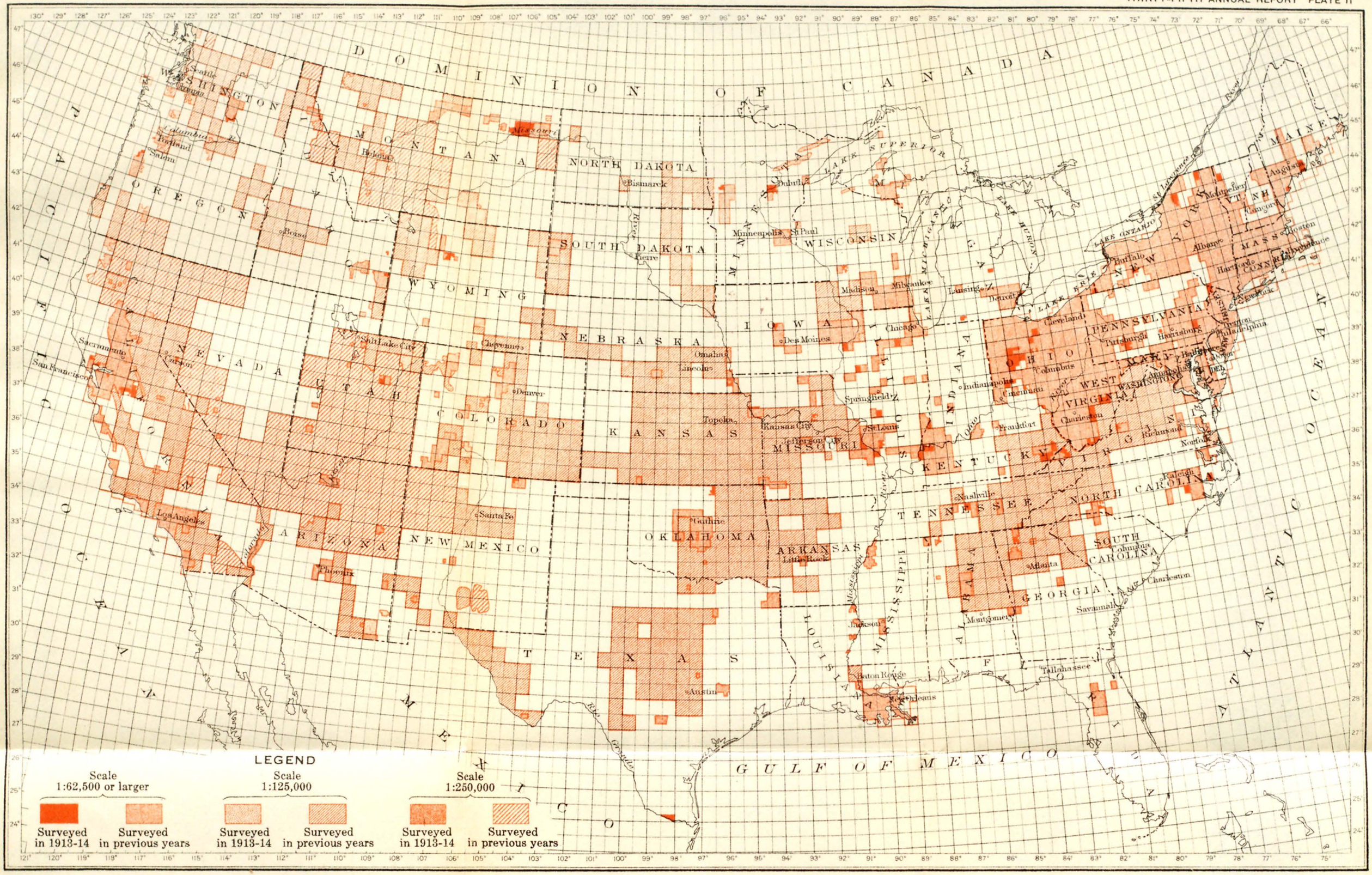
As is shown in the following tables, which give the details of topographic mapping and spirit leveling for the fiscal year, the total new area mapped was 18,808 square miles, making the total area surveyed to date in the United States 1,197,782 square miles, or 39.6 per cent of the entire country. In addition, 4,290 square miles of resurvey was completed, making the total area of actual surveys during the year 23,098 square miles.

In connection with these surveys 5,365 linear miles of primary and precise levels were run, making 247,407 miles of primary and precise levels run since the authorization of this work by Congress in 1896. In the course of this work 1,326 permanent bench marks were established. In addition, 791 linear miles of river surveys were run.

Triangulation stations to the number of 134 were occupied, and 123 were permanently marked. Primary traverse lines aggregating 2,299 miles were run, in connection with which 273 permanent marks were set. In the course of this work 21,810 square miles was covered by primary control.

The area covered by detailed topographic surveys in Alaska during the fiscal year, as reported on page 77, was 287 square miles, for publication on the scale of 1:62,500.

Topographic surveys were also carried on in Hawaii, the area mapped during the fiscal year being 342 square miles, for publication on the scale of 1:31,680, making the total area surveyed to date in Hawaii 1,374 square miles. In connection with the surveys in Hawaii, 44 miles of primary levels were run and seven permanent bench marks were established, making the total number of miles of primary and precise levels run by this Survey in Hawaii 578.



MAP OF THE UNITED STATES, SHOWING AREAS COVERED BY TOPOGRAPHIC SURVEYS
AND THE SCALE EMPLOYED FOR EACH AREA

Scale $\frac{1}{14,000,000}$

100 0 100 200 300 400 500 Miles

SNYDER & BLACK, N.Y.

Present condition of topographic surveys of the United States and new areas surveyed July 1, 1913, to June 30, 1914.

	New area mapped July 1, 1913, to June 30, 1914.	Total area mapped to June 30, 1914.	Percentage of total area of State mapped to June 30, 1914.
	Square miles.	*Square miles.*	
Alabama	39	18,752	36
Arizona	1,304	68,064	60
Crkansas	.....	21,380	40
Aalifornia	1,672	111,116	70
Colorado	2,118	47,344	46
Connecticut	.....	4,965	100
Delaware	.....	1,202	51
District of Columbia	.....	70	100
Florida	.....	2,080	4
Georgia	.....	17,337	29
Idaho	1,036	25,498	30
Illinois	884	14,012	25
Indiana	209	3,250	9
Iowa	162	11,533	21
Kansas	.....	64,159	78
Kentucky	319	17,973	44
Louisiana	.....	8,311	17
Maine	296	9,210	28
Maryland	.....	12,327	100
Massachusetts	.....	8,266	100
Michigan	154	5,745	10
Minnesota	515	6,087	7
Mississippi	.....	1,889	4
Missouri	502	36,166	52
Montana	641	56,606	39
Nebraska	213	26,524	34
Nevada	380	51,062	46
New Hampshire	.....	3,380	36
New Jersey	.....	8,224	100
New Mexico	82	35,932	29
New York	713	42,940	87
North Carolina	647	18,308	35
North Dakota	.....	9,716	14
Ohio	2,473	37,200	91
Oklahoma	156	39,768	56
Oregon	893	21,635	22
Pennsylvania	479	24,646	55
Rhode Island	.....	1,248	100
South Carolina	.....	5,640	18
South Dakota	.....	18,594	24
Tennessee	242	21,153	50
Texas	296	67,683	25
Utah	385	68,290	80
Vermont	213	3,966	41
Virginia	.....	29,980	70
Washington	1,332	24,601	35
West Virginia	.....	24,170	100
Wisconsin	144	11,933	21
Wyoming	309	27,847	28
	18,808	1,197,782	39.6
Hawaii	342	1,374	21

ATLANTIC DIVISION.

FIELD WORK.

SUMMARY.

During the season topographic mapping was carried on in Alabama, Georgia, Maine, Mississippi, New Jersey, New York, North Carolina, Pennsylvania, Tennessee, Vermont, Virginia, and West Virginia. This work comprised the completion of the survey of 11 quadrangles, and of the resurvey of 7 quadrangles, in addition to which 5 quadrangles were partly surveyed and 7 were partly

resurveyed. The total new area mapped was 2,629 square miles, for publication on the scale of 1:62,500. The area resurveyed was 2,104 square miles, for publication on the scale of 1:62,500. In connection with this work 1,046 miles of primary levels were run and 262 permanent bench marks were established.

Primary triangulation and primary traverse were carried on at different times by 10 parties, the work being distributed over portions of Alabama, New Jersey, New York, North Carolina, Mississippi, Pennsylvania, and West Virginia. The total area covered by this primary control was about 2,815 square miles, of which 2,147 square miles was controlled by primary traverse, 565 miles being run and 59 permanent marks set. Twenty-six triangulation stations were occupied and 15 were permanently marked. The result of this work was to make control available in 15 quadrangles.

Topographic surveys in Atlantic division from July 1, 1913, to June 30, 1914.

State.	Contour interval.	For publication on scale of 1:62,500.		Total area surveyed.	Primary levels.		Primary traverse.		Triangulation.	
		New.	Resurvey.		Distance run.	Bench marks.	Distance run.	Permanent marks.	Stations occupied.	Stations marked.
	Feet.	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Miles.*		*Miles.*			
Alabama	20	39	.....	39	58	16	142	15	.....	.....
Georgia	50	.....	207	207	90	23	.....	.....	.....	.....
Maine	20	296	60	356	174	49	.....	.....	.....	.....
Mississippi	.....	.....	.....	.....	.....	.....	127	13	.....	.....
New Jersey	20	.....	21	21	.....	.....	5	.....	2	.....
New York	20	713	.....	713	173	40	69	6	13	8
North Carolina	20	647	.....	647	165	32	170	20	.....	.....
Pennsylvania	20	479	214	693	54	16	28	2	8	7
Tennessee	20	242	.....	242	74	20	.....	.....	.....	.....
Vermont	20	213	.....	213	70	14	.....	.....	.....	.....
Virginia	50	.....	427	427	79	24	.....	.....	.....	.....
West Virginia	50	.....	1,175	1,175	109	28	24	3	3	.....
	.....	2,629	2,104	4,733	1,046	262	565	59	26	15

DETAILS OF WORK BY STATES.

Alabama.—The State geologist of Alabama allotted $10,000 to carry out unfinished cooperative work begun in 1911–12. A portion of the new State funds was made available in the spring of 1914, and the survey of the Florence quadrangle, in Colbert and Lauderdale counties, was commenced by C. E. Cooke, the area mapped being 39 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet.

In addition to this cooperative work, H. S. Senseney ran 78 miles of primary levels and established 16 permanent bench marks for the control of the Cooks Springs quadrangle, in St. Clair and Shelby counties, and J. R. Ellis ran 142 miles of primary traverse and set 15 permanent marks for the control of the Cooks Springs and Weogufka quadrangles, in Coosa, Shelby, and Talladega counties.

Georgia.—The resurvey of the Talking Rock quadrangle, in Gilmer, Gordon, Murray, and Pickens counties, was commenced by Albert Pike, A. M. Walker, E. I. Ireland, and K. W. Trimble, the area mapped being 207 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. For the control of this area H. S. Senseney and K. W. Trimble ran 90 miles of primary levels and established 23 permanent bench marks.

Maine.—For the continuation of cooperative topographic surveys in Maine the State Water Storage Commission allotted $4,900, which was met by the United States Geological Survey with an equal amount. The survey of the Waldoboro quadrangle, in Knox and Lincoln counties, was completed, and that of the Liberty quadrangle, in Kennebec, Knox, Lincoln, and Waldo counties, was commenced by W. H. Griffin, James McCormick, J. H. LeFeaver, and C. H. Davey, the total area mapped being 296 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of these areas and of the Belfast quadrangle, in Knox and Waldo counties, K. E. Schlachter, J. M. Perkins, and Mr. Davey ran 137 miles of primary levels and established 39 permanent bench marks.

In addition to the cooperative work in Maine, the resurvey of the Portland and Casco Bay quadrangles, in Cumberland and York counties, was commenced by Hersey Munroe, J. H. Wheat, and R. C. Seitz, the area mapped being 60 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of these areas Mr. Seitz ran 27 miles of primary levels and established 10 permanent bench marks.

Mississippi.—For the control of the Natchez and Vicksburg quadrangles, in Adams, Jefferson, Issaquena, and Warren counties, Miss., and Concordia and Madison parishes, La., J. R. Ellis ran 127 miles of primary traverse and set 13 permanent marks, this work being entirely in Mississippi.

New Jersey.—(See Pennsylvania, Milford quadrangle, p. 94.)

New York.—The State engineer and surveyor of New York allotted $10,000 for the continuation of cooperative topographic surveys in that State, and the United States Geological Survey allotted an equal amount. The survey of the Chateaugay, Gouverneur, and Lake Bonaparte quadrangles, in Clinton, Franklin, Jefferson, Lewis, and St. Lawrence counties, was completed, and that of the Canaseraga quadrangle, in Allegany and Livingston counties, was commenced by G. S. Smith, R. A. Kiger, J. M. Whitman, S. P. Floore, Roscoe Reeves, E. E. Witherspoon, W. H. S. Morey, R. C. McKinney, and A. J. Kavanagh, the total area mapped being 672 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of these areas and of the Oswegatchie quad-

rangle, in Herkimer, Lewis, and St. Lawrence counties, G. T. Hawkins occupied 13 triangulation stations and permanently marked 8; S. S. Gannett and Mr. Kavanagh ran 58 miles of primary traverse and set 6 permanent marks; and Mr. Kavanagh ran 173 miles of primary levels and established 40 permanent bench marks. (See also Pennsylvania, Milford quadrangle, below.)

North Carolina.—The survey of the Belhaven and Kinston quadrangles, in Beaufort, Hyde, Washington, Greene, Lenoir, and Pitt counties, was completed, and that of the Gastonia quadrangle, in Gaston, Lincoln, and Mecklenberg counties, was commenced by G. S. Smith, J. M. Whitman, W. H. S. Morey, R. L. Harrison, R. A. Kiger, J. H. LeFeaver, J. B. Metcalfe, jr., and Roscoe Reeves, the total area mapped being 647 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of these areas and of the Bunyon quadrangle, in Beaufort and Martin counties, G. T. Hawkins and C. W. Arnold ran 170 miles of primary traverse and set 20 permanent marks, and Mr. Metcalfe, Mr. Arnold, and R. H. Kilmer ran 165 miles of primary levels and established 31 permanent bench marks.

Pennsylvania.—The Topographic and Geologic Survey Commission of Pennsylvania expended $6,816.55 for the continuation of the cooperative topographic survey of the State, and the United States Geological Survey expended a like sum. The survey of the Northeast and Somerset quadrangles, in Erie, Somerset, and Westmoreland counties, was completed, and that of the Windber quadrangle, in Bedford, Cambria, and Somerset counties, was begun by Oscar Jones, Robert Muldrow, J. F. McBeth, T. F. Slaughter, and E. E. Witherspoon, the area mapped being 317 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. S. S. Gannett and G. T. Hawkins measured a base line on the Carnegie quadrangle, in Allegheny County, to check triangulation, occupying 5 triangulation stations and marking 4.

In addition to this work the survey of the Milford quadrangle, N. Y.-N. J.-Pa., in Sullivan (N. Y.), Sussex (N. J.), and Pike (Pa.) counties, was completed by Hersey Munroe, R. C. McKinney, W. O. Tufts, Olinus Smith, R. L. Harrison, W. H. S. Morey, J. M. Whitman, S. P. Floore, and Roscoe Reeves, the New York and Pennsylvania portions of this work being done in cooperation with the respective States. In mapping this quadrangle, 203 square miles of unmapped area was surveyed, 162 square miles in Pennsylvania and 41 square miles in New York, and 21 square miles in New Jersey was resurveyed, all for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of this area G. T. Hawkins and J. B. Metcalfe occupied 5 triangulation stations and marked 3, Mr. Hawkins ran 44 miles of primary traverse and set 2

permanent marks, and K. F. Maxcy ran 42 miles of primary levels and established 12 permanent bench marks.

In addition to the cooperative work in Pennsylvania the resurvey of the Reading quadrangle, in Berks County, was completed by Hersey Munroe, R. C. McKinney, and Olinus Smith, the area mapped being 214 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of this area Mr. Maxcy ran 12 miles of primary levels and established 4 permanent bench marks.

Tennessee.—The survey of the Murfreesboro quadrangle, in Rutherford and Wilson counties, was completed by J. F. McBeth, C. S. Wells, and T. F. Slaughter, the area mapped being 242 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of this area Mr. Wells ran 74 miles of primary levels and established 20 permanent bench marks.

Vermont.—For cooperative topographic surveys in Vermont the governor allotted $2,000 and the United States Geological Survey allotted an equal amount. The survey of the Milton quadrangle was completed by C. E. Cooke, J. F. McBeth, and J. B. Metcalfe, jr., the area mapped being 213 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. In connection with this work Mr. Metcalfe ran 70 miles of primary levels and established 14 permanent bench marks. The cooperative funds being insufficient to cover the completion of the work on the Milton quadrangle, the additional expenses were borne by the Federal Survey.

Virginia.—For the continuation of cooperative topographic surveys in Virginia the State geologist allotted $4,250 and the United States Geological Survey allotted an equal amount. The resurvey of the Virginia portions of the Clintwood and Regina quadrangles, in Buchanan, Dickenson, and Wise counties, was completed, and the resurvey of the Bucu quadrangle, in Buchanan, Dickenson, and Russell counties, was commenced by J. I. Gayetty, C. W. Arnold, and F. W. Farnsworth, the area mapped being 381 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. For the control of these areas, H. S. Senseney ran 46 miles of primary levels and established 15 permanent bench marks.

In addition to the cooperative work in Virginia, the resurvey of the Eagle Rock quadrangle, in Alleghany, Botetourt, and Craig counties, was completed by T. F. Slaughter, the area mapped being 46 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. For the control of this area Mr. Senseney ran 33 miles of primary levels and established 9 permanent bench marks.

West Virginia.—In the continuation of cooperative topographic surveys in West Virginia the State geologist expended $14,045 and

the United States Geological Survey $11,705. A resurvey of areas previously mapped resulted in the completion of the survey of Hacker Valley, Pickens, and Summersville quadrangles, in Braxton, Clay, Nicholas, Randolph, Upshur, and Webster counties, and of the West Virginia portions of the Ingleside and Peterstown quadrangles, in Mercer, Monroe, and Summers counties, and of a part of the Winona quadrangle, in Fayette, Greenbrier, and Nicholas counties, the area mapped being 1,175 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. This work was done by E. I. Ireland, Fred McLaughlin, K. E. Schlachter, S. A. Judson, H. S. Senseney, M. A. Roudabush, C. S. Wells, and Kostka Mudd.

For the control of these areas, C. B. Kendall occupied 3 triangulation stations and Mr. Schlachter ran 109 miles of primary levels and established 28 permanent bench marks.

In addition to the cooperative work the State expended $286.41, not met by Federal funds, on the resurvey of the portions of Berkeley and Jefferson counties for which maps on the scale of 1:62,500 were not already available. Preparatory to this work, G. T. Hawkins and J. B. Metcalfe, jr., ran 24 miles of primary traverse and established 3 permanent bench marks, this work falling in the Martinsburg quadrangle.

OFFICE WORK.

The drafting of the following sheets was completed: Washington and vicinity, D. C.-Md.-Va.; Waldoboro, Me.; Chateaugay, Gouverneur, and Lake Bonaparte, N. Y.; Milford, Pa.-N. Y.-N. J.; Northeast, Reading, and Somerset, Pa.; Milton, Vt.; Clintwood, Va.-Ky.; Eagle Rock and Fairfax, Va.; Hacker Valley, Pickens, and Summersville, W. Va.

Progress in the drafting of additional sheets was made as follows: Florence, Ala., 5 per cent; Canaseraga, N. Y., 31 per cent; Regina, Va.-Ky., 10 per cent; Bluefield, W. Va.-Va., 46 per cent; Peterstown, W. Va.-Va., 60 per cent.

The following computations and adjustments were made:

Primary-level circuits were adjusted for the Cooks Springs (Ala.), Talking Rock (Ga.), Liberty and Waldoboro (Me.), Chateaugay, Gouverneur, and Malone (N. Y.), Kinston (N. C.), Milford (Pa.-N. Y.-N. J.), Reading (Pa.), Milton (Vt.), Bucu, Clintwood, and Eagle Rock (Va.), Hacker Valley and Pickens (W. Va.) quadrangles.

Precise-level circuits were adjusted for the Flattop, Ingleside, and Peterstown (W. Va.) quadrangles.

Geographic positions were computed for the Cooks Springs (Ala,), Portland (Me.), Canaseraga, Hornell, Oswegatchie, and White

Lake (N. Y.), Belhaven, Bunyon, Jamesville, Kinston, and Plymouth (N. C.), Milford (Pa.-N. Y.-N. J.), Carnegie (Pa.), Hacker Valley, Ingleside, Peterstown, Pickens, Summersville, and Winona (W. Va.) quadrangles.

CENTRAL DIVISION.

FIELD WORK.

SUMMARY.

During the season topographic mapping was carried on in Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio, Virginia, and Wisconsin. This work comprised the completion of the survey of 20 quadrangles and 1 special area and of the resurvey of 4 quadrangles and 1 special area, and also of 1 special area which was partly surveyed and partly resurveyed, in addition to which 18 quadrangles were partly surveyed and 3 quadrangles were partly resurveyed. The total new area mapped was 5,362 square miles, for publication on the scale of 1:62,500; and the area resurveyed was 1,138 square miles, for publication on the scale of 1:62,500. In connection with this work 2,399 miles of primary levels were run and 580 permanent bench marks were established.

Primary traverse was carried on at different times by five parties, the work being distributed over portions of Illinois, Indiana, Iowa, Michigan, Minnesota, and Missouri. The total area covered by this primary control was about 4,588 square miles, 1,234 linear miles of primary traverse being run and 115 permanent marks set. The result of this work was to make control available in 74 quadrangles.

Topographic surveys in central division from July 1, 1913, to June 30, 1914.

State.	Contour interval.	For publication on scale of 1 : 62,500.		Total area surveyed.	Primary levels.		Primary traverse.	
		New.	Resurvey.		Distance run.	Bench marks.	Distance run.	Permanent marks.
	Feet.	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Miles.*		*Miles.*	
Illinois	20	884	232	1,116	392	106	184	13
Indiana	20	209	.....	209	56	12	41	2
Iowa	20	162	.....	162	156	42	40	7
Kentucky	10, 20, 50	319	710	1,029	261	74	.....	.....
Michigan	5, 20	154	.....	154	334	74	129	10
Minnesota	10	515	.....	515	32	8	20	.....
Missouri	20	502	193	695	252	84	820	83
Ohio	10, 20	2,473	.....	2,473	861	173	.....	.....
Virginia	50	.....	3	3	.....	.....	.....	.....
Wisconsin	20	144	.....	144	55	7	.....	.....
	.....	5,362	1,138	6,500	2,399	580	1,234	115

DETAILS OF WORK BY STATES.

Illinois.—The governor of Illinois allotted $10,000 for the continuation of cooperative topographic surveys in Illinois and an additional $1,500 from a fund advanced by private persons for the mapping of the Gallatin County portions of the Equality and Shawneetown quadrangles, and the United States Geological Survey allotted $11,500 to meet these amounts. The survey of the Mount Olive and Avon quadrangles and the Illinois portion of the Edgington quadrangle, in Macoupin, Montgomery, Fulton, Knox, McDonough, Warren, Mercer, and Rock Island counties, was completed, and that of the Sparta quadrangle, in Perry, Randolph, St. Clair, and Washington counties, was commenced by Frank Tweedy, W. L. Miller, Fred Graff, jr., Gilbert Young, L. L. Lee, and W. S. Gehres, the area mapped being 794 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. The survey of the Iowa portion of the Edgington quadrangle, in Muscatine and Scott counties, was completed by Frank Tweedy, the area mapped being 52 square miles, for publication on the same scale as the Illinois portion, all expenses being borne by the Federal Survey. The mapping of the Equality quadrangle and of the Illinois portion of the Shawneetown quadrangle was continued by O. H. Nelson, E. L. Hain, J. A. Duck, and F. B. Barrett, the area mapped being 90 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. The resurvey of the Marseilles quadrangle, in Grundy, Kendall, and La Salle counties, was completed, and that of the Morris quadrangle, in Grundy and Kendall counties, was commenced by L. L. Lee, the area mapped being 232 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of these areas and of the Brownfield quadrangle, in Johnson, Massac, and Pope counties, W. S. Gehres, C. R. French, G. W. Lucas, R. G. Clinite, and S. R. Archer ran 413 miles of primary levels and established 111 permanent bench marks, 21 miles of levels and 5 bench marks being in Iowa. For the control of the Birds, Equality, Brownfield, Marion, Stonefort, Vienna, Merom, Oaktown, and Vincennes (Ill.-Ind.) quadrangles and the Illinois portion of the Golconda and Paducah quadrangles, in Crawford, Lawrence, Gallatin, Pope, Hardin, Saline, Johnson, Massac, Williamson, Pulaski, and Clark counties, Ill., and Knox and Sullivan counties, Ind., C. B. Kendall ran 217 miles of primary traverse and set 15 permanent marks, 33 miles and 2 marks being in Indiana.

Indiana.—The mapping of the Indiana portion of the Vincennes quadrangle, in Knox County, was completed by C. L. Sadler and Charles Hartmann, jr., the area mapped being 97 square miles, for publication on the scale of 1:62,500, with a contour interval of 20

feet. For the control of this area S. L. Parker ran 30 miles of primary levels and established 6 permanent bench marks. (See also pp. 98 and 100.)

Iowa.—The State geologist allotted $1,750 for the continuation of cooperative topographic surveys in Iowa, and the Federal Survey allotted an equal amount. The survey of the Boone quadrangle, in Boone, Hamilton, and Webster counties, was continued by W. L. Miller, the area mapped being 110 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of the Attica, Chariton, and New Virginia quadrangles, in Lucas, Marion, Munroe, Warren, and Clarke counties, C. B. Kendall ran 40 miles of primary traverse and set 7 permanent marks, and R. G. Clinite ran 135 miles of primary levels and established 37 permanent marks. (See also p. 98.)

Kentucky.—The Kentucky Geological Survey allotted $10,000 for the continuation of cooperative topographic surveys in Kentucky and the Federal Survey allotted an equal amount. The survey of the Kentucky portions of the Evansville and Shawneetown quadrangles, in Crittenden, Union, and Henderson counties, was completed, and that of the Alzey quadrangle, in Henderson and Union counties, was commenced by C. W. Goodlove, C. P. McKinley, J. H. Wilson, R. M. Herrington, and W. S. Gehres, the area mapped being 319 square miles, for publication on the scale of 1:62,500, with contour intervals of 10 and 20 feet. The survey of the Indiana portion of the Alzey quadrangle, in Posey County, was commenced by C. W. Goodlove, R. M. Herrington, and W. S. Gehres, the area mapped being 112 square miles, for publication on the same scale as the Kentucky portion. All expenses of work in the Indiana area were borne entirely from Federal funds. The resurvey of the Cornettsville, Ovenfork, and Virgie quadrangles, in Floyd, Harlan, Knott, Leslie, Letcher, Pike, and Perry counties, was completed, and that of the Laynesville quadrangle, in Floyd, Johnson, Martin, and Pike counties, was commenced by J. R. Eakin, C. P. McKinley, J. M. Rawls, N. E. Ballmer, W. A. Reiter, H. E. Burney, S. A. Judson, Howard Clark, L. A. Darrah, and J. T. Graves, the area mapped being 713 square miles, for publication on the scale of 1:62,500, with a 50-foot contour interval. An area of 3 square miles in the Ovenfork quadrangle falling in Wise County, Va., is included in the total area above given. For the control of the Cornettsville, Laynesville, Virgie, Inez, and Alzey quadrangles and the Kentucky portion of the Evansville quadrangles, in Harlan, Knott, Leslie, Letcher, Perry, Floyd, and Pike counties, S. R. Archer and E. C. Bibbee ran 275 miles of primary levels and established 76 permanent bench marks, 14 miles and 2 marks being in Indiana.

Michigan.—For the continuation of cooperative topographic surveys in Michigan the State geologist allotted $2,500, which was met by the United States Geological Survey with an equal amount. The survey of the St. Charles quadrangle and of the Michigan portion of the Centerville quadrangle, in Midland, Saginaw, and St. Joseph counties, was commenced by C. L. Sadler, L. L. Lee, and H. E. Burney, the area mapped being 154 square miles, for publication on the scale of 1:62,500, with contour intervals of 5 and 20 feet. For the control of these areas and of the Chesaning, Corunna, Burt, Durand, and Schoolcraft quadrangles and the Michigan portion of the Centerville, Sturgis, and Shipshewanna quadrangles, in Midland, Saginaw, Shiawassee, Ingham, Livingston, Genesee, and St. Joseph counties, Mich., and Elkhart, Lagrange, and Noble counties, Ind., J. H. Wilson ran 137 miles of primary traverse (8 miles in Indiana) and established 10 permanent marks. For the control of the Coldwater, Reading, St. Charles, Chesaning, Corunna, Saginaw, Schoolcraft, Kalamazoo, Wayland, Sturgis, and Centerville (Mich.-Ind.) quadrangles, in Midland, Saginaw, Shiawassee, Ingham, Livingston, Bay, St. Joseph, Kalamazoo, Branch, Hillsdale, Allegan, and Kent counties, Mich., and Elkhart and Lagrange counties, Ind., R. G. Clinite and E. C. Bibbee ran 346 miles of primary levels and established 78 permanent bench marks, 12 miles of levels and 4 bench marks being in Indiana. (See also pp. 98 and 99.)

Minnesota.—The State drainage engineer of Minnesota allotted $10,000 for the continuation of cooperative topographic surveys in that State, and the United States Geological Survey made an equal allotment. The survey of the Emily quadrangle, in Aitkin and Crow Wing counties, was completed, and that of the Aitkin and Pelican Rapids quadrangles, in Aitkin, Becker, Clay, and Ottertail counties, was commenced by A. M. Walker, E. L. Hain, F. B. Barrett, J. H. Wilson, and L. B. Roberts, the total area mapped being 515 square miles, for publication on the scale of 1:62,500, with a contour interval of 10 feet. For the control of the Emily quadrangle, J. H. Wilson ran 20 miles of primary traverse.

In addition to the cooperative work in Minnesota, a special drainage survey of the diminished Red Lake Indian Reservation was made by A. P. Meade for the Office of Indian Affairs, the funds for this work having been allotted from the unexpended balance remaining from the appropriation for the survey of the ceded Chippewa lands. The area covered by this survey was 943 square miles. In connection with this work, Mr. Meade ran 32 miles of primary levels and established 8 permanent bench marks. The funds expended on this work amounted to $3,320.11.

Missouri.—The State geologist of Missouri allotted $7,500 for the continuation of the cooperative topographic survey of that State, and

the United States Geological Survey allotted an equal amount. A further allotment of $2,500 was made by the State for the completion of the map of Platte County, on the scale of 1:62,500, with a contour interval of 20 feet. In connection with this county map J. G. Staack, J. A. Duck, O. H. Nelson, and F. B. Barrett surveyed 48 square miles and resurveyed 59 square miles, covering portions of the Armourdale, Dearborn, Sugar Lake, Gower, and Waldron quadrangles. The survey of the Missouri portion of the Crystal City quadrangle, in Jefferson, Ste. Genevieve, and St. Francois counties, was completed by F. W. Hughes and W. F. Hicks, the area mapped being 207 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of this area and of the Cuba, Eminence, Sinkin, Stone Hill, Salem, and Steelville quadrangles, in Crawford, Dent, Franklin, Reynolds, Shannon, and Gasconade counties, E. C. Bibbee and G. W. Lucas ran 153 miles of primary levels and established 45 permanent bench marks. To complete the survey of Ste. Genevieve County on the scale of 1:62,500, with a contour interval of 20 feet, F. W. Hughes mapped 3 square miles in the Knob Lick quadrangle. The resurvey of the Sturgeon quadrangle, in Audrain, Boone, Howard, and Randolph counties, was continued by C. G. Anderson and W. L. Miller, the area mapped being 134 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of the Chillicothe, Gallatin, Gillman City, Gower, Maysville, Plattsburg, Polo, Trenton, Winston, Boynton, Braymer, Chula, Dawn, Galt, Lucerne, Milan, Celt, Fordland, Lebanon, Long Lane, Niangua, Passover, Sleeper, Exchange, Bandyville, Montier, Corridon, Willow Springs, Ruble, Cedar Gap, Redford, Cabool, Macomb, and Eminence 15-minute quadrangles and the Sedalia, Harrisonville, Lexington, and Warrensburg 30-minute quadrangles, in Grundy, Livingston, Caldwell, Daviess, Harrison, Buchanan, Clinton, Platte, Ray, Dekalb, Putnam, Sullivan, Carroll, Linn, Mercer, Camden, Dallas, Christian, Douglas, Webster, Laclede, Miller, Morgan, Carter, Reynolds, Shannon, Oregon, Howell, Wright, Texas, Cass, Jackson, Johnson, Lafayette, Henry, and Pettis counties, E. L. McNair ran 820 miles of primary traverse and set 83 permanent marks.

In addition to the cooperative work, the mapping of the Missouri portion of the Chester quadrangle, in Perry and Ste. Genevieve counties, was completed, and that of the Missouri portion of the Kimmswick quadrangle, in Jefferson and St. Louis counties, was commenced by F. W. Hughes, E. L. Hain, O. H. Nelson, F. B. Barrett, G. W. Lucas, W. F. Hicks, and R. H. Randall, the area mapped being 244 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of these areas G. W. Lucas ran 99 miles of primary levels and established 39 permanent bench marks.

Ohio.—The governor of Ohio allotted $25,000 for the continuation of cooperative topographic surveys in that State, and the United States Geological Survey allotted $10,000. The survey of the Alger, Bellefontaine, Brinkhaven, Bucyrus, East Liberty, Larue, Kenton, Mount Gilead, Norwalk, Richwood, Shauck, and Waynesville quadrangles and of the Ohio portion of the Greenup quadrangle, in Allen, Auglaize, Hardin, Logan, Champaign, Holmes, Knox, Coshocton, Crawford, Huron, Seneca, Union, Lawrence, Scioto, Marion, Wyandot, Morrow, Clark, Richland, Greene, Warren, and Montgomery counties, was completed, and that of the Greenfield, Mechanicsburg, and St. Paris quadrangles, in Fayette, Highland, Ross, Champaign, Clark, Logan, Madison, and Union counties, was commenced, the total area mapped being 2,473 square miles, for publication on the scale of 1:62,500, with contour intervals of 10 and 20 feet. This work was done by J. H. Jennings, C. W. Goodlove, Fred Graff, jr., Merrill Hackett, A. B. Searle, Gilbert Young, J. A. Duck, N. E. Ballmer, R. M. Herrington, W. S. Gehres, M. A. Roudabush, G. R. Logue, C. R. French, and H. E. Burney.

For the control of these areas and of the Octa and Xenia quadrangles, in Clinton, Greene, and Warren counties, E. C. Bibbee, C. E. Mills, S. L. Parker, R. G. Clinite, and F. L. Whaley ran 861 miles of primary levels and established 173 permanent bench marks.

Wisconsin.—The survey of the Rapp quadrangle, in Monroe County, was commenced by R. T. Evans, O. H. Nelson, J. M. Perkins, and D. H. Watson, the area mapped being 144 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of this area J. M. Perkins ran 55 miles of primary levels and established 7 permanent bench marks.

OFFICE WORK.

The drafting of the following sheets was completed: Avon, Marseilles, and Mount Olive, Ill.; Edgington, Ill.-Iowa; Vincennes, Ill.-Ind.; Cornettsville, Ky.; Ovenfork, Ky.-Va.; Cuyuna, Minn.; Platte County, Mo.; Chester, Crystal City, and Renault, Mo.-Ill.; Alger, Bellefontaine, Brinkhaven, Bucyrus, Coshocton, Crestline, East Liberty, Kenton, Larue, Millersburg, Mount Gilead, Norwalk, Richwood, Shauck, Siam, and Waynesville, Ohio.

Progress in the drafting of additional sheets was made as follows: Equality, Ill., 52 per cent; Boone, Iowa, 80 per cent; Shawneetown, Ky.-Ill., 73 per cent; Pelican Rapids, Minn., 29 per cent; diminished Red Lake Reservation, Minn., 90 per cent; Greenup, Ohio, 34 per cent.

The following computations and adjustments were made:

Primary-level circuits were adjusted for the Avon, Equality, and Marseilles (Ill.), Shipshewanna (Ind.-Mich.), Attica and Chariton

(Iowa), Alzey, Cornettsville, Evansville, Laynesville, Ovenfork, and Virgie (Ky.), Chesaning, Coldwater, Corunna, Kalamazoo, Reading, St. Charles, Schoolcraft, and Wayland (Mich.), Centerville and Sturgis (Mich.-Ind.), Chester, Crystal City, Kimmswick, and Renault (Mo.), Alger, Bellefontaine, East Liberty, Greenville, Kenton, Mechanicsburg, Milford Center, Octa, Richwood, St. Paris, Waynesville, and Xenia (Ohio) quadrangles.

Geographic positions were computed for the Birds, Brownfield, Equality, Fords Ferry, Golconda, Stonefort, Vienna, and Vincennes (Ill.), Merom (Ind.-Ill.), Oaktown and Vincennes (Ind.), Shipshewanna (Ind.-Mich.), Attica and Chariton (Iowa), Burt, Chesaning, Corunna, Dewitt, Durand, Elsie, Freeland, Ithaca, Jones, Merrill, Muir, Perrinton, Saginaw, St. Charles, and Schoolcraft (Mich.), Centerville and Sturgis (Mich.-Ind.), Aitkin (Minn.), Bandyville, Boynton, Braymer, Cabool, Cedar Gap, Celt, Chillicothe, Chula, Clear Springs, Corridon, Dawn, Eminence, Exchange, Fordland, Gallatin, Galt, Gower, Lebanon, Long Lane, Low Wossie, Lucerne, Maysville, Macomb, Milan, Montier, Neosho, Niangua, Passover, Plattsburg, Polo, Redford, Ritchey, Ruble, Sleeper, Trenton, Willow Springs, and Winston (Mo.) quadrangles.

ROCKY MOUNTAIN DIVISION.

FIELD WORK.

SUMMARY.

During the season topographic mapping was carried on in Colorado, Montana, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. This work comprised the completion of the survey of 11 quadrangles, in addition to which 5 quadrangles were partly surveyed. The total new area mapped was 3,781 square miles, 2,548 for publication on the scale of 1:125,000, 1,229 square miles for publication on the scale of 1:62,500, and 4 square miles for publication on the scale of 1:31,680. In addition, the map of 1 quadrangle was revised and those of 2 quadrangles were partly revised, the area covered being 1,105 square miles. In connection with this work 474 miles of primary levels were run and 160 permanent bench marks were established. A profile survey was made of a portion of one stream, covering a distance of 228 linear miles.

Primary traverse and primary triangulation were carried on at different times by four parties, the work extending over portions of Colorado, Montana, New Mexico, and Oklahoma. The total area covered by this primary control was about 4,120 square miles, of which 240 was controlled by primary traverse, 73 miles being run and 3 permanent marks set. Twenty-three triangulation stations

were occupied and 24 marked. The result of this work was to make control available in 8 quadrangles.

Topographic surveys in Rocky Mountain division from July 1, 1913, to June 30, 1914.

State.	Contour interval.	For publication on scale of—			Total area surveyed.	Primary levels.		Primary traverse.		Triangulation.	
		1:125,000	1:62,500	1:31,680		Distance run.	Bench marks.	Distance run.	Permanent marks.	Stations occupied.	Stations marked.
	Feet.	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Miles.*		*Miles.*			
Colorado	100	2,118	.....	.....	2,118	213	77	.....	.....	15	18
Montana	5,20,100	430	199	4	633	45	15	.....	.....	.....	.....
Nebraska	20	.....	213	.....	213	.....	.....	.....	.....	.....	.....
New Mexico	50	.....	82	.....	82	.....	.....	.....	.....	8	6
Oklahoma	25	.....	156	.....	156	50	25	73	3	.....	.....
Texas	5	.....	296	.....	296	114	31	.....	.....	.....	.....
Wyoming	25	.....	283	.....	283	52	12	.....	.....	.....	.....
		2,548	1,229	4	3,781	474	160	73	3	23	24

DETAILS OF WORK BY STATES.

Colorado.—The survey of the Longs Peak and Chromo quadrangles, lying partly in the Arapahoe, Colorado, Rio Grande, and San Juan national forests, in Boulder, Grand, Larimer, Archuleta, Conejos, Mineral, and Rio Grande counties, was completed by B. A. Jenkins, S. T. Penick, C. A. Ecklund, C. C. Holder, and R. R. Monbeck, the total area mapped being 792 square miles, of which 634 square miles is in the national forest, for publication on the scale of 1:125,000, with a contour interval of 100 feet. For the control of the Longs Peak quadrangle and of the Mount Powell, Kremmling, James Peak, Eagle, and Glenwood Springs quadrangles, partly in the Arapahoe, Holy Cross, Leadville, Pike, and White River national forests, in Eagle, Grand, Summit, Jackson, Boulder, Gilpin, Clear Creek, Routt, and Park counties, C. F. Urquhart and C. B. Kendall occupied 15 triangulation stations and permanently marked 18. The survey of the Creede quadrangle, in the Cochetopa, Rio Grande, and San Juan national forests, in Mineral, Rio Grande, and Saguache counties, was continued, and that of the Lay quadrangle, in Moffat County, was begun, by J. H. Wilke, Basil Duke, Mr. Penick, L. B. Glasgow, Mr. Holder, and Mr. Rowell, the area mapped being 1,326 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet, 831 square miles being in the national forests. For the control of these areas and of the Home, Montrose, Naturita, and Coventry quadrangles, lying partly in the Arapahoe, Colorado, La Sal, Gunnison, Montezuma, and Uncompahgre national forests, in Jackson, Larimer, Montrose, and

San Miguel counties, Mr. Ecklund, Mr. Rowell, and H. B. Edwards ran 213 miles of primary levels and established 77 permanent bench marks.

Montana.—The survey of the Stryker quadrangle, lying partly in the Blackfeet National Forest, in Flathead and Lincoln counties, was completed by R. T. Evans, Gilbert Young, C. P. McKinley, and F. L. Whaley, the total area mapped being 430 square miles, of which 347 square miles is in the national forest, for publication on the scale of 1:125,000, with a contour interval of 100 feet. For the control of this area Mr. Whaley ran 45 miles of primary levels and established 15 permanent bench marks. The survey of the portions of the Wolf Point, Oswego, and Frazer quadrangles, lying south of Missouri River, in Dawson, Valley, and Sheridan counties, was completed, and that of the portion of the Nashua quadrangle, lying south of Missouri River, in Dawson and Valley counties, was begun, the area mapped being 199 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. The portions of these quadrangles lying north of Missouri River were mapped by the General Land Office.

A profile survey of Missouri River was made by R. H. Reineck, the distance traversed being 228 linear miles, in Broadwater, Cascade, and Lewis and Clark counties. In connection with this work a reservoir site covering 4 square miles was surveyed, for publication on the scale of 1:31,680, with a contour interval of 5 feet. (See also p. 108.)

Nebraska.—The board of regents of the University of Nebraska allotted $2,000 for the continuation of the cooperative topographic surveys in that State, and the United States Geological Survey allotted an equal amount. The survey of the Howe quadrangle, in Nemaha and Richardson counties, was completed by R. H. Reineck, S. T. Penick, and R. R. Monbeck, the area mapped being 213 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet.

New Mexico.—The survey of the Brilliant quadrangle, in Colfax County, was completed by E. P. Davis, C. A. Ecklund, and C. C. Holder, the total area mapped being 82 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. For the control of the Reserve quadrangle, in Socorro County, C. B. Kendall and Mr. Holder occupied 8 triangulation stations and permanently marked 6.

Oklahoma.—The director of the Oklahoma Geological Survey allotted $1,000 for the continuation of cooperative topographic surveys in that State, and the United States Geological Survey allotted an equal amount. The survey of the Foraker quadrangle, in Osage

County, was commenced by S. T. Penick and R. R. Monbeck, the area mapped being 156 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet. For the control of this quadrangle E. L. McNair ran 73 miles of primary traverse and set 3 permanent marks, and Mr. Monbeck and R. W. Burchard ran 50 miles of primary levels and established 25 permanent bench marks.

In addition to the cooperative work in Oklahoma, the revision of the map of the Claremore quadrangle, in Rogers, Tulsa, Wagoner, and Washington counties, was completed, and that of the Hominy quadrangle, in Osage, Pawnee, and Tulsa counties, was commenced by R. W. Berry, the area covered by this revision being 981 square miles, for publication on the scale of 1:125,000, with a contour interval of 50 feet.

A secondary level line was run in the Cushing oil field by Mr. Berry to establish elevations desired by the Bureau of Mines, which bore all expenses of this work.

South Dakota.—The revision of the portions of the maps of Sturgis and Spearfish quadrangles, in Lawrence and Meade counties, covering mining districts, was completed by R. W. Berry, the area revised being 124 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet.

Texas.—The survey of the Texas portion of the Mission and San Juan quadrangles, in Hidalgo County, was completed by E. P. Davis, R. C. Seitz, and C. A. Ecklund, the area mapped being 296 square miles, for publication on the scale of 1:62,500, with a contour interval of 5 feet. For the control of these areas Mr. Seitz ran 114 miles of primary levels and established 31 permanent bench marks.

Wyoming.—The survey of the Ilo quadrangle, in Hot Springs County, was completed, and that of the northwest quarter of the Thermopolis quadrangle, in Hot Springs and Washakie counties, was begun by C. C. Gardner, R. H. Reineck, G. M. Ruby, and C. R. Fisher, the total area mapped being 283 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet. For the control of these areas Mr. Fisher ran 52 miles of primary levels and established 12 permanent bench marks. (See also pp. 108 and 110.)

OFFICE WORK.

The drafting of the following sheets was completed: Chromo and Longs Peak, Colo.; Frazer, Missouri River, Oswego, Stryker, and Wolf Point, Mont.; Falls City and Howe, Nebr.; Brilliant, N. Mex.; Spearfish and Sturgis (revision), S. Dak.; Ilo, Wyo.

The Cuskers, Spring Creek, Todd Lakes, and Tule Valley 15′ maps in Montana, surveys for which were made by the General Land Office, were adjusted, assembled, and photolithographed by the topographic branch.

Progress in the drafting of additional sheets was made as follows: Creede, Colo., 83 per cent; Lay, Colo., 46 per cent; Nashua, Mont., 90 per cent; Mission, Tex., 30 per cent; San Juan, Tex., 75 per cent; Thermopolis, Wyo., 5 per cent.

The following computations and adjustments were made:

Primary-level circuits were adjusted for the Chromo, Creede, Del Norte, Elkhead, Lay, Longs Peak, and San Cristobal (Colo.), Marston (Mont.), Brownsville, Mission, Point Isabel, and San Juan (Tex.), and Ilo (Wyo.) quadrangles.

Geographic positions were computed for the Kremmling, Longs Peak, and Mount Powell (Colo.), Hamilton (Mont.), Canyon Largo, Mogollon, and Reserve (N. Mex.), Foraker (Okla.), and Mission, Clarksville, and San Juan (Tex.) quadrangles.

NORTHWESTERN DIVISION.

FIELD WORK.

SUMMARY.

During the season topographic mapping was carried on in Idaho (with small areas extending into Montana and Wyoming), Oregon, and Washington. This work comprised the completion of the survey of 6 quadrangles and of 2 special areas and the partial survey of 12 quadrangles. The total new area mapped was 3,295 square miles, 136 square miles for publication on the scale of 1:31,680, 675 square miles for publication on the scale of 1:62,500, 1,812 square miles for publication on the scale of 1:125,000, and 672 square miles for publication on the scale of 1:250,000. In connection with this work 722 miles of primary and precise levels were run and 203 permanent bench marks were established. In addition, profile surveys were made of portions of 10 rivers, the distance traversed being 449 linear miles, in connection with which 4 square miles was surveyed for publication on the scale of 1:31,680.

Primary triangulation and primary traverse were carried on at different times by three parties in portions of Idaho, Montana, Oregon, and Washington. The total area covered by this primary control was about 7,787 square miles, of which about 1,042 square miles was controlled by primary traverse, 384 miles being run and 96 permanent marks set. Forty-four triangulation stations were occupied and 56 permanently marked. The result of this work was to make control available in 23 quadrangles.

Topographic surveys in northwestern division from July 1, 1913, to June 30, 1914.

State.	Contour interval.	For publication on scale of—				Total area surveyed.	Primary levels.		Primary traverse.		Triangulation.	
		1:250,000	1:125,000	1:62,500	1:31,680		Distance run.	Bench marks.	Distance run.	Permanent marks.	Stations occupied.	Stations marked.
	Feet.	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Miles.*		*Miles.*			
Idaho	50,100	672	200	164	.....	1,036	10	2	.....	....	15	33
Oregon	5,50	.....	739	.....	132	893	466	126	352	91	17	16
Washington	5,25,50,100	.....	865	485	4	1,332	246	75	32	5	.....	.....
Montana	100	.....	8	.....	.....	8	.....	....	.....	....	12	7
Wyoming	50	.....	.....	26	.....	26	.....	....	.....	....	.....	.....
		672	1,812	675	136	3,295	722	203	384	96	44	56

DETAILS OF WORK BY STATES.

Idaho.—The survey of T. 2 N., R. 45 E., T. 3 N., R. 44 E., and T. 4 N., Rs. 44 and 45 E., in Bingham and Fremont counties, was commenced by J. L. Lewis and C. G. Anderson, the area mapped being 47 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. The survey of the Fort Hall Indian Reservation, in Bannock, Bingham, and Oneida counties, was completed by C. G. Anderson, the area mapped being 672 square miles, for publication on the scale of 1:250,000, with a contour interval of 100 feet. A profile survey of Bear River was made by Albert Pike, covering 86 miles of the river, from Riverdale to Novene, in Bannock and Oneida counties, for publication on the scale of 1:31,680, with contour intervals of 5 and 25 feet. For the control of the Mink Creek quadrangle, in Bannock, Bear Lake, and Franklin counties, Howard Clark ran 10 miles of primary levels and established 2 permanent bench marks.

Idaho-Montana.—The survey of the Taft quadrangle, in the Lolo, Cabinet, St. Joe, and Cœur d'Alene national forests, in Shoshone County, Idaho, and Missoula and Sanders counties, Mont., was continued by J. E. Blackburn, the area mapped being 208 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. Of this area 200 square miles lies in Idaho and 8 in Montana, and 200 square miles is in the national forests. For the control of the Salmon, Fishtrap, Polaris, Gibbons Pass, Trappers Peak, Noble, Watchtower Peak, Vinegar Hill, Hamilton, and Sapphire quadrangles, in Lemhi and Idaho counties, Idaho, and Beaverhead, Deer Lodge, Granite, and Ravalli counties, Mont., T. M. Bannon occupied 27 triangulation stations and marked 40, of which 15 stations were occupied and 33 marked in Idaho.

Idaho-Wyoming.—The mapping of the Freedom quadrangle, in the Caribou National Forest, in Bannock County, Idaho, and Lin-

coln County, Wyo., was completed by J. L. Lewis, the area mapped being 143 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. Of this area 117 square miles lies in Idaho and 26 square miles in Wyoming.

Oregon.—The State engineer of Oregon allotted $18,000 for the continuation of cooperative topographic surveys in that State and the United States Geological Survey allotted an equal amount. The survey of the Willamette Valley was continued and included the completion of the mapping of the Albany quadrangle and the continuation of the mapping of the Salem and Corvallis quadrangles, in Benton, Linn, Marion, and Polk counties, the total area mapped being 132 square miles, for publication on the scale of 1:31,680, with a contour interval of 5 feet. This work was done by J. H. Wheat, Charles Hartmann, jr., W. S. S. Johnson, Frederick Rider, W. R. Chenoweth, and W. G. Carson. The mapping of the Reedville quadrangle, in Clackamas, Yamhill, and Washington counties, was commenced by C. H. Birdseye, the area mapped being 22 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet. For the control of these areas and of the Aumsville, Dallas, Mount Angel, and McCoy quadrangles, in Clackamas, Linn, Marion, Polk, and Yamhill counties, L. F. Biggs ran 352 miles of primary traverse and set 91 permanent marks, and Mr. Biggs and D. S. Birkett ran 327 miles of primary levels and established 83 permanent bench marks. The mapping of the Oregon portion of the Arlington quadrangle, in Gilliam and Sherman counties, and that of the Condon quadrangle, in Gilliam, Morrow, Sherman, and Wheeler counties, was commenced by C. H. Birdseye, C. L. Sadler, O. G. Taylor, and S. E. Taylor, the area mapped being 227 square miles, for publication on the scale of 1:125,000, with a contour interval of 50 feet. For the control of the Condon, Heppner, Spray, Paulina, Round Mountain, and Twickenham quadrangles, in Gilliam, Morrow, Sherman, Wheeler, Grant, Crook, and Wasco counties, J. R. Ellis occupied 17 and marked 16 triangulation stations, and for the control of the Condon quadrangle D. S. Birkett ran 123 miles of primary levels and established 38 permanent bench marks. Profile surveys of Willamette, Santiam, Clackamas, Sandy, and Hood rivers were made by S. G. Lunde, Charles Hartmann, jr., R. L. Harrison, and W. R. Chenoweth, the distance traversed being 250 linear miles in Clackamas, Lane, Marion, Linn, and Wasco counties. Of this distance 190 miles lies in the Oregon, Cascade, Santiam, and Umpqua national forests.

In addition to the cooperative work in Oregon, the mapping of the Cazadero quadrangle, in the Oregon National Forest, in Clackamas and Multnomah counties, was completed, and that of the Diamond Lake quadrangle, in the Umpqua, Crater, and Paulina national

forests, in Douglas, Lane, and Klamath counties, was continued by J. G. Staack and O. H. Nelson, the area mapped being 512 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. For the control of the Diamond Lake quadrangle Mr. Nelson ran 16 miles of primary levels and established 5 permanent bench marks.

Washington.—The Board of Geological Survey of Washington allotted $12,500 for the continuation of cooperative topographic surveys in that State and the United States Geological Survey allotted an equal amount. The survey of the Arlington, Ocosta, and Wenatchee quadrangles, in Klickitat, Chehalis, and Chelan counties, was completed by A. E. Murlin, H. L. McDonald, Charles Hartmann, jr., F. W. Crisp, and Frederick Rider, and that of the Chehalis, Haven, and Mitchell quadrangles, in Lewis, Thurston, Benton, Kittitas, Yakima, and Grant counties, was continued, the total area mapped being 870 square miles, 605 square miles for publication on the scale of 1:125,000, with a contour interval of 50 feet, and 265 square miles for publication on the scale of 1:62,500, with contour intervals of 25 and 50 feet. For the control of the Ocosta quadrangle L. F. Biggs ran 32 miles of primary traverse and set 5 permanent marks, and for the control of the Arlington and Tacoma quadrangles, the latter of which had been previously mapped, D. S. Birkett ran 97 miles of primary and precise levels and established 23 permanent bench marks. Profile surveys were made by A. J. Ogle of portions of Snoqualmie, Skykomish, Stilaguamish, and Sultan rivers, the distance traversed being 113 linear miles in King and Snohomish counties. In connection with this work reservoir sites covering 4 square miles were surveyed, for publication on the scale of 1:31,680, with contour intervals of 5 and 25 feet.

In addition to the cooperative work in Washington, the survey of the Mount Rainier National Park, in Pierce and Lewis counties, was completed by C. H. Birdseye, W. O. Tufts, O. G. Taylor, and S. E. Taylor, the area mapped being 198 square miles, for publication on the scale of 1:62,500, with a contour interval of 100 feet. Of this area 62 square miles lies outside of the park, in the Mount Rainier quadrangle. The mapping of the Mount St. Helens quadrangle, in the Columbia National Forest, in Clarke, Cowlitz, Lewis, and Skamania counties, was continued by Albert Pike and W. R. Chenoweth, the area mapped being 260 square miles, of which 150 square miles is in the national forest, for publication on the scale of 1:125,000, with a contour interval of 100 feet. For the control of these areas and of the Eatonville quadrangle, in Lewis and Pierce counties, E. M. Bandli ran 149 miles of primary levels and established 52 permanent bench marks.

OFFICE WORK.

The drafting of the following sheets was completed: Bear River and Fort Hall Indian Reservation, Idaho; Freedom, Idaho-Wyo.; Albany, Cazadero, Clackamas River, Hood River, Sandy River, Santiam River, and Willamette River, Oreg.; Arlington, Oreg.-Wash.; Hoquiam, Mount Rainier National Park, Ocosta, Sanpoil River, Skykomish River, Snoqualmie River, Sultan River, and Wenatchee, Wash.

Progress in the drafting of additional sheets was made as follows: Victor, Idaho, 6 per cent; Taft, Idaho-Mont., 83 per cent; Condon, Oreg., 22 per cent; Corvallis, Oreg., 22 per cent; Diamond Lake, Oreg., 38 per cent; Salem, Oreg., 17 per cent; Chehalis, Wash., 40 per cent; Haven, Wash., 37 per cent; Mitchell, Wash., 37 per cent; Mount Rainier, Wash., 7 per cent; Mount St. Helens, Wash., 37 per cent.

The following computations and adjustments were made:

Primary-level circuits were adjusted for the Arlington, Blalock Island, Castlerock, Eatonville, Fordnah, Haven, Kalama, Mount St. Helens, and Mount Rainier (Wash.), Arlington, Aumsville, Condon, Dallas, Mount Angel, Reedville, and Salem (Oreg.) quadrangles.

Geographic positions were computed for the Cape Elizabeth, Hoquiam, Humptulips, and Ocosta (Wash.), Condon, Crook, Heppner, Independence, Paulina, Rickreall, Round Mountain, Salem, Spray, and Sydney (Oreg.), Dickey, Gibbons Pass, Hamilton, Junction, May, Nicholia, Noble, Polaris, Salmon, Sapphire, Trappers Peak, Watchtower Peak, and Vinegar Hill (Idaho-Mont.) quadrangles.

PACIFIC DIVISION.

FIELD WORK.

SUMMARY.

During the season topographic mapping was carried on in Arizona, California, Nevada, and Utah. This work comprised the completion of the survey of 13 quadrangles, the partial survey of 9 quadrangles, the partial resurvey of 3 quadrangles and 1 special area, and the partial revision of the map of 1 special area. The total new area mapped was 3,741 square miles—2,979 square miles for publication on the scale of 1:125,000, 153 square miles for publication on the scale of 1:62,500, and 609 square miles for publication on the scale of 1:31,680. The area resurveyed was 1,048 square miles—745 square miles for publication on the scale of 1:125,000, 245 square miles for publication on the scale of 1:62,500, and 58 square miles for publication on the scale of 1:24,000. In connection with this work 724 miles of primary and precise levels were run, and 124 permanent bench

marks were established. In addition, profile surveys were made of three rivers, the distance traversed being 114 linear miles.

Primary triangulation was carried on at different times by 5 parties, the work being distributed over portions of California, Nevada, and Utah. The total area covered by this primary control was about 2,500 square miles, 41 triangulation stations being occupied and 28 permanently marked. The result of this work was to make control available in 11 quadrangles.

Topographic surveys were made in the Territory of Hawaii covering portions of one island (Hawaii). The survey of two 15-minute quadrangles was completed and that of one 15-minute quadrangle was continued, the total area mapped being 342 square miles, for publication on the scale of 1:31,680, in connection with which 44 miles of primary levels were run and 7 permanent bench marks were established. Primary triangulation and primary traverse were also carried on, 43 miles of primary traverse being run, and 4 triangulation stations were occupied and 1 marked.

Topographic surveys in Pacific division from July 1, 1913, to June 30, 1914.

State.	Contour interval.	For publication on scale of—						Total area surveyed.	Primary and precise levels.		Primary traverse.		Triangulation.	
		1:125,000		1:62,500		1:31,680	1:24,000							
		New.	Resurvey.	New.	Resurvey.	New.	Resurvey.		Distance run.	Bench marks.	Distance run.	Permanent marks.	Stations occupied.	Stations marked.
	Feet.	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Miles.*		*Miles.*			
Arizona	100	1,304	.....	.....	.....	.....	.....	1,304	111	26	.....	.....	.....	.....
California	5,25,100	910	.....	153	86	609	.....	1,758	331	27	.....	.....	20	14
Nevada	25,100	380	.....	.....	.....	.....	58	438	77	18	.....	.....	5	5
Utah	50,100	385	745	.....	159	.....	.....	1,289	205	50	.....	.....	16	9
		2,979	745	153	245	609	58	4,789	724	121	.....	.....	41	28
Hawaii	10	.....	.....	.....	.....	342	.....	342	44	7	43	.....	4	1

DETAILS OF WORK BY STATES.

Arizona.—The survey of the Pearce quadrangle, lying partly in the Chiricahua National Forest, in Cochise County, was completed, and that of the San Simon quadrangle, also partly in the Chiricahua National Forest, in Cochise, Graham, and Greenlee counties, Ariz., and Grant County, N. Mex., was commenced by S. E. Taylor and Cornelius Schnurr, the area mapped being 1,304 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet, 55 square miles being within the national forest. For the control of these areas Mr. Schnurr ran 111 miles of primary levels and established 26 permanent marks. All the work in the San Simon quadrangle was in the Arizona portion.

California.—The department of engineering of California allotted $14,000 for the continuation of cooperative topographic surveys in that State, and the United States Geological Survey allotted a like sum. The survey of the San Joaquin Valley was continued, the mapping of the Cooperstown, Ripon, Bachelor Valley, Salida, Dickenson, Oakdale, Westport, Montpellier, Reservoir, and Westley 7½-minute quadrangles and of the valley portion of the Lone Tree 7½-minute quadrangle being completed and that of the Empire, Denair, and Waterford 7½-minute quadrangles and of the Copperopolis 15-minute quadrangle being commenced by Duncan Hannegan, W. N. Vance, A. O. Burkland, H. W. Peabody, J. B. Leavitt, F. A. Danforth, S. H. Birdseye, D. H. Watson, C. A. Stonesifer, and R. M. La Follette, the total area mapped being 687 square miles—609 square miles for publication on the scale of 1:31,680, with a contour interval of 5 feet, and 78 square miles for publication on the scale of 1:62,500, with a contour interval of 25 feet. For the control of the Cressy, No. 5, No. 6, Atwater, Planada, and Merced quadrangles, in Merced and Stanislaus counties, C. L. Nelson occupied 13 triangulation stations and marked 10.

In addition to the funds for regular cooperative surveys in California, $2,500 was allotted by the University of California for the survey of the Santa Rosa quadrangle, in Napa and Sonoma counties, to be met by an equal amount by the United States Geological Survey from funds for 1915. The funds from the university were made available in the spring of 1914, and the survey of the Santa Rosa quadrangle was commenced by A. J. Ogle, the area mapped being 75 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet. For the control of this area C. F. Urquhart and Mr. Ogle occupied 7 and marked 4 triangulation stations.

In addition to the cooperative work in California, the survey of the Seiad and Sawyers Bar quadrangles, in Klamath, Siskiyou, and Trinity national forests, in Humboldt, Siskiyou, and Trinity counties, was continued by J. P. Harrison, C. W. Wardle, C. A. Stonesifer, and J. W. Muller, the area mapped being 638 square miles, all in national forests, for publication on the scale of 1:125,000 with a contour interval of 100 feet.

A precise-level line was run by L. F. Biggs across the Tehachapi Pass from Bakersfield to San Pedro, 282 miles being run and 13 permanent bench marks established, in order to check elevations previously established so as to determine possible earth movement.

The revision of the map of San Francisco and vicinity was begun by J. P. Harrison, T. P. Pendleton, B. A. Jenkins, S. E. Taylor, F. A. Danforth, and C. A. Stonesifer, the area revised being 173 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet, covering portions of the San Francisco, Concord,

Haywards, and San Mateo quadrangles, in Alameda, Contra Costa, Marin, and San Francisco counties. In connection with this work the resurvey of the Mare Island quadrangle, the southwest quarter of the Napa quadrangle, in Napa and Solano counties, was begun by J. B. Leavitt, the area mapped being 86 square miles, for publication on the same scale as the revision work.

California-Nevada.—The survey of the White Mountain quadrangle, lying partly in the Inyo and Mono national forests, in Mono County, Cal., and Mineral and Esmeralda counties, Nev., was begun by T. P. Pendleton and D. H. Watson, the area mapped being 652 square miles, of which 160 square miles is in the national forests, for publication on the scale of 1:125,000, with a contour interval of 100 feet. Of the area mapped 272 square miles falls in California and 380 square miles in Nevada. For the control of this area Mr. Watson ran 49 miles of primary levels and established 14 permanent bench marks, this line being entirely in California.

Nevada.—The resurvey of the Yerington mining district, in the Wabuska and Wellington quadrangles, in Lyon County, was begun by R. H. Chapman and E. R. Bartlett, the area mapped being 58 square miles, for publication on the scale of 1:24,000, with a contour interval of 25 feet. For the control of this area Mr. Chapman occupied and marked 5 triangulation stations and ran 27 miles of primary levels and established 12 permanent bench marks. For the control of the Mina quadrangle, in Mineral County, D. H. Watson ran 50 miles of primary levels and established 6 permanent bench marks.

Utah.—The survey of the Logan quadrangle, in the Cache National Forest, in Box Elder, Cache, and Rich counties, was begun by H. H. Hodgeson and Howard Clark, the area mapped being 385 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. The resurvey of the Wellington quadrangle, in Carbon County, was continued, and that of the Vernal quadrangle, in Uinta County, was begun by Oscar Jones, E. R. Bartlett, Cornelius Schnurr, and E. C. Burt, the total area mapped being 904 square miles—159 square miles for publication on the scale of 1:62,500, with a contour interval of 50 feet, and 745 square miles for publication on the scale of 1:125,000, with a contour interval of 100 feet. For the control of the Logan, Vernal, and Corinne quadrangles Mr. Jones and Mr. Hodgeson occupied 16 triangulation stations and marked 9, and for the control of the Logan, Vernal, and Randolph quadrangles Mr. Clark and Mr. Burt ran 205 miles of primary levels and established 50 permanent bench marks. Profile surveys of Green, Uinta, and White rivers, in the Vernal quadrangle, were made by Mr. Schnurr, the distance traversed being 114 linear miles, for publication on the scale of 1:48,000, with contour intervals of 5 and 25 feet.

Hawaii.—Cooperative topographic surveys were continued in the Hawaiian Islands under an arrangement similar to that of the previous fiscal year, the Territory allotting $16,000 and the United States Geological Survey $5,000. In the spring of 1914 the Territory allotted an additional $1,000 which was not met by Federal funds. The survey of the island of Hawaii was continued, the area mapped being 342 square miles, for publication on the scale of 1:31,680, with a contour interval of 10 feet. This work covered portions of the Kohala, Waipio, and Hilo 15-minute quadrangles, the first two being completed, and was done by A. T. Fowler, A. O. Burkland, Olinus Smith, J. M. Rawls, N. E. Ballmer, and S. H. Birdseye. For the control of these areas Mr. Fowler occupied 4 triangulation stations and marked 1, and ran 43 miles of primary traverse, and Mr. Ballmer ran 44 miles of primary levels and established 7 permanent bench marks.

The work of making tracings of data acquired by the War Department for the preparation of a map of the entire island of Oahu on the scale of 1:48,000, with a contour interval of 40 feet, was continued, and the edges of the various sheets adjusted and joined and boundary lines shown.

OFFICE WORK.

The drafting of the following sheets was completed: Hereford, Maricopa, and Mesa (revision), Ariz.; Bachelor Valley, Cooperstown, Lone Tree Valley, Mojave, Montpellier, Dickenson, Oakdale, Patterson, Reservoir, Ripon, Romain, Salida, Searles Lake, Soledad, Thalheim, Trigo, Westley, and Westport, Cal.; Honomu, Kohala, and Waipio, Hawaii.

Progress in the drafting of additional sheets was made as follows: Napa, Cal., 66 per cent; San Francisco and vicinity (revision), Cal., 88 per cent; Seiad, Cal., 45 per cent; White Mountain, Cal.-Nev., 16 per cent; Yerington mining district, Nev., 55 per cent; Logan, Utah, 20 per cent; Vernal, Utah, 73 per cent; Wellington, Utah, 99 per cent.

The following computations and adjustments were made:

Primary-level circuits were adjusted for the Don Luis and Pearce (Ariz.), Searles Lake and Crucero (Cal.), Wabuska and Wellington (Nev.), Logan, Randolph, and Vernal (Utah), Hilo, Honomu, Kohala, and Waipio (Hawaii) quadrangles and for the Yerington mining district (Nev.).

Geographic positions were computed for the Boyles and Nutriosa (Ariz.), Wabuska and Wellington (Nev.), and Logan (Utah) quadrangles, and for the Yerington mining district (Nev.), and 62 positions were computed for the San Joaquin Valley (Cal.). Preliminary computations were made for the Searles Lake, Crucero, Ivanpah, and Santa Rosa (Cal.), and Vernal (Utah) quadrangles.

INSPECTION OF TOPOGRAPHIC SURVEYING AND MAPPING.

J. H. Renshawe spent August, September, and October in inspecting the work of various field parties in the Atlantic and Central divisions. W. M. Beaman inspected field work in the vicinity of Washington, D. C., during portions of July, November, and December, and in August, September, October, and November visited topographic parties in the Atlantic, Central, Rocky Mountain, Northwestern and Pacific divisions.

The office duties of Messrs. Renshawe and Beaman, as heretofore, involved careful supervision of the inking and preparation of the final drawings of the topographic branch and their examination prior to submission for engraving. Mr. Beaman's duties also included the examination of river-survey and other sheets prepared for photolithography and the examination and transmission of land classification, woodland, and other special information; attention to referred matters, largely from the editor of topographic maps, and the proper transmission of all original topographic map manuscript. A considerable portion of Mr. Renshawe's time, as stated on page 89, was spent in preparing colored relief maps of national parks.

INSTRUMENTS AND TOPOGRAPHIC RECORDS.

As in past years, the repairs to all topographic instruments were made under the supervision of E. M. Douglas, who also had charge of the topographic records.

The additions to the topographic records consisted of 284 triangulation and primary-traverse field and computation books, 193 level books, not including the rodman's books, which were given duplicate numbers, 330 vertical-angle or stadia books, 36 plane-table sheets, and 60 envelopes of field data, all of which have been numbered and catalogued.

MAP OF THE UNITED STATES.

Of the work in progress last year on the 1:1,000,000 scale map of the United States, under the direction of A. F. Hassan, base maps of the following States have been completed: New Hampshire (portions of sheets K 18 and 19 and L 19), Virginia (portions of sheets J 17 and 18), West Virginia (portions of sheets J and K 17 and J 18), Kentucky (portions of sheets J 16 and 17), Missouri (portions of sheets J and K 15 and J 16), and Washington (portions of sheets L and M 10 and 11). The adjustment of the township lines and 50 per cent of the compilation in Oregon (portions of sheets K and L 10 and 11), the contouring of sheets I and J 10, and 85 per cent of the contouring of sheet K 18 were completed. The States of Missouri and Washington cooperated in the preparation of maps of those States.

WATER-RESOURCES BRANCH.

ORGANIZATION AND SCOPE OF WORK.

The water-resources branch includes three divisions—surface water, ground water, and water utilization—each of which is appropriately subdivided into sections for field work. The organization of the branch is as follows:

Chief of branch, N. C. Grover, chief hydraulic engineer.
Division of surface waters, John C. Hoyt, hydraulic engineer, in charge.
Division of ground waters, O. E. Meinzer, assistant geologist, in charge.
Division of water utilization, N. C. Grover, chief hydraulic engineer, in charge.

PERSONNEL.

The technical force of the water-resources branch has been reduced 8 during the year by transfers, resignations, and deaths, and has been increased by the appointment of 14 junior engineers, a net increase of 6. At the end of the year the technical force consisted of 1 chief hydraulic engineer, 8 hydraulic engineers, 1 engineer, 1 hydrographer, 1 chemist, 26 assistant engineers, 2 assistant geologists, 1 assistant chemist, 32 junior engineers, 1 junior chemist, and 2 geologic aids, a total of 76. Of this number, 1 hydraulic engineer, 2 assistant engineers, 1 assistant chemist, and 2 junior engineers are on furlough, and 1 hydrographer and 3 assistant engineers are employed occasionally at a per diem compensation.

ALLOTMENTS.

The appropriation was the same as in the preceding year ($150,000). The cooperative funds made available by allotments by States have been increased in some States and decreased in others, making necessary corresponding adjustments of the work.

The appropriation for the fiscal year was allotted as follows:

Allotments of appropriation for investigation of water resources, 1913–14.

Administrative expenses of the Survey	$12,000
Branch administration	9,420
Computations and reports	13,475
Inspection	1,000
Stream gaging in—	
Vermont	900
Massachusetts	2,250
New York	2,500
Virginia and Maryland	500
North Carolina, South Carolina, Georgia, Tennessee, and Florida	4,150
Ohio Valley	6,000
Minnesota	3,500
Wisconsin	1,900
Iowa	500

Stream gaging in—Continued.	
Colorado and Wyoming	$6,500
Montana	4,500
North Dakota	450
Utah	4,500
Nevada	2,500
Idaho	4,500
Oregon	4,500
Washington	4,500
California	4,500
New Mexico	4,500
Arizona	3,000
Hawaii	5,000
Yellowstone and Glacier national parks	550
Investigation of ground waters, including quality of waters	16,800
Land-classification board	12,500
Water-power investigations	12,000
Débris investigations	1,105
	150,000

Of the total appropriation, 74 per cent was allotted for work in public-land States.

COOPERATION.

STATES.

Cooperative funds were allotted by several States as follows:

Amounts allotted by States for cooperative work with United States Geological Survey in investigation of water resources.

Arizona		$3,000
California:		
State engineer	$9,000	
Conservation commission	7,500	
		16,500
Connecticut		1,000
Hawaii		15,000
Idaho		9,000
Iowa		500
Massachusetts		3,000
Minnesota		3,500
Nevada		2,500
New Mexico		12,000
New York:		
State engineer	$1,500	
Conservation commission	10,000	
		11,500
Oregon		10,000
Utah		5,500
Vermont		1,200
Washington		5,000
Wisconsin		8,500
		107,700

The work done under cooperative agreements in the several States has been limited to stream gaging, except as indicated below.

California.—In addition to a large amount of stream-gaging work in California, investigations of ground water in Sacramento and Santa Clara valleys were continued during the year and are still in progress. Measurements of depths to ground-water level were made in southern California. Reports containing the results of hydrometric investigations were prepared and published.

Connecticut.—The cooperative work in Connecticut consisted chiefly of ground-water surveys.

Hawaii.—In addition to the stream-gaging work in Hawaii measurements of precipitation and studies of water losses in irrigation canals are being made.

Idaho.—Studies of the losses and gains in the rivers and irrigation systems of a portion of Idaho have been made at the request of the State engineer in conjunction with the regular stream gaging.

Oregon.—Special reports on Deschutes River and on the chemical composition of river waters of Oregon are now in press. A complete report on stream-flow investigations in Oregon is being compiled.

Utah.—A detailed study of the water supply and the present and possible future use of Sevier River is in progress.

In addition to the cooperative work described above, in which the States have furnished money for examinations made by the Survey staff, investigations of ground waters in cooperation with the agricultural experiment stations of New Mexico and Arizona were continued as in previous years. The contributions of the experiment stations consisted in making analyses of samples of water and soluble salts collected during ground-water surveys in these States.

RECLAMATION SERVICE.

Cooperation with the Reclamation Service in stream-gaging work has been continued as in previous years. The gaging stations operated at the expense of the reclamation fund are located on streams relied on to furnish water to reclamation projects under construction by that Service. The field work of stream gaging is done by Survey engineers who are engaged in such work in the locality, and repayment of actual cost is made by the Reclamation Service through a transfer of funds.

OFFICE OF INDIAN AFFAIRS.

Investigations and reports have been made by the Survey at the request of the Commissioner of Indian Affairs in connection with the classification of lands within Indian reservations with regard to water-power and reservoir sites and for the purpose of locating ground-water supplies, as follows:

Flathead Reservation.—The report on the power-site and reservoir possibilities on the Flathead Reservation was made under authority dated January 24, 1913.

Klamath Reservation.—A report was made on the power-site and reservoir possibilities of the Klamath Reservation under authorization of October 12, 1911.

Moki and Navajo reservations.—The investigation of the occurrence and availability of ground-water supplies in the Moki and Navajo reservations, authorized April 11, 1913, was continued in the field during July and a part of August, and a report thereon was sent to the Office of Indian Affairs.

An investigation of the possibility of developing water power on Hogback canal, located in T. 12 N., Rs. 1 and 2 W., and T. 13 N., R. 2 W., New Mexico meridian, in the Navajo Reservation, has been made under authority dated July 2, 1913, but the report thereon has not been filed.

San Carlos Reservation.—An investigation to determine the practicability of developing ground-water supplies for irrigation on the San Carlos Reservation was authorized May 25, 1914, and plans have been made to begin the field work soon after July 1.

Wind River Reservation.—Under authority dated July 2, 1913, power-site and reservoir possibilities on the Wind River Reservation were examined, but no report thereon has been made.

Yakima Reservation.—A report was made on the power-site and reservoir possibilities of the Yakima Reservation, under authorization of September 5, 1912.

Stream gaging.—Stream-gaging work has been continued on the following Indian reservations in accordance with authorizations of the Office of Indian Affairs: Colville, Crow, Fort Hall, Klamath, Menominee, Pine Ridge, Queniult, Rosebud, San Carlos, Standing Rock, Warm Springs, and Yakima.

PUBLIC-HEALTH SERVICE.

Special stream-gaging work is being done in the Ohio River basin in cooperation with the Public-Health Service in connection with an investigation of the pollution of that river.

CITY OF SAN FRANCISCO.

Stream gaging is in progress on Tuolumne River, in California, in cooperation with the city of San Francisco, in connection with the utilization of the water of that river, to be stored in the Hetch Hetchy Valley as a water supply for the city.

PUBLICATIONS.

The work of the water-resources branch during the year is represented by 15 water-supply papers and 6 advance chapters. Titles and brief summaries of these publications are given on pages 25–28. Thirty-three other publications were in press at the close of the year and five manuscripts were in hand awaiting editing.

DIVISION OF SURFACE WATERS.

ORGANIZATION.

The work of the division of surface waters consists primarily of the measurement of the flow of rivers. Incidental to this work special investigations are made relative to conditions affecting stream flow and its utilization. For this work the United States is divided into 14 districts, including Hawaii. Two of these districts were established during the year—(1) New Mexico and Arizona and (2) Washington—and the Alaska district was discontinued.

Each district office is supervised by a district engineer, assisted by a trained corps of engineering and clerical assistants. The following list gives the districts, the name of the district engineer, and the location of each district office and suboffice:

North Atlantic district: C. C. Covert, district engineer, Federal Building, Albany, N. Y.

Middle Atlantic district: G. C. Stevens, Washington, D. C.

South Atlantic and eastern Gulf district: Warren E. Hall, district engineer, Federal Building, Atlanta, Ga.

Ohio Valley district: A. H. Horton, district engineer, Federal Building, New port, Ky.[1]

Upper Mississippi River district: W. G. Hoyt, district engineer, Capitol Building, Madison, Wis.; suboffice, Old Capitol Building, St. Paul, Minn.

Upper Missouri district: W. A. Lamb, district engineer, Montana National Bank Building, Helena, Mont.

Rocky Mountain district: Robert Follansbee, district engineer, Chamber of Commerce Building, Denver, Colo.

Great Basin district: E. A. Porter, district engineer, Federal Building, Salt Lake City, Utah.

Idaho district: G. C. Baldwin, district engineer, Idaho Building, Boise, Idaho.

Oregon district: Fred F. Henshaw, district engineer, Couch Building, Portland, Oreg.

Washington district: G. L. Parker, district engineer, Federal Building, Tacoma, Wash.

California district: H. D. McGlashan, district engineer, Customhouse, San Francisco, Cal.; suboffice, Federal Building, Los Angeles, Cal.

Arizona and New Mexico district: G. A. Gray, district engineer, Capitol Building, Santa Fe, N. Mex.; suboffice, 610 North Sixth Avenue, Phoenix, Ariz.

Hawaiian district: G. K. Larrison, district engineer, Kapiolani Building, Honolulu.

CHARACTER AND METHODS OF WORK.

From the district offices field investigations incident to the work are made, and the results are sufficiently analyzed to insure that they are both accurate and complete. Places known as gaging stations are selected, at which sufficient measurements of discharge and other data are collected for determining the daily flow. At the end of the

[1] Office temporarily closed during later part of year; work conducted from Washington office.

year 1,371 gaging stations were maintained, exclusive of those in Alaska. During the year 445 stations were discontinued and 425 stations established. In addition records ready for publication were received for about 250 stations from other Government bureaus and private persons. Many of the stations are maintained in cooperation with other Federal bureaus, State organizations, or private persons.

The following table shows the distribution of the stations and measurements by States and also indicates the number of stations maintained by cooperating parties:

Report of gaging stations and cooperating parties for the year ending June 30, 1914.

State.	Geological Survey alone.	Reclamation Service.	Forest Service.	Indian Service.	Army engineers.	Weather Bureau.	Other Federal bureaus.	State cooperation.	Municipal cooperation.	Private persons.	Counted more than once.	Maintained at end of year.	Established during year.	Discontinued during year.	Regular gagings during year.	Miscellaneous gagings during year.
Alabama	....	....	....	....	1	....	....	5	....	.....	.....	6	3	5	4	.....
Arizona	....	5	....	4	2	....	....	18	....	.....	3	26	7	....	281	40
California	....	8	40	2	....	2	7	163	11	40	110	163	16	64	1,096	394
Colorado	....	2	42	....	....	1	....	13	....	4	2	60	9	23	302	8
Connecticut	1	....	....	....	....	....	....	.....	....	1	.....	2	1	....	8	.....
Florida	....	....	....	....	....	....	....	.....	....	.....	.....	.....	5	6	9	10
Georgia	1	....	....	....	....	4	....	.....	....	9	2	12	....	7	13	13
Idaho	....	7	15	10	....	2	....	66	1	36	44	93	10	32	573	65
Illinois	....	....	....	....	....	1	....	.....	....	.....	.....	1	....	....	.....	.....
Indiana	....	....	....	....	....	1	....	.....	....	.....	.....	1	....	....	5	1
Iowa	....	....	....	....	....	1	....	11	....	2	3	11	7	1	33	12
Kentucky	....	....	....	....	....	1	....	.....	....	.....	.....	1	1	....	1	2
Maryland	3	....	....	....	....	....	....	.....	....	.....	.....	3	1	....	11	.....
Massachusetts	....	....	....	....	....	....	....	12	....	2	2	12	1	1	84	6
Michigan	....	....	....	....	....	....	....	1	1	3	.....	5	1	3	2	1
Minnesota	....	....	....	....	....	2	1	36	....	3	5	37	14	20	174	3
Mississippi	....	....	....	....	....	....	....	.....	....	.....	.....	.....	....	1	.....	.....
Montana	16	56	16	7	....	1	2	26	....	3	1	126	1	8	540	31
Nebraska	....	....	....	....	....	....	....	13	....	.....	.....	13	7	6	.....	.....
Nevada	....	2	....	2	....	....	3	60	....	31	38	60	35	8	252	39
New Hampshire	....	....	....	....	....	....	....	.....	....	4	.....	4	....	....	7	.....
New Jersey	....	....	....	....	....	....	2	.....	....	.....	.....	2	....	....	1	.....
New Mexico	....	6	7	2	1	....	....	67	....	.....	15	68	17	11	696	247
New York	....	....	....	....	1	1	....	40	1	6	9	40	5	10	298	66
North Carolina	2	....	....	....	....	1	1	.....	....	9	1	12	3	1	21	.....
North Dakota	....	....	....	1	....	....	....	7	....	.....	.....	8	....	....	40	.....
Ohio	1	....	....	....	....	....	2	.....	1	.....	.....	4	2	1	4	3
Oklahoma	....	3	....	....	....	....	....	.....	....	.....	.....	3	....	....	7	.....
Oregon	2	7	2	4	1	3	1	38	4	43	3	[a] 102	47	55	376	179
Pennsylvania	....	....	....	....	....	....	3	.....	....	.....	.....	3	2	....	1	1
Rhode Island	....	....	....	....	....	....	....	.....	....	.....	.....	.....	....	1	.....	.....
South Carolina	....	....	....	....	....	....	....	.....	....	.....	.....	.....	....	1	.....	.....
South Dakota	....	1	....	4	....	....	....	.....	....	.....	.....	5	....	....	32	3
Tennessee	....	....	....	....	....	3	....	2	....	.....	.....	5	1	6	1	.....
Texas	....	4	....	....	....	....	....	.....	....	.....	.....	4	4	....	.....	.....
Utah	....	....	2	....	....	....	....	143	6	95	103	143	95	28	697	93
Vermont	....	....	....	....	....	....	....	10	....	2	2	10	2	4	48	.....
Virginia	9	....	....	....	....	....	1	.....	....	3	.....	13	....	....	25	.....
Washington	5	24	7	11	....	1	2	5	3	34	2	90	36	5	221	47
West Virginia	14	....	....	....	....	....	....	8	....	2	.....	24	3	1	35	.....
Wisconsin	....	....	....	....	2	1	....	42	....	12	15	42	36	2	265	7
Wyoming	....	6	....	....	....	....	4	2	....	5	1	16	8	....	40	22
Hawaii	....	....	....	....	....	....	....	116	....	25	.....	141	45	134	393	106
Total	54	131	131	47	8	26	29	904	28	374	361	1,371	425	445	6,596	1,399

[a] Total, June 30, 1913, should have been 110 instead of 97, 13 stations having been omitted.

The results of field data collected from the district offices are transmitted to the Washington office, where they are reviewed in the computing section and prepared for publication. This review not only

insures accuracy in the data but also brings the results from different parts of the country to a uniform standard. A regular field inspection is also maintained, whereby the standard of the work in the several districts is made uniform.

PUBLICATIONS.

The results of stream measurements are published in an annual progress report, divided into 12 parts. The following table gives the titles of these 12 parts and the numbers of the papers containing the data for each region during the last five years. Prior to 1913 the publication year had been made to coincide with the calendar year. Beginning with 1913, the seasonal or climatic year, October 1–September 30, has been adopted for reports on regions west of the Rocky Mountains and on the upper Mississippi and Ohio rivers, and in future reports for the whole country the records published will cover seasonal years.

Numbers of water-supply papers containing results of stream measurements, 1909–1913.

	1909	1910	1911	1912	1913
North Atlantic coast basins	261	281	301	321	351
South Atlantic coast and eastern Gulf of Mexico basins	262	282	302	322	352
Ohio River basin	263	283	303	323	353
St. Lawrence River basin	264	284	304	324	354
Hudson Bay and upper Mississippi River basins	265	285	305	325	355
Missouri River basin	266	286	306	326	356
Lower Mississippi River basin	267	287	307	327	357
Western Gulf of Mexico basins	268	288	308	328	358
Colorado River basin	269	289	309	329	359
Great Basin	270, [a] 271	290, [a] 291	310	330	360
California basins	271	291	311	331	361
North Pasific coast basins	272	292	312	332	362

[a] Great Basin in California, excepting Truckee and Carson drainage basins.

In addition to the regular progress reports, special reports on various hydraulic subjects have been completed for publication during the year, as indicated in the list given on pages 25–28.

DIVISION OF GROUND WATERS.

SCOPE OF WORK.

The main function of the division of ground waters is to make a survey of the waters that occur below the surface of the ground, with reference to their utilization. Certain areas are investigated each year, these investigations forming a part of a comprehensive plan that includes the entire country. In recent years the methods of work have been further standardized and special attention has been given to detailed surveys of the mineral character of the ground waters and to quantitative determinations of the underground supplies annually available in specific areas. Because of the great interest

throughout the West in irrigation with ground water and the prospects for important developments along this line, most of the work has been done in the arid and semiarid States and with special reference to irrigation.

The chemical and sanitary investigations, which are under the direct supervision of R. B. Dole, cover both surface and ground waters. During the year progress was made in the preparation of a comprehensive report on the quality of the surface waters of the United States by Mr. Dole, assisted by E. C. Bain. Mr. Dole also prepared the chapter on the production of mineral waters and a discussion of the radioactivity of mineral waters for the annual volume Mineral Resources of the United States.

Maps and manuscripts for geologic folios were reviewed and parts relating to ground waters were prepared.

During the year investigations of ground waters or quality of water were in progress in 19 States, as follows: Arizona, Arkansas, California, Connecticut, Florida, Georgia, Idaho, Kansas, Louisiana, Montana, Nebraska, Nevada, New Mexico, Oklahoma, Oregon, Texas, Utah, Washington, and Wyoming. The work in Arkansas, Florida, Georgia, and Texas was done in cooperation with the section of Coastal Plain investigations of the geologic branch, and the work in Idaho was done by the division of water utilization.

WORK BY STATES.

Arizona.—The report on the geology and water resources of Sulphur Spring Valley, Ariz., prepared by O. E. Meinzer, of the Federal Survey, in cooperation with R. H. Forbes and F. C. Kelton, of the State Experiment Station, was published as Water-Supply Paper 320.

Ground-water investigations, which for several years have been conducted for the Office of Indian Affairs in the Moki and Navajo reservations, in Arizona and adjacent parts of New Mexico and Utah, were continued during the year by H. E. Gregory, assisted by W. B. Emery and K. C. Heald. A report was submitted to the Commissioner of Indian Affairs on the results of the field work done in the summer of 1913, and much progress was made by Prof. Gregory in the preparation of a comprehensive report for publication as a water-supply paper, based on all the work that has been done in this region.

A few weeks was spent by A. T. Schwennesen in the San Simon Valley for the purpose of obtaining well data, measuring the flow and pressure of artesian wells, and collecting samples of well waters. This investigation, which is to be continued next year, is being conducted in cooperation with R. H. Forbes, director of the Arizona Experiment Station.

Arkansas.—The report on the geology and ground-water resources of eastern and northeastern Arkansas, by L. W. Stephenson and

A. F. Crider, with a discussion of the chemical character of the waters, by R. B. Dole, was completed by the authors.

California.—An investigation of the underground storage of flood water by artificial methods in the San Bernardino Valley, conducted by C. H. Lee, through cooperation with the California State Conservation Commission, was completed in the previous year, and the results were published in the report of the commission.

The report on California springs, by G. A. Waring, was completed and is in press.

The final report on ground water in the San Joaquin Valley, by W. C. Mendenhall, R. B. Dole, and Herman Stabler, has been delayed because of the heavy duties of two of the authors on the land-classification board, but it is now nearly finished. Progress has also been made by Mr. Mendenhall in the preparation of the San Jacinto report.

Ground-water investigations were continued in the Sacramento Valley by Kirk Bryan. The field work was nearly completed and good progress was made in the preparation of a report on this area. The analytical work was done by S. C. Dinsmore, of the Nevada Experiment Station and Food and Drug Commission, and G. H. P. Lichthardt, city chemist, Sacramento.

Progress was also made in the investigations of the Santa Clara Valley by W. O. Clark, and a report on the water supply of the Niles cone has been practically completed by Mr. Clark.

Since 1900 the Geological Survey has, at more or less irregular intervals, made measurements of the depth to water in certain wells in southern California. At the beginning of this fiscal year arrangements were made for the continuation of these measurements at regular intervals. The measurements this year were made by F. C. Ebert.

The sanitary condition of Yosemite National Park was investigated by Mr. Dole, and a report thereon, with recommendations for improvements, was submitted to the Secretary of the Interior.

Connecticut.—Investigations in Connecticut were continued in cooperation with the State Geological and Natural History Survey. A report on the Hartford, Stamford, Salisbury, Willimantic, and Saybrook areas, by H. E. Gregory and A. J. Ellis, was completed. Field work was done by Mr. Ellis in the Waterbury area and the Pomperaug Valley, and a report on the Waterbury area was nearly completed by him.

Florida.—The report on the geology and ground waters of Florida, by G. C. Matson and Samuel Sanford, prepared in cooperation with the Florida Geological Survey, was published as Water-Supply Paper 319. Progress was also made by R. B. Dole in the preparation of a report on the quality of the ground waters of Florida.

A report on some chemical characteristics of sea water at Tortugas and around Biscayne Bay, by Mr. Dole, was issued in publication 182 of the Carnegie Institution of Washington.

Georgia.—The report on the ground waters of the Coastal Plain of Georgia, by L. W. Stephenson and Otto Veatch, with a discussion of the chemical character of the waters by Mr. Dole, is in press as Water-Supply Paper 341. The investigation on which this report is based was conducted in cooperation with the Georgia Geological Survey.

Idaho.—Data on ground water in southeastern Idaho were collected by W. B. Heroy and V. E. J. Mayer for purposes of land classification. These data were filed with the land-classification board.

Kansas.—A brief investigation of the ground-water supply available for irrigation in the vicinity of Wichita was made by Mr. Meinzer in November, 1913, and a report thereon was published in February, 1914, as Water-Supply Paper 345–A.

Louisiana.—Sixty samples of water from the mouth of Mississippi River were analyzed by Mr. Bain and a report thereon submitted to the geologic branch. This work was done in connection with a study of the Mississippi Delta by E. W. Shaw.

Montana.—The report on the water resources of Butte was completed by Mr. Meinzer and will be issued as Water-Supply Paper 345–G.

The sanitary condition of Glacier National Park was investigated by Mr. Dole, and a report thereon, with recommendations for certain improvements, was submitted to the Secretary of the Interior.

Nebraska.—A brief investigation of the ground-water supplies available for irrigation in parts of southwestern Nebraska was made by N. H. Darton in the fall of 1913, and a short report on this area was published as a press bulletin under date of December 4, 1913.

Nevada.—The report on ground water in southeastern Nevada was completed by Everett Carpenter, and is in press as Water-Supply Paper 365.

Field work was done in the Big Smoky, Clayton, and Klondike valleys by Mr. Meinzer in September and October, 1913, and a report on this area was partly prepared. Analyses of water and soluble salts were made in connection with this investigation by S. C. Dinsmore.

New Mexico.—A preliminary report on ground water in Luna County was prepared by Mr. Darton and published as Water-Supply Paper 345–C. The final report on this area was also completed.

The report on the Tularosa Basin and adjacent areas, prepared by Mr. Meinzer, of the Federal Survey, in cooperation with R. F. Hare,

of the State experiment station, was sent to press and will be issued as Water-Supply Paper 343.

A number of pumping tests in the irrigated area of the Mimbres Valley were made by Mr. Schwennesen, in August, 1913, the results of which were published in Water-Supply Paper 345–C.

A ground-water survey of the southern part of Grant County, including the Animas, Playas, and Hachita valleys, was undertaken in cooperation with the State experiment station. The field work was completed, and at the close of the fiscal year work on the report was well advanced. The field investigations and the preparation of the report were assigned to Mr. Schwennesen, of the Survey, and the analytical work is being done by Dr. Hare, of the experiment station.

The report on the ground waters of the Moki and Navajo reservations, which is being written by Prof. Gregory, covers a part of northwestern New Mexico.

Oklahoma.—Brief examinations of the vicinity of Enid and of the valley of the North Fork of Canadian River near Oklahoma City were made by Mr. Schwennesen in January, 1914, to determine the practicability of developing irrigation supplies from underground sources, and reports based on this work were published as Water-Supply Papers 345–B and 345–D, respectively.

Oregon.—The report on the quality of the surface waters of Oregon, by Walton Van Winkle, which is based on an investigation conducted in cooperation with J. H. Lewis, State engineer of Oregon, was completed and sent to press as Water-Supply Paper 363.

Texas.—The work in Texas this year was confined to the Coastal Plain and was conducted in cooperation with the section of Coastal Plain investigations.

The report on the geology and ground-water resources of Texas east of Brazos River, by Alexander Deussen, was completed and sent to press as Water-Supply Paper 335.

A similar report on the area between Brazos and Guadalupe rivers, by Messrs. Deussen and Dole, is nearly completed. Other reports covering the section from Guadalupe River to the Rio Grande, by Messrs. Deussen, Stephenson, Matson, and Dole, are in progress. A report on the ground-water supply of La Salle, McMullin, and Dimmit counties, by Messrs. Deussen and Dole, was nearly completed.

Utah.—The report on ground water in Box Elder and Tooele counties, prepared by Mr. Carpenter, was published as Water-Supply Paper 333. The investigations that were conducted in the Moki and Navajo reservations include a part of southeastern Utah.

Washington.—The report on the quality of the surface waters of Washington, prepared by Mr. Van Winkle, in cooperation with the State Board of Health, is in press as Water-Supply Paper 339.

Wyoming.—The sanitary condition of Yellowstone National Park was investigated by Mr. Dole and a report thereon, with recommendations for certain improvements, was submitted to the Secretary of the Interior.

DIVISION OF WATER UTILIZATION.

The organization of the division of water utilization has been continued during the year as described in previous annual reports. E. C. La Rue and E. C. Murphy, hydraulic engineers, have performed the greater part of the field work involved in the examination of water-power withdrawals, rights of way, and Carey Act segregations. The work of examining land for designation under the enlarged-homestead act has been done in part by Mr. La Rue and Mr. Murphy and in part by W. B. Heroy, geologist, W. N. White, assistant classifier, and V. E. J. Mayer, junior clerk, in the land-classification board, who were detailed to the work during a portion of the field season. In addition to the routine field work of the division, Mr. La Rue has devoted several weeks to the preparation of a manuscript for publication relative to the present and probable future utilization of Colorado River for irrigation, power, and navigation; and Mr. Murphy has spent about three months in the field examination of the possibilities of water-power and reservoir development in Arizona in order that designation of lands valuable for such purposes may be made in accordance with the act of Congress admitting Arizona to statehood.

LAND-CLASSIFICATION BOARD.

GENERAL FEATURES.

The land-classification board has had no important changes in its personnel and its work has followed essentially the lines of the previous fiscal year. The energies of its staff have been devoted largely to the expeditious promulgation of public-land classifications based on the field work of the other branches of the Survey, the continuation of the cooperative correspondence with other bureaus of the department, by which the technical information in the Survey is rendered available in public-land administration, and the preparation of special reports of widely diverse character for various governmental organizations.

At the close of the year the board's staff contained 34 permanent employees, of whom 9 are geologists, 4 engineers, 3 draftsmen, 16 clerks, and 2 messengers.

SPECIAL FEATURES.

Among the items of particular importance in the work of the board during the year, the large volume of coal and phosphate classifications has a prominent place. More than 8,250,000 acres of lands withdrawn for coal classifications were classified and restored to

entry during the year and more than 1,400,000 acres additional were classified for early restoration. Nearly 1,300,000 acres of coal lands were appraised and were made available for purchase at the appraised prices. This work increases the total of appraised lands to more than 19,600,000 acres at the close of the fiscal year. The average price of the lands thus appraised is slightly less than $40 an acre.

Progress has also been made in the examination of withdrawn phosphate lands. Nearly 3,000,000 acres were included in withdrawals on July 1, 1913, and approximately 1,700,000 acres were examined during the fiscal year. The results of this examination will appear in extensive modifications of the outstanding withdrawals by large restorations and much smaller additional withdrawals.

An additional large element in the work of the board is the classification for the Office of Indian Affairs of somewhat more than 2,400,000 acres of lands in the various reservations. These classifications were based on the field work of the fiscal years 1912–13 and 1913–14, and were made at the request of the commissioner to assist in the proper disposition of the Indian lands.

Several special reports were prepared during the year upon power developments on the public domain and upon the interrelations of the companies engaged in the development of hydroelectric energy. Most of these special reports were prepared for the department, but a large body of data bearing on power developments and control was supplied to the Committee on Public Lands of the House of Representatives to assist it in its consideration of the Ferris water-power bill (H. R. 14893). These data have been published as Exhibit N of the hearings on this bill before the Committee on Public Lands, Sixty-third Congress, second session.

No new legislation providing for the disposition of the reserved coal, oil and gas, phosphate, or potash deposits of the public domain has been enacted during the year, but the outlook for such legislation was brighter at its close than at any time since the question has been seriously agitated.

These various factors of the board's activities are reflected in a measure in the volume of its correspondence. During the year 15,515 letters were referred to the board, and 19,356 reports, letters, and notifications were prepared by the board. This is an average of 52 incoming pieces of mail and about 64 outgoing pieces for each working-day—a record that is not substantially different from that of the preceding year.

COOPERATIVE CORRESPONDENCE.

In November, 1913, in order to expedite the disposition of cases in the department, the cooperative agreement between the General

Land Office and the Geological Survey, which forms the basis of the cooperative correspondence, was partly suspended. Although this partial suspension permitted the patenting of land to land-grant railroads and others without scrutiny as to its mineral character, it enabled the Geological Survey to dispose of practically all its accumulated cases by the close of the fiscal year.

The suspension did not affect cases involving withdrawn lands, cases already referred to the Survey, claims for small holdings, Santa Fe Pacific selections, Indian allotments, or cases in Alaska and California. These cases, together with those received between the opening of the fiscal year and the suspension of the agreement, aggregate 4,478 requests for information received during the year, and 2,711 field-service reports for action. The Survey furnished information in 7,628 cases and acted on 3,620 field-service reports, leaving 199 requests for information and 197 field-service reports pending. Thus the Survey is practically current in this work and should be able to keep current on the resumption of the agreement.

The following table shows the year's record in the several classes of cooperative cases, including those discussed more particularly under the work of the hydrographic and mineral divisions and including also enlarged-homestead petitions, which, while not cooperative cases, are sufficiently similar in the methods by which they are handled to be appropriately considered in the same connection.

Balance sheet of cooperative cases for the year ended June 30, 1914.

Class of cases.	Pending July 1, 1913.	Received.	Disposed of.	Pending June 30, 1914.	Gain (+) or loss (−).
Involving mineral character only:					
Land Office requests for information	60	223	271	12	+ 48
Land Office field-service reports	275	1,237	1,427	85	+ 190
Applications for reclassification, coal	15	16	31	0	+ 15
Applications for classification, coal	.....	43	40	3	− 3
	350	1,519	1,769	100	+ 250
Involving water resources only:					
Land Office requests for information	43	306	335	14	+ 29
Land Office field-service reports	16	85	85	16	0
Forest-reserve cases	28	63	89	2	+ 26
Applications for reclassification, power	19	46	52	13	+ 6
Right-of-way applications	58	503	451	110	− 52
Carey Act lists	0	19	19	0	0
Enlarged-homestead petitions	1,347	5,709	5,399	1,657	− 310
Desert-land proofs under irrigation projects	15	219	115	119	− 104
	1,526	6,950	6,545	1,931	− 405
Involving both mineral character and water resources:					
Land Office requests for information	2,611	3,055	5,529	137	+2,474
Land Office field-service reports	180	495	615	60	+ 120
Land Office requests for information as to water resources, accompanied by field-service reports as to mineral character	635	894	1,493	36	+ 599
Indian Office cases	319	1,278	1,562	35	+ 284
	3,745	5,722	9,199	268	+3,477
	5,621	14,191	17,513	2,299	+3,322

MINERAL CLASSIFICATIONS.

COAL.

The regulations governing the classification and valuation of coal lands approved by Secretary Fisher February 20, 1913,[1] have been in force during the fiscal year. Although not materially affecting the classification and valuation of the lignite-bearing lands as accomplished under the old procedure, these regulations have furnished a more rational basis for the classification and valuation of the lands containing coal of higher grade. This result has been attained mainly through the graded allowance for maximum workable depth with beds of different thicknesses and the decreased prices charged for lands underlain by thin coal beds.

Withdrawals and restorations.—The fiscal year has shown a notable decrease in the area of land included in outstanding withdrawals of coal lands, as the lands classified and restored have exceeded the area withdrawn during the year by over 8,250,000 acres.

Classifications.—Every effort has been made during the year to hasten the classification and appraisal of coal lands and to obtain information regarding the withdrawn areas which were believed to be largely noncoal lands, in order that these areas might be eliminated from the withdrawals. During the year over 1,350,000 acres were classified as coal land and over 8,335,000 acres were classified as noncoal land. The greater part of the area classified as coal land is in the region of the medium and low grade coals in northeastern Wyoming, eastern Montana, and North Dakota, although several small areas of high-grade coal in Utah, Colorado, and New Mexico have been examined and classified. No small part of the work has been the classification of lands in Indian reservations that were thrown open to settlement.

The following three tables summarize the withdrawals, restorations, classifications, and valuations by States during the fiscal year:

Coal land withdrawn and restored during year ended June 30, 1914, in acres.

State.	Outstanding July 1, 1913.	Withdrawals during fiscal year 1914.	Restorations during fiscal year 1914.	Outstanding June 30, 1914.
Arizona	118,718	.....	.....	118,718
California	239,903	.....	222,139	17,764
Colorado	5,037,721	11,520	302,578	4,746,663
Idaho	391,786	.....	53,334	338,452
Montana	16,051,915	.....	1,848,550	14,203,365
Nevada	83,833	.....	.....	83,833
New Mexico	5,738,847	11,044	200,008	5,549,883
North Dakota	15,921,287	.....	718,754	15,202,533
Oregon	26,561	.....	.....	26,561
Utah	6,431,963	.....	443,899	5,988,064
Washington	2,206,030	.....	825,102	1,380,928
Wyoming	6,615,221	.....	3,664,065	2,951,156
	58,863,785	22,564	8,278,429	50,607,920

[1] U. S. Geol. Survey Bull. 537, pp. 96–97, 1913.

Coal land classified to June 30, 1914, in acres.

State.	Classified prior to July 1, 1913.		Classified during fiscal year 1914.		Classified to June 30, 1914.		
	Coal.	Noncoal.	Coal.	Noncoal.	Coal.	Noncoal.	Total.
Arizona	.....	42,492	.....	.....	.....	42,492	42,492
Arkansas	60,715	70,038	.....	.....	60,715	70,038	130,753
California	8,720	6,242	.....	222,139	8,720	228,381	237,101
Colorado	3,345,831	8,826,559	27,558	275,020	3,373,389	9,101,579	12,474,968
Idaho	2,113	7,883,591	.....	53,334	2,113	7,936,925	7,939,038
Montana	4,664,050	17,198,654	180,596	1,711,552	4,844,646	18,910,206	23,754,852
Nevada	5,880	2,428	.....	.....	5,880	2,428	8,308
New Mexico	972,301	2,874,926	4,118	357,638	976,419	3,232,564	4,208,983
North Dakota	1,775,497	2,281,250	323,827	630,381	2,099,324	2,911,631	5,010,955
Oregon	12,146	1,047,063	2,775	.....	14,921	[a] 1,044,448	1,059,369
South Dakota	249,897	6,956,334	.....	.....	249,897	6,956,334	7,206,231
Utah	697,955	2,334,624	368,667	293,268	1,066,622	2,627,892	3,694,514
Washington	360	659,474	61,713	726,624	62,073	1,386,098	1,448,171
Wyoming	7,355,578	10,593,514	381,260	4,065,757	7,736,838	14,659,271	22,396,109
	19,151,043	60,777,189	1,350,514	8,335,713	20,501,557	69,110,287	89,611,844

[a] Decrease in noncoal area during fiscal year due to reclassification of 2,615 acres as coal land.

Valuation of coal lands.

State.	Appraised prior to July 1, 1913.	Appraised during fiscal year 1914.	Total outstanding appraised June 30, 1914.	Total valuation of appraised coal land.	Average value per acre.
	Acres.	*Acres.*	*Acres.*		
Arkansas	60,715	.....	60,715	$1,473,762	$24.20
California	7,720	.....	7,720	585,086	75.70
Colorado	2,844,202	27,718	2,871,920	168,490,129	58.60
Idaho	2,113	.....	2,113	51,824	24.50
Montana	4,550,945	180,676	4,731,621	116,710,126	24.60
Nevada	5,880	.....	5,880	117,600	20.00
New Mexico	953,772	4,695	958,467	21,257,857	22.10
North Dakota	1,775,497	323,827	2,099,324	34,062,345	16.20
Oregon	1,897	2,775	4,672	79,259	16.90
South Dakota	249,897	.....	249,897	2,756,427	11.00
Utah	670,272	378,229	1,048,501	44,316,401	42.20
Washington	40	60	100	3,200	32.00
Wyoming	7,180,509	381,420	7,561,929	387,401,682	51.20
	18,303,459	1,299,400	19,602,859	777,305,698	39.60

During the last year, as during preceding years, the sales of coal lands at valuations fixed under departmental regulations have continued as the lands have been required by the coal-mining industry. The policy of withdrawal and classification established in 1906 has had two principal effects: (1) It has largely put an end to the earlier prevalent practice of acquiring large areas of coal lands under other laws than the coal-land law; (2) it has practically stopped purchase under the coal-land law itself for idle speculative holdings. There is no indication, however, that those who really wish to establish mines hesitate to purchase at Government valuations. Indeed, many requests are received in the course of a year for the early valuation of lands in order that they may be purchased for development. The following table shows the sales made since June 30, 1899. The table is divided into two parts, one showing the sales during the 8 years preceding the adoption of the classification policy, the

other showing the sales for the 7 years since. Some of the figures in this table differ from those published in preceding annual reports because the earlier tables had been based on preliminary reports of sale furnished by the General Land Office or obtained from its records, and some of these preliminary figures differ from the final figures published in the annual reports of the commissioner. The table now presented is based on the official published figures of the commissioner except for the year ending June 30, 1914. Preliminary figures only are available for this year and they are subject to correction in later reports.

Sales and prices of coal land in United States, exclusive of Alaska, from July 1, 1899, to June 30, 1914.

Year.	Number of entries.	Area.	Amount.	Average price per acre.
Eight years prior to July 1, 1907.				
1900	82	11,401.91	$210,338.70	$18.45
1901	84	10,955.91	207,933.00	18.97
1902	88	12,575.46	174,683.30	13.89
1903	252	38,007.88	498,997.00	13.13
1904	190	28,827.42	395.209.90	13.74
1905	158	20,456.35	277,402.40	13.56
1906	244	42,143.39	538,683.70	12.78
1907	187	25,158.81	350,973.54	13.95
	1,285	189,527.13	2,654,221.54	14.00
Seven years since July 1, 1907.				
1908	303	44,821.12	636,663.18	14.20
1909	213	31,045.12	556,502.03	17.92
1910	248	38,325.26	772,325.41	20.15
1911	108	23,001.95	384,024.90	16.69
1912	68	9,053.34	430,767.58	47.58
1913	76	10,338.70	270,425.10	26.15
1914	71	9,306.33	307,487.95	33.04
	1,087	165,891.82	3,358,196.15	20.24
	2,372	355,418.95	6,012,417.69	16.91

Tables have been given in some preceding annual reports to show the number of acres sold and the prices realized since July 1, 1907. These tables, like the preceding tables, have been based on preliminary figures obtained from the General Land Office. These preliminary figures have differed, generally in minor degree, from the figures that finally appear in the reports of the General Land Office. The commissioner, however, does not publish detailed statements of the number of acres sold at each particular price, so that data are not available for correcting the preliminary figures, because there is no final compilation in this form. The following table therefore represents the preliminary figures furnished by the commissioner, showing by acres and prices per acre the sales during the year ended June 30, 1914, only:

Sales of coal lands at various prices during the fiscal year ended June 30, 1914.

Price per acre.	Area.	Amount.	Price per acre.	Area.	Amount.
$10	2,354.37	$23,543.70	$130	40.00	$5,200.00
15	120.00	1,800.00	135	80.00	10,800.00
20	4,435.19	88,703.80	140	201.20	28,168.00
25	872.61	21,815.25	240	40.00	9,600.00
28	40.00	1,120.00	250	80.00	20,000.00
30	201.01	6,030.30	260	80.00	20,800.00
32	80.00	2,560.00	275	40.00	11,000.00
34	40.00	1,360.00	280	40.00	11,200.00
50	400.46	20,023.00	300	40.00	12,000.00
55	40.00	2,200.00			
110	41.49	4,563.90		9,306.33	307,487.95
125	40.00	5,000.00			

Applications for classification and reclassification.—During the fiscal year the Survey received about 60 applications for the classification of withdrawn lands either as coal or noncoal land, and 16 applications for the revision of outstanding coal and noncoal classifications. Because many of these applications ask for noncoal classification in withdrawn areas regarding which the Survey has no detailed data, and because the evidence submitted by the applicant to show the noncoal character of the land has usually been of little value, few such requests have been granted. On the other hand, most of the applications for classification as coal land have related to lignite areas, and the applicants have been able to supply sufficient information to warrant the action requested. More than half of the applications for classification have been granted. The requests for reclassification have related mainly to the area of flat-lying lignite in eastern Montana where, because no coal is exposed on or near the land, claimants have been unwilling to accept the coal classification. Most of the applications of this character have been denied, only 3 out of 31 acted on having been granted.

OIL.

The classification of the public lands with reference to their prospective value for deposits of petroleum and natural gas was continued during the year in the States of California and Wyoming.

In California about 120,000 acres in Kern, Los Angeles, and Orange counties were withdrawn from entry, and a little less than 100,000 acres in Monterey, Fresno, and San Benito counties, which field examinations by the Survey have shown to be barren of valuable accumulations of oil, were restored. In Wyoming, on the basis of geologic evidence resulting from detailed field investigations, nearly 89,000 acres in Park, Hot Springs, and Washakie counties were included in petroleum reserves, and about 90,000 acres, principally in Crook County but including small areas in Lincoln and Bighorn counties, were restored. The following table shows the results of oil-land classification during the year:

Oil lands withdrawn and restored, fiscal year 1914, in acres.

	Outstanding July 1, 1913.	New withdrawals.	Restorations.	Outstanding June 30, 1914.
Arizona	230,400			230,400
California	1,388,080	120,647	98,283	1,410,444
Colorado	87,474			87,474
Louisiana	414,720			414,720
Utah	1,952,326			1,952,326
Wyoming	523,138	88,841	89,584	522,395
	4,596,138	209,488	187,867	4,617,759

Of especial interest during the year was the modification by Executive order of Petroleum Reserve No. 8 in Wyoming, to the extent of permitting exploration for natural gas on certain areas within the reserve. The recommendation of this action was based on an urgent appeal by residents of Greybull and Basin, Wyo., for immediate relief from a fuel famine which threatened those communities, and the exigencies of the situation amply justified the relief measures adopted. This case illustrates the needs of many other communities and the hampered position of legitimate operators who would satisfy those needs were legislative means provided whereby the oil and gas resources of the public domain might be sanely developed.

PHOSPHATE.

There has been no change in the procedure as regards classification of phosphate lands during the fiscal year. The regulations governing the withdrawal and restoration of phosphate lands have not been modified since they were adopted by the Survey on March 2, 1912. Deposits containing less than 30 per cent of tricalcium phosphate are considered nonmineral lands. Phosphate beds that are from 1 foot to 6 feet or more in thickness and contain 70 per cent or more of tricalcium phosphate are held to depths ranging from zero along the outcrop to the maximum of 5,000 feet in direct ratio to the variation of thickness of bed from 1 to 6 feet. For beds containing less than 70 per cent of tricalcium phosphate the depth limit varies from zero to the depth of a 70 per cent bed of any given thickness in direct ratio to the variation in tricalcium phosphate content from 30 to 70 per cent.

Phosphate classification during the fiscal year was restricted largely to the withdrawn areas in Montana and Wyoming, but some additional work was done in the Fort Hall Indian Reservation, in eastern Idaho. The results of these detailed examinations have materially modified the outstanding phosphate reserves. As shown in the report on this subject for 1912–13, the restorations during that year exceeded the withdrawals by more than a quarter of a million

acres, with a corresponding reduction of the area of outstanding reserves. Field examinations for the fiscal year 1913–14 have resulted in further large eliminations from the reserves and only minor additions to the outstanding withdrawals. Approximately 1,700,000 acres were examined, and when action has been taken on all the data obtained the resulting restorations will more than double those of 1912–13. The results of the phosphate examinations for the fiscal year, in so far as action has been taken, are set forth in the following summary:

Phosphate lands withdrawn and restored, fiscal year 1914, in acres.

State.	Outstanding July 1, 1913.	Withdrawals during fiscal year.	Restorations during fiscal year.	Outstanding June 30, 1914.
Florida	120,457	.....	80	120,377
Idaho	916,769	84,507	.....	1,001,276
Montana	274,861	34,114	187,277	121,698
Utah	107,745	.....	71,552	36,193
Wyoming	1,502,724	51,264	.....	1,553,988
	2,922,556	169,885	258,909	2,833,532

No phosphate examinations were made by the Survey in Florida during the year, but 80 acres were restored to entry and four of the outstanding reserves were modified so as to permit the issuance of patent to certain agricultural lands on which valid settlement had been made. Only vacant lands in the general phosphate region are included in the phosphate withdrawals in Florida, but in order to guard against unnecessary interference with settlement the homesteader who may desire to enter withdrawn land may submit properly authenticated evidence, setting forth the reasons which seem to him to show that the land is nonphosphate. If the tests and the information submitted to the Survey prove the nonphosphate character of the land, it is recommended for restoration.

It should be noted that under the act of Congress approved July 17, 1914 (Public No. 28, 63d Congress), any form of nonmineral entry or selection may be made upon lands withdrawn, classified, or reported as containing phosphate, nitrate, potash, oil, gas, or asphaltic minerals, the United States reserving the deposits for which the lands are reported valuable, with the right to prospect for, mine, and remove them. Thus lands valuable for these minerals are available for agricultural use, in the same way that coal lands have been so available since 1910.

POTASH.

Field work by the Survey in search of potash was continued during the fiscal year. As in previous years the work was largely of an exploratory character. It resulted in the withdrawal of 92,160 acres in the Black Rock Desert, Nev., and led to the restoration of some of the lands included in Potash Reserve No. 2, California No. 1.

The withdrawals and restorations are summarized below:

Potash lands withdrawn and restored, fiscal year 1914, in acres.

State.	Outstanding July 1, 1913.	Withdrawals during fiscal year.	Restorations during fiscal year.	Outstanding June 30, 1914.
California	94,407	.....	320	94,087
Nevada	39,422	92,160	.....	131,582
	133,829	92,160	320	225,669

METALLIFEROUS LANDS.

Withdrawals.—The only outstanding withdrawal of metalliferous land (the only one of its type that has been made) is Mineral Land Withdrawal No. 1, Arizona No. 1. The withdrawal covers an area in the Warren mining district, Bisbee, Ariz., and merely prevents the alienation under the nonmineral land laws of lands on which geologic conditions are believed to be favorable to the occurrence of deep-seated deposits of copper. Because of the depth of these deposits discovery and hence valid location will be difficult, and will depend on extensive drilling or deep shafting, and will require time. Meanwhile the lands in the withdrawn area are open to exploration and purchase under the mining laws, so far as they apply to metalliferous minerals, but are not subject to other forms of entry.

Classifications.—The act of February 26, 1895 (36 Stat., 683), made provision for classifying, with respect to their mineral or nonmineral character, the lands within the Northern Pacific Railroad grant in certain land districts in Montana and Idaho, the work to be done by commissioners appointed for the purpose. The classifications made in many areas were unsatisfactory, and a reclassification was provided for in the sundry civil act of June 25, 1910 (36 Stat., 703). At the request of the General Land Office the reclassification was made by the Geological Survey. Field examination of these lands was first undertaken by the Survey during the field season of 1910. The work was continued during the field season of 1911 and was completed in 1912, except on a few small tracts in Montana, which were examined in 1913. The results of the Northern Pacific classification work for the four years are shown in the following table:

Lands in Northern Pacific Railroad grant in Idaho and Montana classified by the United States Geological Survey, in acres.

State.	1910–11	1911–12	1912–13	1913–14	Total.
Idaho:					
Mineral	46,645	19,144	1,000	.....	65,789
Nonmineral	90,712	53,055	1,200	.....	144,967
Montana:					
Mineral	130,386	1,134	19,800	480	151,800
Nonmineral	21,802	83,981	65,570	7,696	179,049
Total:					
Mineral	176,031	20,278	20,800	480	217,589
Nonmineral	112,514	137,036	66,770	7,696	324,016
Grand total	288,545	157,314	87,570	8,176	541,605

Certain additional areas in Idaho, Montana, North Dakota, Oregon, Washington, and Wyoming were examined in the field.

Lands within the Flathead Indian Reservation, Mont.; Klamath Indian Reservation, Oreg.; Colville Indian Reservation, Wash.; Shoshone Indian Reservation, Wyo.; and Sullys Hill Park, N. Dak., were examined for the Office of Indian Affairs by the Survey in order to differentiate between the mineral and nonmineral lands as a basis for allotments and sales. The work in the Flathead Reservation was begun by the Survey during the field season of 1911, and continued during the field seasons of 1912 and 1913. The examinations in the Colville Indian Reservation were begun in 1912 and completed in 1913. The examination of the lands in the Shoshone Reservation was completed in 1913. The work in the reservations during 1913 resulted in the following classifications, all of which were promulgated during the fiscal year 1914:

Metalliferous classifications made during the fiscal year 1914, in acres.

State.	Mineral.	Nonmineral.	Total.
Idaho	.....	10,045	10,045
Montana	3,769	279,104	282,873
North Dakota	.....	779	779
Oregon	.....	1,193,033	1,193,033
Washington	143,284	774,191	917,475
Wyoming	.....	1,500,000	1,500,000
	147,053	3,757,152	3,904,205

HYDROGRAPHIC CLASSIFICATIONS.

WATER POWER.

Withdrawals and restorations.—The classification of the public lands with relation to their value in connection with water power was continued during the year, the withdrawals being made under the authority conferred by the two acts of June 25, 1910 (36 Stat., 847; 36 Stat., 858), and the act of August 24, 1912 (37 Stat., 497). On

July 1, 1913, the area included in outstanding withdrawals was 1,898,405 acres. During the year 183,612 acres additional were withdrawn and 90,400 acres previously included in power-site reserves were restored to the public domain. On June 30, 1914, the total area withdrawn in connection with water power was 1,991,617 acres.

The following table shows the action taken during the year and the areas outstanding, classified by States:

Power sites withdrawn, restored to entry, and outstanding, in acres.

State.	Outstanding July 1, 1913.	Withdrawn during fiscal year 1914.	Restored to entry during fiscal year 1914.	Outstanding June 30, 1914.
Alabama		120		120
Arkansas	17,704			17,704
Arizona	187,231	3,200		190,431
California	222,391	9,343	8,965	222,769
Colorado	254,620	15,930	160	270,390
Idaho	291,921	15,614	34,776	272,759
Minnesota	10,722	298		11,020
Montana	149,900	32,451	25,310	157,041
Nebraska		761		761
Nevada	15,667	3,420		19,087
New Mexico	13,577			13,577
Oregon	195,665	73,360	2,315	266,710
Utah	376,515	6,295	4,663	378,147
Washington	99,498	10,530	12,491	97,537
Wyoming	62,994	12,290	1,720	73,564
	1,898,405	183,612	90,400	1,991,617

Applications for reclassification.—At the beginning of the fiscal year 19 applications for the reclassification of lands included in power-site reserves were awaiting action and during the year 46 were received. Out of this total of 65 cases action was taken on 52, leaving 13 pending at the close of the year.

Right of way applications.—Departmental regulations of January 6, 1913, under the act of Congress approved March 4, 1911 (36 Stat., 1253, 1254), and of March 1, 1913, under the act of Congress approved February 15, 1901 (31 Stat., 790), charge the Geological Survey with important administrative duties in connection with applications for rights of way over the public lands for purposes relating to the development of water power. Such applications when received in proper form at the General Land Office are now forwarded to the Survey for consideration of such matters as relative priority of applications, incompatibility of works, relative beneficial utilization of resources, and the engineering and economic features involved in the applications and permits. If the approval of an application is found to be compatible with the public interest, a draft of agreement is prepared setting forth terms on which the use of the desired right of way is to be conditioned, and a report is made on the circumstances in the case.

In addition to applications for rights of way for hydroelectric development a large number of applications for rights of way of

other types are referred to the Geological Survey for consideration and report. These embrace applications for rights of way for railroads under the acts of March 3, 1875 (18 Stat., 482), and March 2, 1899 (30 Stat., 990), affecting public lands and Indian reservations, respectively, on which report is made as to whether or not the construction of the railroad will interfere with power or irrigation development on streams in the vicinity of the right of way; applications for rights of way under the act of March 3, 1891 (26 Stat., 1095), for irrigation uses on which report is made as to interference with power development, the feasibility of the project, and other features; applications for rights of way across national forests for mining, milling, and municipal purposes under the act of February 1, 1905 (33 Stat., 628); and a variety of miscellaneous applications for domestic, municipal, mining, and railroad water supply. The number of each type received and the action taken thereon is indicated in the following table:

Applications for rights of way.

Classes.	Pending July 1, 1913.	Fiscal year July 1, 1913, to June 30, 1914.		
		Received.	Acted on.	Pending June 30, 1914.
Railroad: Acts of Congress approved Mar. 3, 1875 (18 Stat., 482), May 13, 1898 (30 Stat., 409), Mar. 2, 1899 (30 Stat., 404), etc	19	119	108	30
Irrigation: Acts of Congress approved Mar. 3, 1891 (26 Stat., 1095), May 11, 1898 (30 Stat., 404), etc	18	237	239	16
Power: Acts of Congress approved Feb. 15, 1901 (31 Stat., 790), Mar. 4, 1911 (36 Stat., 1253, 1254), etc	21	63	31	53
Miscellaneous: Acts of Congress approved Jan. 21, 1895 (28 Stat., 635), May 11, 1898 (30 Stat., 404), May 21, 1896 (29 Stat., 127), Jan. 13, 1897 (29 Stat., 404), Feb. 15, 1901 (31 Stat., 790), Feb. 1, 1905 (33 Stat., 628), Mar. 4, 1911 (36 Stat., 1253, 1254), etc	.....	84	73	11
	58	503	451	110

The first application received from the Secretary's office was dated Oct. 11, 1909; from the General Land Office Nov. 11, 1909; from the Office of Indian Affairs Dec. 23, 1909.

IRRIGATION.

Reservoir withdrawals.—A number of reservoir sites, principally valuable for the storage of water for irrigation, have been investigated by the Geological Survey, and the land included therein withdrawn from entry on its recommendation. The area included in such withdrawals at the close of the fiscal year is shown in the following table:

Reservoir sites restored to entry during fiscal year 1914, in acres.

State.	Outstanding July 1, 1913.	Restorations during fiscal year.	Outstanding June 30, 1914.
Arizona	23,040	.....	23,040
Montana	15,640	.....	15,640
North Dakota	1,569	.....	1,569
Oregon	10,619	.....	10,619
South Dakota	8,542	.....	8,542
Washington	36,083	140	35,943
	95,493	140	95,353

Carey Act segregations.—During the year 19 proposed segregation lists under the Carey Act were received for report as to available water supply, general feasibility of plan of reclamation, and mineral character of the lands, and reports on all these lists had been submitted before the fiscal year closed.

Irrigation projects.—The Geological Survey, by the instructions of the Secretary of the Interior, dated March 15, 1913, furnishes to the Commissioner of the General Land Office all information at hand relative to the water supply available and the feasibility of irrigation projects, water rights or shares in which are presented as evidence of compliance with the requirements of the desert-land act. Such cases to the number of 219 were received during the year, and 15 were carried over from the preceding year. Of these, 115 cases were reported on and 119 were pending June 30, 1914.

ENLARGED HOMESTEADS.

Classification of lands under the enlarged-homestead acts of February 19, 1909 (35 Stat., 639), June 17, 1910 (36 Stat., 531), and June 13, 1912 (37 Stat., 132), was continued during the year, the provisions of these acts having now been extended to 12 western public-land States. Designations during the fiscal year have added a large acreage to that previously classified, the additional lands having been included as a result of investigations of surface and underground water supplies. The table following summarizes the work of the year:

Enlarged-homestead designations and cancellations, fiscal year 1914, in acres.

State.	Outstanding July 1, 1913.	Designations during fiscal year 1914.	Cancellations during fiscal year 1914.	Outstanding June 30, 1914.
Arizona	26,959,779	588,311	3,018,054	24,530,036
California	1,793	848,713	.....	850,506
Colorado	20,382,717	3,963,548	52,968	24,293,297
Idaho:				
Sections 1–5 only	5,542,238	1,683,841	32,859	7,193,220
Section 6	14,654	38,662	.....	53,316
Total	5,556,892	1,722,503	32,859	7,246,536
Montana	32,247,483	10,835,795	86,207	42,997,071
Nevada	49,503,509	349,365	3,548,941	46,303,933
New Mexico	17,907,739	1,330,532	192,275	19,045,996
North Dakota	130,502	8,252,142	2,880	8,379,764
Oregon	11,517,936	4,327,189	975,300	14,869,825
Utah:				
Sections 1–5 only	7,065,989	68,548	168,228	6,966,309
Section 6	1,200,686	16,540	120	1,217,106
Total	8,266,675	85,088	168,348	8,183,415
Washington	3,408,897	474,784	222,828	3,660,853
Wyoming	17,620,773	324,319	24,596	17,920,496
	193,504,695	33,102,289	8,325,256	218,281,728

The general provisions of the acts, which apply in all 12 States, permit the entry by one person of 320 acres of "nonmineral, nonirrigable, unreserved, and unappropriated surveyed public lands which do not contain merchantable timber." As a prerequisite to the allowance of such entry, the land must have been designated by the Secretary of the Interior as not being, in his opinion, "susceptible of successful irrigation at a reasonable cost from any known source of water supply." Under the provisions of section 6 of the acts of February 19, 1909, and June 17, 1910, applicable in Utah and Idaho, the Secretary may further designate lands which do not have upon them "such a sufficient supply of water suitable for domestic purposes as would make continuous residence upon the lands possible," and entrymen upon such lands are relieved of the necessity of residence.

Designations under the enlarged-homestead act are made either in large compact areas, as a result of field investigations covering districts of considerable size, or in small units, as a result of the requests of prospective entrymen. These requests are referred to as enlarged-homestead petitions, and because of the fact that the larger areas of land to which the acts are believed to be applicable have already been designated, the record of the year shows a large increase in the number of petitions received. The handling of the largely increased number of applications of this character has been made possible only by the adoption of additional labor-saving devices, the substitution of form post cards for typewritten letters, and the standardization

of office methods. The following table indicates the disposition made of petitions received during the year:

Action on petitions under enlarged-homestead acts during fiscal year 1914.

State.	Pending July 31, 1913.	Received.	Action taken.			Total acted on.	Pending June 30, 1914.
			All designated.	Part designated.	Refused.		
Arizona	6	104	81	10	11	102	8
California	4	213	121	7	23	151	66
Colorado	69	203	172	22	24	218	54
Idaho	305	1,049	695	49	129	873	481
Montana	195	1,733	1,149	93	67	1,309	619
Nevada	.....	6	5	1	.....	6	.....
New Mexico	43	143	115	10	19	144	42
North Dakota	604	1,171	1,578	47	83	1,708	67
Oregon	42	715	543	40	38	621	136
South Dakota	.....	6	.....	.....	6	6	.....
Utah	35	101	49	4	4	57	79
Washington	15	128	95	2	7	104	39
Wyoming	29	137	62	12	26	100	66
	1,347	5,709	4,665	297	437	5,399	1,657

A set of maps of the States affected, showing areas designated under the enlarged-homestead acts and the status of designations June 30, 1914, has been printed.

PUBLIC WATER RESERVES.

As information has become available, recommendations have continued to be made for the creation of public water reserves, in order that important springs and sources of stock water on the desert and semiarid range lands may remain accessible to the public. Additions amounting to 74,814 acres have been made during the year to reserves of this type. The action taken is summarized in the following table:

Public water reserves withdrawn and restored, fiscal year 1914, in acres.

State.	Outstanding July 1, 1913.	Withdrawn during fiscal year 1914.	Restored to entry during fiscal year 1914.	Outstanding June 30, 1914.
Arizona	1,200	.....	.....	1,200
California	94	43,430	.....	43,524
Colorado	.....	480	.....	480
New Mexico	.....	1,440	.....	1,440
Oregon	.....	2,500	.....	2,500
Utah	26,303	6,564	160	32,707
Wyoming	62,979	20,400	1,468	81,911
	90,576	74,814	1,628	163,762

PUBLICATION BRANCH.

BOOK-PUBLICATION DIVISION.

SECTION OF TEXTS.

During the year 47,751 pages of manuscript were edited and prepared for printing and proof sheets for 16,786 final printed pages were read and corrected. This work involved the handling of 4,574 galley proofs and 28,202 page proofs. The corresponding figures for 1912–13 were 38,191 pages of manuscript, 22,395 final printed pages, 4,877 galley proofs, and 38,864 page proofs. Indexes were prepared for 56 publications, covering 11,143 pages; the figures for the previous year were 55 publications and 14,942 pages. The list given on pages 13–31 shows the number, scope, and character of the reports issued during the year.

At the close of the fiscal year seven persons were employed in this section. The water-resources branch has continued to render special assistance in copy preparing and proof reading.

SECTION OF ILLUSTRATIONS.

The number of illustrations prepared was 3,068 and included 384 maps, 429 photographs prepared for reproduction, 490 diagrams and sections, 4 landscapes, 1,499 paleontologic drawings and photographs, and 262 miscellaneous.

The processes used for the reproduction of these illustrations, and the number reproduced by each process, were as follows: Chromolithography and photolithography, 261 subjects; halftone engraving, 928 subjects; zinc etching, 752 subjects; wax engraving, 50 subjects; cuts already engraved, 57 subjects. Proofs to the number of 2,179 were received and compared critically. Of these 287 were revises. The finished work representing all the illustrations furnished by contractors was examined. Engraved cuts to the number of 155 were reused during the year and electrotypes of 72 cuts were furnished to outside applicants.

At the close of the year material for illustrating 27 reports is on hand.

As in previous years, a cost record has been maintained covering the work prepared. This record shows from month to month a satisfactory earning capacity of the force. The personnel of the section at the close of the year consists of the chief of the section, 10 draftsmen (8 permanently employed and 2 temporarily), 1 under clerk, and 1 assistant map printer.

SECTION OF DISTRIBUTION.

The section of distribution received during the year 171 new books, 42 reprinted books, 5 geologic folios, 10 geologic maps, 86 new topographic maps, 6 revised maps, 11 photolithographs, and 190 reprints

of maps, a total of 521 publications. The total of all editions received was 475,925 books, 23,070 geologic folios, and 929,446 maps, a grand total of 1,428,441.

There were distributed 586,514 books, 64,543 folios, and 454,654 maps (including 338,253 maps, 59,075 folios, and 197 books sold), a total of 1,105,711, a notable increase in distribution of book publications, a decrease in sale of topographic maps, due to increase in price, and an increase in number of folios, sold at low price because of damage by fire.

The total amount received and turned into the Treasury as the result of sales of publications was $28,596.71. The proceeds of sales of topographic and geologic maps was $25,035.01, of topographic and geologic folios, $3,225.95, and of books $335.75. The amounts received from map and folio sales are essentially the same as for the previous year.

Sixteen persons were employed in this section during the year, and 90,930 letters were received and answered during that period.

DIVISION OF MAP EDITING.

SECTION OF GEOLOGIC MAPS.

This section continued in charge of George W. Stose, geologist, who directed the publication of the maps and illustrations of the geologic folios and critically reviewed all geologic maps intended for publication in other reports of the Survey.

Five folios (Nos. 188 to 192, inclusive), which are included in the list on pages 29–30, were published during the year, and one folio comprising the text and economic-geology maps of three folios (Placerville, Sacramento, and Jackson) now out of print was published as Folio Reprint 3, 5, and 11. The maps for the Belleville-Breese (Ill.), Columbus (Ohio), San Francisco (Cal.), Philipsburg (Mont.), and Van Horn (Tex.) folios were printed, and the folios will be published as soon as the descriptive texts can be printed. The maps of the Bisbee (Ariz.) folio have been reprinted and the folio will soon be reprinted, with slight revision and additions. The reprint of the Joplin folio was nearly completed, and the reprint of the Ann Arbor folio, with extensive revision, was well advanced.

The folios in course of publication and in preparation in this section are arranged in order of progress in the following list:

Joplin, Mo. (reprint) (No. 148).
Bisbee, Ariz. (reprint) (No. 112).
San Francisco, Cal. (five quadrangles) (No. 193).
Van Horn, Tex. (No. 194).
Belleville-Breese, Ill. (No. 195).
Philipsburg, Mont. (No. 196).
Columbus, Ohio (No. 197).

Ann Arbor, Mich. (reprint) (No. 155).
Eureka Springs-Harrison, Ark.
Castle Rock, Colo.
Silver City, N. Mex.
Galena-Elizabeth, Ill.
Colorado Springs, Colo.
Minneapolis-St. Paul, Minn. (four quadrangles).
Tolchester, Md.
Detroit, Mich. (five quadrangles).
Deming, N. Mex.
Herman-Morris, Minn. (four quadrangles).
Montevallo-Columbiana, Ala.
Bessemer-Vandiver, Ala.
Elkton-Wilmington, Md.-Del.
Bellefonte, Pa.
Sheffield-Sandisfield, Mass.
Pittsfield-Becket, Mass.
Cleveland, Ohio (three quadrangles).
Colchester-Macomb, Ill.
Leavenworth-Smithville, Kans.

Two draftsmen in addition to the geologist in charge are employed in the section.

SECTION OF TOPOGRAPHIC MAPS.

At the beginning of the year 194 atlas sheets and maps of special areas were on hand for publication. Of these, 1 map was withdrawn for additional field work and 5 incomplete atlas sheets have been combined each with an adjoining atlas sheet, leaving 188. The accessions during the year were 89, making a total of 277, of which 94 (89 new engraved sheets, 1 revised and reengraved sheet, and 4 three-color photolithographs) have been published. In addition to these maps 1 sheet has been revised, corrected, and published in a new edition, and 7 photolithographs of State maps have been published, making the total number of separate map publications for the year 102. The following statement shows the comparative status of map editing and publication on June 30 for four years past:

Progress of map publication for four years ended June 30, 1914.

	1914	1913	1912	1911
Published during the year	102	101	114	86
In process of engraving	69	89	65	56
Unedited	114	105	102	95

The manuscripts edited during the year comprise 75 topographic atlas sheets and other maps prepared for engraving, 4 detailed topographic sheets for photolithography in three colors, 3 State maps on scale of 1:500,000, 148 sheets of plans and profiles of 17 rivers, corrections for 138 engraved maps about to be reprinted, and 242 maps

for illustration of 42 Geological Survey reports. The proof read comprises 89 new topographic maps, corrections to 54 old maps, the 9-sheet contour map of the United States, and 2 maps reproduced under contract. The index maps for 17 circulars of the series 9–323 were revised during the year and all printed but 3, which are now in press. Revised lists of topographic maps were prepared as copy for a new edition of the pamphlet "Topographic maps and folios and geologic folios."

Six men were employed in this work continuously, except that the editor of topographic maps was engaged in topographic field work for two months.

DIVISION OF ENGRAVING AND PRINTING.

MAPS AND FOLIOS.

During the fiscal year 89 topographic maps were engraved and printed; 2 topographic atlas sheets were corrected after field revision and new editions printed; and 7 State maps, scale 1:500,000, and 4 three-color topographic maps were photolithographed and printed during the year, making the total number of new maps and new editions printed 102.

The work on hand July 1, 1913, involving extensive corrections to maps of areas in Alaska and also the United States 9-sheet map, was completed during the present year.

Corrections were engraved upon the plates of 154 sheets (including 138 for reprinting editions and 16 for various purposes). Of those corrected for reprinting and including new maps (engraved and photolithographed) 301 different editions were printed and delivered to the map room. This is a decrease of 77 editions and 287,994 copies of regular office maps from the previous year.

Five new geologic folios and one reprint folio were published during the year, which is two more than the number published in the preceding year, and of the number published this year, two are double folios. Octavo editions of two of this number and of one folio reported last year were published during the present year. Editions and partial editions of folios and octavos amounting to 28,230 copies were printed and delivered. This is an increase of 9,684 copies during the year.

CONTRACT ENGRAVING AND PRINTING.

For the Government Printing Office the following items were printed and delivered: Illustrations for the annual report of the Isthmian Canal Commission; annual report of the Chief of Engineers United States Army; annual report of the Commissioner General of Immigration; annual report of the War Department, volume 2; annual report of the Governor of Hawaii; annual report of the Superintendent of the Coast and Geodetic Survey; annual report of

the Commissioner of Indian Affairs; Census report, population, volumes 1–3; report of the Commissioner of Fisheries, 1911, and special papers; Census report, Agriculture, Part I; special publication No. 16, Coast and Geodetic Survey; technical paper No. 50, Bureau of Mines; Report on lumber industry, Part II, map of Idaho; Report on education of the natives of Alaska; Ordnance pamphlet No. 132, Navy Department; hearings, Paint Creek mining district, W. Va., Part II; report of the Commissioner of Corporations on water-power development in the United States; report of the Commissioner of Corporations on the lumber industry, Part III; report of the Commissioner of Corporations on transportation by water in the United States, Part III, Water terminals; Bulletin No. 54, Department of Agriculture; Bulletin No. 114, Department of Agriculture; American Ephemeris and Nautical Almanac, 1917; Statistical atlas, 1910; Bureau of the Census; separate chapters from Census report, volume 5, Agriculture, general report and analysis; Physical investigations of New York lakes, Bureau of Fisheries; 11 House documents; illustrations for Geological Survey Bulletins 528, 531–F, 531–I, 536, 538, 541–A, 541–D, 541–F, 541–H, 546, 547, 549, 550, 551, 552, 575, 579, Water-Supply papers 305, 335, 341, 358, and The stone industry in 1912, advance chapter from Mineral Resources. In addition, the following separate illustrations were printed and delivered to the Government Printing Office: Diagrams of two bird reservations, one national monument, and two reservations for use of natives of Alaska; panoramic view of Crater Lake National Park; Ringlemann's scale for grading the density of smoke; map of the United States by counties; map showing origin of the scenic features of Glacier National Park; relief map of Yosemite National Park; map showing glaciers of Mount Rainier National Park; map showing glaciers of Glacier National Park; cross-section paper (General Land Office); maps of 48 States; forest atlas conventional township sketching (Forest Service).

The following work was done for other Government departments and bureaus: For the Forest Service, maps of 17 national forests, 7 fire folder and tourist maps, 12 proclamation diagrams of national forests, 13 enlargements of field sheets, map of national forests, district No. 2, maps of national forests, districts Nos. 3 and 5, 9 maps of rivers showing hydroelectric development, and other miscellaneous work; for the General Land Office, 1,516 township plats, 753 mineral and homestead plats, two State maps showing homesteads, and map of Powell town site; for the Office of Indian Affairs, maps of three Indian reservations and lookout station protractor. Work was also done for the Reclamation Service, Interstate Commerce Commission, District of Columbia, Department of Justice, Bureau of Mines, Isthmian Canal Commission, Navy Department

(Bureau of Steam Engineering), Post Office Department, Army Service Schools, Engineer School (United States Army), Coast Artillery School, United States National Museum, Bureau of Standards, United States and Canada Boundary Survey, Alaska Boundary Survey, Army War College, Bureau of Soils, Alaskan Engineering Commission, Department of the Interior, and Weather Bureau.

In addition to the above, a large amount of miscellaneous work was done for other divisions and branches of the Survey. This work for various branches of the Government, including work done for other divisions and branches of the Survey, amounted to about $65,000, for which the division was reimbursed by transfer of credit on the books of the United States Treasury.

Work was also done for the city of Rochester, Columbia Planograph Co., Julius Bien Co., Edward T. Miller Co., Lord Baltimore Press, Bailey Willis (Argentine Government), Norris Peters Co., Isaac Markens, Geo. W. Bromley & Co., Harvard Cooperative Society, and Stecher Lithographic Co., and the money received in payment for the work, amounting to about $100, was turned into the Treasury of the United States to be credited to miscellaneous receipts. Under cooperative agreements, transfer impressions were furnished without charge to the State surveys of New York, West Virginia, Kentucky, Illinois, and Maryland.

Of contract and miscellaneous printing of all kinds, the total number of copies delivered was 1,792,420, which required approximately 2,150,000 printings. The total number of copies printed, including topographic maps and geologic folios, was 2,758,893, requiring approximately 7,300,000 impressions. On requisition of the Government Printing Office, 296 transfer impressions were made and shipped to contracting printers.

INSTRUMENT SHOP.

The work of the instrument shop consisted of repairs on surveying, drafting, engraving, stream-gaging, and other instruments both for the Geological Survey and the Reclamation Service and General Land Office, and the making of copper plates and electrotypes. More than 2,400 repairs and overhauls were made, 75,966 square inches of new copper plates were made, 4,284 square inches were resurfaced, and 1,428 square inches of electrotypes were made.

PHOTOGRAPHIC LABORATORY.

The output of the photographic laboratory included 16,123 negatives, of which 9,069 were dry, 3,568 were wet, 4,355 were photolithographic, and 846 were paper; 3,539 zinc plates; 258 zinc etchings; 293 celluloids; and 27,874 prints, of which 14,952 were maps and diagrams and 22,922 were photographs for illustrations.

ADMINISTRATIVE BRANCH.

EXECUTIVE DIVISION.

The work in the executive division was of the same scope as in other years.

Mails, files, and records.—During the year 146,903 pieces of mail were opened and referred. Of this number, 2,387 were registered. In addition, 108,599 letters were received direct by the other divisions—a total of 255,502 for the Survey, an increase of 8 per cent compared with the total number of letters received during the fiscal year 1913.

Of the letters opened in this division, 26,691 contained remittances for Survey publications, a decrease of 5 per cent compared with the number of similar letters received during the last fiscal year, and the amount of money received, $29,805.73, shows a decrease of $254.47 compared with that received during 1913.

The recording, referring, and filing of correspondence required practically the entire services of five clerks. The number of letters mailed through the division was 121,401, an increase of about 21.5 per cent over the preceding year. This number does not include the outgoing registered mail, which numbered 15,995 pieces, or 228,593 pieces of letter mail sent direct from the other divisions—a total of 365,989 for the Survey, an increase of 20 per cent over the total number sent in 1913.

Personnel.—The roll of those holding Secretary's appointments numbered at the close of the fiscal year 891, compared with 893 at the close of the fiscal year 1913. The total number of changes in the personnel for the year was 604, which included original appointments, separations, promotions, extensions, and changes of status of every description. Of these, 162 were new appointments, 164 were separations, 231 were promotions, and 3 were reductions.

During the year 12,984 days of annual leave and 2,138 days of sick leave were granted, being 58 per cent of the amount of annual leave and 10 per cent of the amount of sick leave which it is permissible to grant under the law; also there were granted 3,460 days of leave without pay.

Express and freight.—During the year 4,187 pieces of freight and express were handled, of which 1,047 were outgoing and 3,140 were incoming. The number of pieces of freight and express handled shows an increase of about 7 per cent over the number handled during the fiscal year 1913. There were 441 transportation accounts checked during the year.

Stationery.—There were 4,874 requisitions filled from stock in the stationery room during the fiscal year 1914.

DIVISION OF ACCOUNTS.

A condensed statement covering the financial transactions of the fiscal year is given below, including disbursements up to September 30. The unexpended balances of that date largely represent outstanding obligations.

Amounts appropriated for and expended by the United States Geological Survey pertaining to the fiscal year ended June 30, 1914.

Title of appropriation.	Appropriation.	Repayments.	Available.	Disbursements.	Balance.
Salaries, office of Director	$35,340.00	.....	$35,340.00	$35,150.50	$189.50
Salaries, scientific assistants	29,900.00	.....	29,900.00	29,872.18	27.82
Skilled laborers, etc	20,000.00	.....	20,000.00	19,994.16	5.84
Gaging streams, etc	150,000.00	$26,261.38	176,261.38	175,058.45	1,202.93
Chemical and physical researches	40,000.00	91.60	40,091.60	37,191.71	2,899.89
Preparation of illustrations	18,280.00	.....	18,280.00	18,278.01	1.99
Mineral resources of United States	75,000.00	219.10	75,219.10	74,610.05	609.05
Geologic maps of United States	110,000.00	55,777.50	165,777.50	159,443.45	6,334.05
Books for the library	2,000.00	.....	2,000.00	1,973.92	26.08
Topographic surveys	350,000.00	4,490.12	354,490.12	351,489.67	3,000.45
Geologic surveys	300,000.00	49,381.20	349,381.20	340,867.38	8,513.82
Mineral resources of Alaska	100,000.00	316.28	100,316.28	98,340.05	1,976.23
Surveying national forests	75,000.00	.....	75,000.00	74,188.28	811.72
Replacing articles destroyed by fire	50,000.00	.....	50,000.00	45,525.68	4,474.32
Reimbursements for loss of personal property	80.16	.....	80.16	80.16	.....
	1,355,600.16	136,537.18	1,492,137.34	1,462,063.65	30,073.69

The following table gives the classified expenditures by the Survey for the fiscal year:

Classification of expenditures by the United States Geological Survey pertaining to the fiscal year ended June 30, 1914.

Appropriation.	Total.	Salaries and wages.	Transportation of persons.	Transportation of things.	Subsistence and support of persons.	Subsistence and care of animals.	Communication service.	Printing, engraving, lithographing, etc.	Furnishing heat, light, power, etc.	Special and miscellaneous service.	Materials.	Stationery, drafting, etc., supplies.
Salaries, office of the Director	$35,150.50	$35,150.50										
Salaries, scientific assistants	29,872.18	29,872.18										
Skilled laborers, etc	19,994.16	19,994.16										
Gaging streams, etc	175,058.45	127,462.14	$15,764.92	$1,099.96	$8,135.25	$588.57	$627.84	$2,063.12		$1,646.14	$2,631.41	$1,479.28
Chemical and physical researches	37,191.71	29,638.15	1,740.82	251.50	1,041.86	22.25	67.85	114.09	$264.00	207.97	147.10	585.99
Preparation of illustrations	18,278.01	17,275.39	14.05	2.10	11.50		14.42	728.97		16.50	2.92	91.09
Mineral resources United States	74,610.05	66,934.50	2,492.63	138.66	1,675.61	10.10	665.07	575.32		544.19	238.20	468.32
Geologic maps	159,443.45	124,335.19	145.06	33.57	130.80		70.69	1,282.66	2,072.13	1,680.47	5,053.62	19,331.15
Books for the library	1,973.92			8.09								
Topographic surveys	351,489.67	237,824.83	27,221.05	3,549.62	41,962.58	10,962.27	809.58	3,916.15		1,504.30	1,450.63	1,048.99
Geologic surveys	340,867.38	272,704.19	22,019.03	3,644.35	15,601.87	5,437.42	596.68	5,193.01	124.80	2,320.47	417.84	1,364.60
Mineral resources of Alaska	98,340.05	62,765.22	14,278.69	3,374.96	3,817.00	303.18	111.50	997.61		415.82	292.80	681.02
Surveying national forests	74,188.28	48,974.56	3,852.40	647.01	9,723.56	4,588.62	57.25	627.48		424.65	336.35	192.76
Replacing articles destroyed by fire	45,525.68	4,126.58	56.70	14.34	48.60	.15	.82	39.38		47.26	1,660.41	12,873.05
Reimbursements for loss of personal property	80.16											
	1,462,063.65	1,077,057.59	87,585.35	12,764.16	82,148.63	21,912.56	3,021.70	15,537.79	2,460.93	8,807.77	12,231.28	38,116.25

Appropriation.	Fuel.	Mechanic's, engineer's, etc., supplies.	Cleaning and toilet supplies.	Wearing apparel.	Forage and other supplies for animals.	Provisions.	Ammunition and explosives.	Special and miscellaneous supplies.	Equipment (including live stock).	Structures (bench marks).	Awards for losses.	Rent.
Gaging streams, etc	$134.28	$79.84	$15.43	$323.00	$289.99	$375.00	$6.95	$78.85	$9,516.48			$2,740.00
Chemical and physical researches	250.94	13.48	3.48	2.75	97.37	156.09	.48	.75	2,412.29			172.50
Preparation of illustrations								3.11	117.96			
Mineral resources United States	1.83	2.38	3.30		12.42	1.42		9.13	406.12			430.85
Geologic maps	433.14	359.70	430.36	22.56				262.83	3,799.52			
Books for the library									1,935.83			
Topographic surveys	175.65	109.86	51.43	23.85	4,196.80	1,086.19	.70	23.57	13,809.56	$1,590.23		171.83
Geologic surveys	101.40	77.60	55.30	43.12	1,899.26	4,978.92	27.25	197.98	4,051.29			11.00
Mineral resources of Alaska	398.80	23.42	17.38	30.70	863.23	3,404.55	81.99	48.71	6,433.47			
Surveying national forests	40.05	11.30	8.75	94.45	1,898.86	87.83	2.15	4.40	2,553.85			62.00
Replacing articles destroyed by fire		18.30	.97					2.95	26,636.17			
Reimbursements for loss of personal property											$80.16	
	1,536.09	695.88	586.40	540.43	9,257.93	10,090.00	119.52	632.28	71,702.54	1,590.23	80.16	3,588.18

LIBRARY.

The growth of the library has continued at about the usual rate. In all, 13,229 publications were received, including books, pamphlets, periodicals, and maps. This number comprises the gifts, exchanges, and purchases. Practically all the important new literature of geology has been obtained and such other publications as are required in the Survey work. From the exchanges a number of valuable books and papers have been received; and the library is indebted to many members of the Survey, besides other friends, for generous gifts of books and separates.

Current receipts are catalogued to date, and in addition steady progress has been made in completely cataloguing certain of the older sections for which only temporary entries were in the catalogue. These sections are as follows: Geological surveys of Switzerland and Tasmania completed; geological surveys of Italy, Belgium, Cape of Good Hope, Egypt, Natal, Portugal, and Spain; Academy of Sciences, St. Petersburg, Mémoires, seventh series; serials (periodicals and scientific transactions) of Central America, Mexico, South America, and the West Indies; miscellaneous periodicals (over 52 sets); and sections of general geology (elementary and older books), dynamic geology, structural geology, glaciers, historical geology, and petroleum. In all, 6,443 books, pamphlets, and maps were catalogued, and 9,548 cards were added to the catalogue, and 1,042 titles were furnished to the Library of Congress for printing.

A large number of interlibrary loans were made, and many students and specialists have availed themselves of the library facilities. The number of readers in the library during the year was 7,943; 8,694 books and maps were lent for use outside. Some progress has been made in cataloguing the older maps in the library, and Henry Gannett has continued to supervise the map collection and to devote a portion of his time to the correspondence which calls for information from the maps.

The bibliography of North American geology for 1912 was completed and published as Bulletin 545. The bibliography for 1913 has been completed and is in press as Bulletin 584.

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