

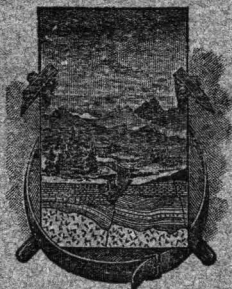
DEPARTMENT OF THE INTERIOR  
UNITED STATES GEOLOGICAL SURVEY  
GEORGE OTIS SMITH, DIRECTOR

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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



WASHINGTON  
GOVERNMENT PRINTING OFFICE

1913

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# THIRTY-FOURTH ANNUAL REPORT OF THE DIRECTOR OF THE UNITED STATES GEOLOGICAL SURVEY.

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GEORGE OTIS SMITH, *Director.*

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The appropriations for the work of the United States Geological Survey for the fiscal year 1912-13 comprised items amounting to \$1,497,920. 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.

### SCOPE OF WORK.

The detailed statement which forms the greater part of this administrative report indicates the nature and extent of the public work performed by the Geological Survey. While in response to public opinion as expressed by Congress, both at the time of the Survey's creation and in recent years, and to the necessities of public-land administration, the greater emphasis has been properly placed upon the work relating to the public domain, yet the activities of this bureau cover the whole country. In the matter of geologic investigation field work was done last year in 45 States and in Alaska, while general studies were continued that have no definite geographic limitations. Topographic mapping was continued in 26 States, the District of Columbia, Alaska, and Hawaii, and the investigation of water resources included the gaging of streams in 42 States, Alaska, and Hawaii, work on underground waters in 19 States, and engineering studies of water utilization on the public lands. Add to this the statistical inquiries covering every mineral product and addressed to about 62,000 producers, with the accompanying study of the nature and extent of the mineral resources upon which the mineral industry depends, and it will be seen that the Geological Survey is in close touch with the physical development of the whole country.

Another measure of the activities of the Geological Survey as a field service may be afforded by the statement that during the year 378 field men of the regular staff, geologists and topographic and

hydraulic engineers, were engaged in field examinations and investigation for longer or shorter periods. This figure does not include an even larger number of temporary assistants.

It follows that the Geological Survey is essentially a field service, and its policy and procedure in the public work intrusted to it are based on recognition and appreciation of field conditions. Practically every officer having large administrative responsibilities connected with its field operations has been connected with the service for at least a score of years and has worked in every grade of field position. This constitutes perhaps the largest factor in the determination of the policy and standards controlling the work of the Geological Survey.

#### GROWTH OF WORK.

During the last six years the field investigations of the Survey and the office work connected therewith have shown remarkable growth. Notwithstanding the fact that within that period the former technologic branch of the Survey has become an independent organization, the Bureau of Mines, the older bureau is larger now than it was six years ago.

In personnel the net growth since 1907 has been about 37 per cent; in general correspondence the number of incoming letters now exceeds that of 1907 by 43 per cent; the total distribution of reports and maps has increased 23 per cent, the increase in maps sold being even larger, 25 per cent; and the total cash receipts from sales of publications are larger by 60 per cent than in 1907. In the matter of total printed pages in the published reports there has also been a notable increase, though it is impossible to state this exactly by reason of changes in measure of page and size of type.

During this period, however, notwithstanding these gains in every particular that can be stated statistically, there has been a net loss in annual appropriations. The \$350,000 appropriated in items under the technologic branch in 1907 has been only in part replaced by increased amounts now appropriated in other items, although the net loss is also in part offset by increased cooperation by the States in the field work of this Federal service. Thus the fact becomes apparent that in spite of a large measure of growth in public demands, as proved by the increase in correspondence and in distribution of publications, especially in publications sold, there has been no increase in the total appropriations available for sustaining the work of this bureau.

If the most recently organized branch of the Survey, the land-classification board, is taken, even more noteworthy items of growth can be cited for a single year. With the board's work largely increased in every line of activity, the formal land-classification reports

prepared for a single bureau, the Office of Indian Affairs, show for 1912-13 an increase in number of 20 per cent over the previous year. The letters received in the land-classification board increased 32 per cent, and the outgoing letters 70 per cent. It is not surprising that the files of this branch doubled in volume this last year.

The fact that more public work is being performed without corresponding increase in expenditure is unmistakable evidence of efficiency and economy. Efficiency in the public service is the end sought by an increasing number of administrative officers throughout the departmental service. The constant and painstaking effort of responsible chiefs and clerks in all grades is to make the largest returns to the public for the money appropriated by Congress. The motive of public service is often as effective in these kinds of Government work as the incentive of personal gain in private enterprise.

Because of this increasing pressure of official work, overtime service has become almost habitual in many of the divisions of the Survey. Of the scientific members of the organization, several will be found working at their desks every evening during the winter, often until midnight, so that many of the geologists and others average at least 10 per cent overtime. In the clerical force, where there is the same devotion to duty but possibly not the same personal interest in the work, the record is no less creditable in the amount of voluntary and, indeed, volunteered service. In one group of clerks, for instance, the overtime throughout the year averages about 5 per cent; in another group the average is 7 per cent, the extra time reaching 9 per cent in one of the winter months. In another section an extra hour a day is required of the whole force during periods of a week or more when the demands from the public are especially heavy, the time of service showing, for instance, an increase of 20 per cent in a single month. The library is regularly kept open an extra hour during the winter to facilitate its use in connection with the official scientific work.

Another gratifying evidence of devotion to work is furnished in the records of attendance. Usually an average of only two-thirds or less of the total annual leave permissible under the law is taken by Survey members, while 10 to 14 per cent is the average sick-leave record ( $12\frac{1}{2}$  per cent this last year). In the field work of the Geological Survey the men know no official hours; they regulate the length of the working day only by the season, and even after darkness has fallen there may be several hours of accounting and clerical work in the tent before the chief of party or his principal assistants turn in for the night.

In connection, however, with this matter of overtime work and what may be considered a maximum output, it is believed that the limit has been reached and that a crisis now faces the work in charge

of this bureau. The activities imposed by Congress upon the Geological Survey have been increasing faster than the appropriations provided therefor, until now it is all too apparent that the organization is undermanned and underequipped. Overtime work under adverse conditions is, as already stated, evidence of enthusiastic loyalty to the public service, but the strain is cumulative and the organization is bound soon to weaken, while both the quality and the quantity of the product must plainly suffer unless more adequate appropriations are voted by Congress. The demand upon the Survey for more work can not be checked, but the means to meet the demand can be provided.

#### LIMITATIONS UPON EFFICIENCY AND ECONOMY.

In the Geological Survey, as in other bureaus of the Government, the endeavor to administer public funds economically is distinctly hampered by statutory and other limitations. In the thirty-third annual report detailed mention was made of the loss of efficiency, as well as danger to life and property, resulting from the crowding of a large office force and a great accumulation of technical records in utterly inadequate quarters. Since that report was published Congress has authorized the erection of an office building of modern type to accommodate the Geological Survey, Office of Indian Affairs, Reclamation Service, Bureau of Mines, and other offices of the Department of the Interior, with a cost limit, exclusive of site, of \$2,596,000. On June 13, 1913, the Secretary of the Treasury included in the current deficiency estimates an item of \$25,000 to provide for technical and engineering services in the Office of the Supervising Architect in preparing plans for the building and for beginning its construction. It is to be noted that the same estimates include an item of \$99,261.83 to replace property and equipment destroyed by the fire of May 18, 1913, in the basement of the building now occupied by the Survey.

Another efficiency limitation of quite a different type from that imposed by inadequate and dangerous quarters is presented in the restrictions placed in one way or another upon the selection of personnel. Under "lump-sum" appropriations there is a fair opportunity to obtain high-grade service in the scientific and technical positions, yet even here the restraining influence of precedent prevents attaching to the higher positions salaries that are more than a fraction of those which the well-trained specialists best fitted for those positions can obtain for similar work in the service of corporations. This condition has resulted in many of the members of the Geological Survey leaving Government service at the time when they have become most valuable as public servants. Thus in the four and one-half years ending January, 1913, 41 geologists left the Government service

for the primary purpose of bettering their financial condition, and these men are known to have received salaries outside of the public service amounting to an average immediate advance of 149 per cent, or practically two and one-half times the salaries paid them by the Geological Survey.

The only optimistic view to take of this condition, whereby some of the better men are constantly resigning in every branch of the bureau, is to count this loss to the Survey as one measure of the educational contribution that the public service is making to the world's work.

In the clerical parts of the Survey organization a restriction whose effect is fully realized only by those who seek efficiency is the apportionment feature of the civil-service law. It is well known that the lists of clerks and stenographers who have passed the civil-service examinations with high rank but who are, simply because of their residence in States whose quotas are exhausted, ineligible for other than temporary appointment contain as a rule far more efficient candidates, as shown by their high ratings, than those who are eligible so far as residence is concerned. The policy of barring the best clerks from the classified service simply because of residence in this or that State seems to the administrative officer only one step removed from exclusion from Government employment on purely partisan grounds, and from his point of view is no more favorable to the attainment of the best results. Too much of the effort in "civil-service reform" has been devoted to the protection of the worker rather than of the work, and too often the needs of the public service to have its work well done have been overlooked in the effort to insure equality of opportunity to all applicants for employment.

A serious limitation upon economy in the administration of the Survey appropriations results from the discordance between the fiscal year and the field season. The necessity of making field plans and starting field projects on July 1, when the natural season for field work is well advanced, involves not only great inconvenience but serious loss. Congress has in some measure relieved this unnatural situation by making certain of the appropriations for the field service wholly or in part immediately available. Yet even this plan fails to afford practical relief when, as last year, the appropriation act was not finally passed until late in the summer (August 24). It is difficult to estimate closely the loss involved, but it can be safely stated that, as a result of this delay, probably never before has the unit cost of field work in the operations of the Geological Survey been so high as this last year.

The division of the field service most severely affected was, of course, that operating in Alaska. Congress for a number of years has recognized the necessity of making the plans for Alaskan investiga-

tions far in advance of the opening of the field season by including the annual grant of funds in the first appropriation bill passed. Thus, the money has usually become available between the first of January and the middle of February, making it possible to formulate plans and to move supplies during the winter. By this policy the plans could be carried out economically and efficiently. It will be evident that the dispatching of a large number of parties to inaccessible regions of Alaska is not practicable until it is definitely known what funds will be available. As a consequence of the delay in the appropriation for 1912-13 but little could be accomplished, and the projects undertaken could be carried out only at relatively heavy expense. Only three parties out of the twelve eventually dispatched to Alaska had a full season for field work, these being supported up to the end of June from the balance left from funds of the previous year and from then to the time the regular appropriation became available by the temporary grants made by Congress. As funds permitted several other parties were dispatched on the basis of these temporary grants, which were, however, so inadequate that the parties were undermanned and but poorly equipped.

Among the important pieces of work which had to be abandoned were an exploration through the western part of the Colville basin to Point Barrow and geologic and topographic reconnaissance surveys in the Talkeetna and Broad Pass regions. In the preparation for the latter undertaking provisions had been dispatched to Valdez Creek, some 300 miles from the coast, at a very heavy expense. A reconnaissance of the Yakataga region and detailed geologic and topographic surveys of the eastern part of the Matanuska coal fields and of the Willow Creek gold district were also planned but could not be carried out.

#### ALASKA RAILROAD COMMISSION.

A special contribution was made by the Survey to the work of the Alaska Railroad Commission, which was created by the Sixty-second Congress and charged with the investigation of transportation routes in Alaska. The commission consisted of five members, and the Survey geologist in charge of the investigation of mineral resources in Alaska was named in the statute as one of these members. Alfred H. Brooks was therefore designated by President Taft to serve as a member of the commission and as vice chairman. Mr. Brooks visited Alaska with the other members of the commission, leaving Washington September 3 and returning December 1, 1912. The resulting report was submitted to the President and by him transmitted to Congress January 20, 1913.

**REPORT ON LAND CLASSIFICATION.**

A feature of special interest in connection with the year's work was the preparation for publication of Bulletin 537, "The classification of the public lands." This bulletin contains contributions by many authors, including the Director of the Survey, practically all the technical force of the land-classification board, and many of the geologists and engineers of the other branches who are engaged in the field work of classification. The object of this publication was to set forth in compact and usable form the history and origin of the Survey's classification work, the basis of that work in law and in the administration of law, and briefly the processes involved both in the original field investigations and in the office study and disposition of field results. The work has grown from small beginnings to a complete organization and a complete system of procedure. It touches upon public-land problems at many points, so that it seemed desirable, both from the point of view of members of the Survey and from that of the public, to set forth, as compactly and clearly as possible, the general features of the organization and the general principles which govern the work. The preparation of the bulletin involved the diversion of a considerable portion of the energies of the land-classification board staff for a part of one or two months of the fiscal year.

**FIRE IN THE SURVEY BUILDING.**

A fire occurred in the basement of the Survey building on Sunday, May 18, the cause of which is unknown, but which may have resulted from the short-circuiting of electrical wires. The destruction of the entire building was at one time seriously threatened, but the fire was fortunately confined to the basement and therefore resulted in the loss of only replaceable property. The fire destroyed about 175,000 copies of the latest topographic maps, destroyed or seriously damaged the entire stock of geologic folios, aggregating about 200,000 copies, and partly or wholly destroyed about 60,000 book publications, most of which were reserve copies, including the older and rarer publications. Among these was the "library reserve," comprising from four to six copies of each publication heretofore issued by the Survey, constituting the only complete sets of Geological Survey publications known to be in existence, except those in libraries. The fire damage is estimated at approximately \$100,000 for property which should be replaced, but this estimate does not include a considerable additional damage to material and publications—not sufficient, however, to condemn them as useless.

## WORK OF THE YEAR.

### DECREASE IN APPROPRIATION.

The appropriations made directly for the Geological Survey showed a decrease of \$10,000 as compared with those for the fiscal year 1912, this amount having been temporarily cut off from the appropriation for the investigation of Alaskan mineral resources. This action was taken by Congress on account of the delay in making the appropriation and the belief by Congress that the full appropriation would not be needed. Owing to the extreme lateness in making the appropriation, and therefore providing for working funds, considerable less than the usual amount of field work was accomplished, the field season being on this account thus cut down practically one-half. However, as soon as the money became available parties were rushed to the field and the utmost endeavors were made to turn out something approaching the present standard of work. Parties were kept in the field later than usual in the fall, considerable work being done after snowfall and more than the usual amount of work was done in the early spring.

### PUBLICATIONS.

The work of the Geological Survey is reflected chiefly in the publication and distribution of its printed reports and maps. During the fiscal year ended June 30, 1913, the number of reports printed was 253,850 copies and the number distributed was 375,213 copies of these reports and reports previously printed. The reports are sent out only on application.

Under the special stimulation of a reduced price because of damage by smoke and water, the geologic folios were sold in large numbers. From May 20, immediately after the fire, to June 30 these sales amounted to more than 27,000 copies, and it is believed that this distribution among teachers, students, business men, and others really desirous of using the publications of this series will make future issues more popular.

The publications of the year are listed below.

THIRTY-THIRD ANNUAL REPORT of the Director of the United States Geological Survey to the Secretary of the Interior, for the fiscal year ended June 30, 1912. 175 pages, 2 plates.

A report on special features of the Survey's work, brief abstracts of publications of the year, and a summary of work by branches and divisions, with maps showing the progress of topographic and geologic surveys.

MONOGRAPH LI. Cambrian Brachiopoda, by C. D. Walcott. (In two parts.) 1912. Part I, 872 pages, 76 text figures; Part II, 104 plates. Price \$4.

A work setting forth the results of a systematic study of the Cambrian brachiopod fauna of the world and its relation to Ordovician and later fauna. This work contains descriptions of 477 species and 59 varieties of Cambrian brachiopods and 42 species and 1 variety of Ordovician brachiopods. Figures of 538 forms are given.

The Cambrian Brachiopoda are considered historically, geologically, and zoologically. The historical treatment comprises a bibliography and a table of synonymic reference, giving a completely cross-referenced list of described species with the present generic and specific reference of each; the geologic treatment covers general geographic and stratigraphic distribution, detailed geographic distribution, detailed stratigraphic distribution, habitat, and fossil localities. The zoologic treatment covers the physical characters of the Brachiopoda, their distribution, their evolution, and their classification.

PROFESSIONAL PAPER 71. Index to the stratigraphy of North America by Bailey Willis, accompanied by a geologic map of North America compiled by the United States Geological Survey in cooperation with the Geological Survey of Canada and the Instituto Geológico de México under the supervision of Bailey Willis and G. W. Stose. 1912. 894 pages, 1 plate, 19 text figures.

This paper is a compilation designed to explain the geologic map which accompanies it. The map is printed in four parts, which together make a wall map 60 by 77 inches, and is excellently adapted to use in classes. It is also sufficiently detailed to be serviceable for close study, for although it shows 42 divisions of rocks that can be studied at close range, the color scheme is so planned that when it is used as a wall map at a distance the minor distinctions merge and the major divisions stand out prominently. The map is therefore indispensable to both teacher and student.

The compiler of this volume has assembled the latest or most authoritative statements of fact and opinion, selected according to his best judgment. The material selected comprises discussions of stratigraphy, citations of significant fossils, and views on correlation. The aim has been to state stratigraphic facts as fully as the data available or the scope of the work permit and to include as much as space allows relating to faunas and correlation. Quotation has been preferred, but where it was not practicable an abstract of facts has been made and the reference given. The last chapter is a bibliography of the publications cited in the text of the work. Each of the 19 text figures is a sketch map of North America showing the distribution of the rocks of a certain geologic period represented on the map and the key to references in the text.

PROFESSIONAL PAPER 74. Geology and ore deposits of the Butte district, Montana, by W. H. Weed. 1912. 262 pages, 41 plates, 109 text figures.

A study of the geology of this important ore-bearing district, which is the greatest mining center in the United States and the second greatest in the world. The book describes in detail the different valuable metals produced—gold, silver, copper, and zinc—their mode of occurrence, and the geologic conditions which led to their formation. A discussion of mining conditions indicates that the output of the district will remain constant for some years to come. The illustrations consist of colored geologic maps, halftone plates, and zinc etchings showing plans and cross sections of the mines and veins.

PROFESSIONAL PAPER 77. Geology and ore deposits of the Park City district, Utah, by J. M. Boutwell, with contributions by L. H. Woolsey. 1912. 231 pages, 44 plates, 18 text figures.

A detailed report on the areal and economic geology of the district surrounding Park City, Utah, with sections on the history and development of its mining industry, mineralogy of its ores, and descriptions of its mines.

The Park City district has won high standing as a "bonanza camp" by yielding large amounts of rich lead-silver ore, and its extensive mines rank well among the dividend-paying argentiferous lead mines of the world. Topographic and geologic maps, structure sections, and numerous halftone plates accompany the paper.

**PROFESSIONAL PAPER 78.** Geology and ore deposits of the Philipsburg quadrangle, Montana, by W. H. Emmons and F. C. Calkins. 1913. 271 pages, 17 plates, 55 text figures.

This paper treats of the geography, geology, and mineralogy of the district adjacent to Philipsburg, Mont., which contains deposits of silver and gold ore that were once richly productive. The paper includes chapters on the ore deposits, history of mining development, and treatment of the ores. The mines are described in detail and numerous illustrations, including topographic and geologic maps of the district, add to the usefulness of the book.

**PROFESSIONAL PAPER 79.** Recurrent *Tropidoleptus* zones of the Upper Devonian in New York, by H. S. Williams. 1913. 103 pages, 4 plates, 18 text figures.

A study of the paleontology of the Upper Devonian rocks of the Watkins Glen district, near Ithaca, N. Y. The importance of the investigation lies chiefly in its disclosures in regard to the ancient geography and geology of the region, as the disappearance and reappearance of the *Tropidoleptus* fauna must have been due to diastrophic changes. The illustrations consist of halftone plates of specimen fossils and sections of the rocks showing the stratigraphic position of the subdivisions of the fauna.

**BULLETIN 471.** Contributions to economic geology (short papers and preliminary reports), 1910, Part II, Mineral fuels. M. R. Campbell, geologist in charge. 1912. 663 pages, 52 plates, 15 text figures.

Includes 27 brief reports of two classes—(1) short papers giving comparatively detailed descriptions of occurrences 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 reports are such only as have a direct economic bearing, all topics of purely scientific interest being excluded.

A complete list of the papers included in the volume follows:

The Campton oil pool, Kentucky, by M. J. Munn.

Oil and gas development in Knox County, Ky., by M. J. Munn.

The Fayette gas field, Alabama, by M. J. Munn.

The Powder River oil field, Wyoming, by C. H. Wegemann.

Geology of the San Juan oil field, Utah, by E. G. Woodruff.

Marsh gas along Grand River near Moab, Utah, by E. G. Woodruff.

Preliminary report on the geology and possible oil resources of the south end of the San Joaquin Valley, Cal., by Robert Anderson.

Coal on Dan River, N. C., by R. W. Stone.

Lignite in the Fort Berthold Indian Reservation, N. Dak., north of Missouri river, by M. A. Pishel.

Geology of certain lignite fields in eastern Montana, by W. R. Calvert.

The Baker lignite field, Custer County, Mont., by C. F. Bowen.

The Terry lignite field, Custer County, Mont., by F. A. Herald.

The Glendive lignite field, Dawson County, Mont., by J. H. Hance.

- The Sidney lignite field, Dawson County, Mont., by Eugene Stebinger.
- The Culbertson lignite field, Valley County, Mont., by A. L. Beekly.
- The southern extension of the Milk River coal field, Chouteau County, Mont., by L. J. Pepperberg.
- The Livingston and Trail Creek coal fields, Park, Gallatin, and Sweetgrass Counties, Mont., by W. R. Calvert.
- The Electric coal field, Park County, Mont., by W. R. Calvert.
- The Little Powder River coal field, Campbell County, Wyo., by J. A. Davis.
- The Sussex coal field, Johnson, Natrona, and Converse counties, Wyo., by C. H. Wegemann.
- The Lost Spring coal field, Converse County, Wyo., by D. E. Winchester.
- Coal fields of the Wind River region, Fremont and Natrona counties, Wyo., by E. G. Woodruff and D. E. Winchester.
- The coal resources of Gunnison Valley, Mesa and Delta counties, Colo., by E. G. Woodruff.
- The Tijeras coal field, Bernalillo County, N. Mex., by W. T. Lee.
- The Deep Creek district of the Vernal coal field, Uinta County, Utah, by C. T. Lupton.
- The Blacktail (Tabby) Mountain coal field, Wasatch County, Utah, by C. T. Lupton.
- Miscellaneous analyses of coal samples from various fields of the United States.

**BULLETIN 498.** Headwater regions of Gulkana and Susitna rivers, Alaska, with accounts of the Valdez Creek and Chistochina placer districts, by F. H. Moffit. 1912. 82 pages, 10 plates, 9 text figures.

Describes briefly the geology and mineral resources of an area between the upper parts of Susitna and Gulkana rivers, as the result of a reconnaissance survey in 1910. One of the chief purposes of the survey was to map and investigate the Valdez Creek placer district, which has been producing gold for a number of years. Topographic and geologic reconnaissance maps, structure sections, and halftone views of interesting geologic features make up the illustrations.

**BULLETIN 501.** The Bonnifield region, Alaska, by S. R. Capps. 1912. 63 pages, 8 plates, 3 text figures.

Describes the geography and general geology of the region lying south of Fairbanks between Tanana River and the crest of the Alaska Range. This district has long been known as a field containing some productive gold placers as well as extensive deposits of lignitic coal. Estimates which include only 122 square miles of the better-known coal fields give a coal content of 9,950,000,000 tons. The book contains topographic and geologic maps of the district described and sections of the rocks.

**BULLETIN 502.** The Eagle River region, southeastern Alaska, by Adolph Knopf. 1912. 61 pages, 5 plates, 3 text figures.

Discusses the rock formations and ore deposits of the Eagle River region, a strip of territory 32 miles long extending northwestward from Salmon Creek, near Juneau, to Berners Bay. This strip embraces nearly a third of the entire length of the Juneau gold belt and contains a large number of prospects under exploration. The illustrations include a topographic and a geologic map of the area discussed and diagrammatic sections.

- BULLETIN 503. Iron-ore deposits of the Eagle Mountains, California, by E. C. Harder. 1912. 81 pages, 13 plates, 4 text figures.

An economic report treating of the structure, character, and quantity of the iron ores of the Eagle Mountains, in Riverside County, Cal., and their relation to the associated rocks. It includes also descriptions of these rocks and discussions of their relations to one another. The book contains a general geologic and topographic map and maps and sections showing distribution and structure of iron ore and associated rocks.

- BULLETIN 508. The Onondaga fauna of the Allegheny region, by E. M. Kindle. 1912. 144 pages, 13 plates.

Results of research work on the fauna of the Onondaga limestone, which is recognized by geologists as a valuable reference formation in correlating other strata. The bulletin discusses the stratigraphy of the formation in the different States in the Allegheny region and the age of the fauna, and gives detailed descriptions and pictures of the fossils.

- BULLETIN 510. Coal fields of Grand Mesa and the West Elk Mountains, Colorado, by W. T. Lee. 1912. 237 pages, 21 plates, 37 text figures.

Results of an investigation undertaken for the purpose, first, of ascertaining the geologic relations of the coal-bearing rocks to other formations; second, of classifying the land by legal subdivisions into coal land and noncoal land; and third, of determining the value of the coal land by ascertaining the thickness of the coal beds, the character and quality of the coal, its accessibility with reference to topographic features, and its location with reference to lines of transportation. The report contains a map of the Grand Mesa and West Elk Mountain field, sections of the coal beds, and halftone plates showing geologic features associated with the coal deposits and characteristic fossils by which coal of different grades may be identified.

- BULLETIN 513. Pliocene and Pleistocene Foraminifera from southern California, by R. M. Bagg, jr. 1912. 153 pages, 28 plates, 3 text figures.

This bulletin describes in detail 128 species and varieties of fossil Foraminifera. The Pliocene specimens were obtained from highly fossiliferous sands at Timms Point, San Pedro, Cal., and the Pleistocene material from sandstone with fossiliferous lenses at Santa Barbara, Cal. The book contains halftone plates giving accurate representations of the specimens.

- BULLETIN 514. Results of spirit leveling in New York, 1906 to 1911, inclusive. R. B. Marshall, chief geographer. 1912. 139 pages, 1 plate.

- BULLETIN 515. Results of spirit leveling in Pennsylvania, 1899 to 1911, inclusive. R. B. Marshall, chief geographer. 1912. 164 pages, 1 plate.

- BULLETIN 516. Results of spirit leveling in Florida, 1911. R. B. Marshall, chief geographer. 1912. 24 pages, 1 plate.

- BULLETIN 517. Results of spirit leveling in Alabama, 1911. R. B. Marshall, chief geographer. 1912. 38 pages, 1 plate.

- BULLETIN 518. Results of spirit leveling in Ohio, 1911. R. B. Marshall, chief geographer. 1912. 108 pages, 1 plate.

- BULLETIN 519. Results of spirit leveling in Tennessee, 1910 and 1911. R. B. Marshall, chief geographer. 1912. 41 pages, 1 plate.

Reports on precise and primary leveling in the States indicated in their titles, showing the exact altitude above sea level of a great number of places. The work in New York, Pennsylvania, Ohio, and Alabama and that of 1910 in Tennessee was done in cooperation with the States. Each bulletin contains a halftone plate showing Geological Survey designs for bench marks.

**BULLETIN 520.** Mineral resources of Alaska (report on progress of investigations in 1911), by A. H. Brooks and others. 1912. 360 pages, 15 plates.

A collection of 18 brief reports on the work of the Geological Survey in Alaska during 1911. Illustrated by maps of Alaska showing distribution of mineral resources and railway routes from the Pacific seaboard to Fairbanks, geologic sketch maps of several of the mining regions, and hydrographs showing the daily discharge of Yukon, Fortymile, and Seventymile rivers.

The titles of the papers are given below:

Administrative report, by A. H. Brooks.

The mining industry in 1911, by A. H. Brooks.

Railway routes from the Pacific seaboard to Fairbanks, by A. H. Brooks.

Tin resources of Alaska, by F. L. Hess.

The Taral and Bremner River districts, by F. H. Moffit.

The Chitina copper district, by F. H. Moffit.

Gold deposits near Valdez, by A. H. Brooks.

Gold deposits of the Seward-Sunrise region, Kenai Peninsula, by B. L. Johnson.

Gold placers of the Yentna district, by S. R. Capps.

Gold placers between Woodchopper and Fourth of July creeks, upper Yukon River, by L. M. Prindle and J. B. Mertie.

Placer mining in the Fortymile and Seventymile River districts, by E. A. Porter.

Water supply of the Fortymile, Seventymile, and Eagle districts in 1911, by E. A. Porter.

Water supply of the Fairbanks, Salchaket, and Circle districts in 1911, by C. E. Ellsworth.

The Rampart and Hot Springs regions, by H. M. Eakin.

The Ruby placer district, by A. G. Maddren.

Geologic investigations along the Canada-Alaska boundary, by A. G. Maddren.

The Alatna-Noatak region, by P. S. Smith.

Notes on mining in Seward Peninsula, by P. S. Smith.

**BULLETIN 521.** The commercial marbles of western Vermont, by T. Nelson Dale. 1912. 170 pages, 17 plates, 25 text figures.

This bulletin has a twofold object—to bring the science of geology to bear upon the problems of the marble industry in western Vermont, and briefly to make known the more important scientific results obtained in the course of the mapping of the marble belts of that part of the State and in the study of its marbles. The district specially considered lies west of the Green Mountain Range in Bennington, Rutland, and Addison counties. The report describes all the quarries of commercial marble that were in operation in the State in 1910. The illustrations include geologic maps of the beds, sections of marble, and halftone plates showing ornamental uses to which Vermont marbles have been put.

**BULLETIN 522.** Portland cement materials and industry in the United States, by E. C. Eckel, with contributions by E. F. Burchard and others. 1913. 401 pages, 19 plates, 2 text figures.

This report contains a brief sketch of the general status of the Portland cement industry, a discussion of the chemical and physical properties necessary to a Portland cement material, and detailed descriptions of the available Portland cement resources of each State in the United States. Emphasis is laid on the fact that the value of cement material depends almost entirely

on its location with respect to fuel supply, transportation routes, and markets. The illustrations consist mainly of maps showing the distribution of cement materials in certain parts of the country.

BULLETIN 523. Nitrate deposits, by H. S. Gale. 1912. 36 pages, 2 plates, 2 text figures.

A paper describing the nitrate deposits of the world and especially of the United States, with sections on the origin of nitrate salts and the value of the United States deposits. The most important of the nitrate salts commercially are sodium nitrate (cubic niter) and potassium nitrate (niter or saltpeter), imported largely from Chile. The bulletin contains maps showing the location of nitrate claims and deposits in Nevada and Utah.

BULLETIN 524. Bibliography of North American geology for 1911, with subject index, by J. M. Nickles. 1912. 162 pages.

A list of papers on North American geology published in 1911, arranged alphabetically by names of authors, an index of subjects or materials, and lists showing chemical analyses reported and minerals, rocks, and formations described.

BULLETIN 527. Ore deposits of the Helena mining region, Montana, by Adolph Knopf. 1913. 143 pages, 7 plates, 4 text figures.

A sketch of the geology of the Helena mining region, an area of 1,300 square miles in southwestern Montana, with descriptions of mines in special districts. The dominating geologic feature of the region is the granite mass which forms the northern extension of a great intrusion known as the Boulder batholith. As a consequence of this granite invasion a series of ore deposits, chiefly gold, silver, and lead, was formed around the margin of the granite and in the roof rocks overlying it. The book contains a geologic map of the region and halftone plates showing specimens of the ores.

BULLETIN 529. The enrichment of sulphide ores, by W. H. Emmons. 1913. 260 pages.

A discussion of the theory of sulphide enrichment, which explains why many ore deposits, especially those of copper, are leached near the surface and are richer below the leached zone, whereas the ore at still greater depths is of lower grade. According to the theory the minerals leached from the upper zone have been carried downward and redeposited, forming an enriched zone, and the deeper, low-grade sulphide ores are assumed to have undergone no change since the original or primary mineralization of the whole deposit. This theory has proved to be of considerable economic value, having been successfully applied in the development of many deposits of the metallic sulphides.

BULLETIN 530. Contributions to economic geology (short papers and preliminary reports), 1911, Part I, Metals and nonmetals except fuels. Waldemar Lindgren, chief geologist. 1913. 400 pages, 7 plates, 51 text figures.

This bulletin is made up of 27 brief reports on investigations of mineral deposits except fuels in the United States in 1911. 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 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 in the volume follows:

Notes on the gold lodes of the Carrville district, Trinity County, Cal., by D. F. MacDonald.

A preliminary report on the geology and ore deposits of Creede, Colo., by W. H. Emmons and E. S. Larsen.

A preliminary account of the ore deposits of the Loon Creek district, Idaho, by J. B. Umpleby.

Geology of the St. Joe-Clearwater region, Idaho, by F. C. Calkins and E. L. Jones, jr.

Notes on the Antelope district, Nevada, by F. C. Schrader.

Notes on the northern La Sal Mountains, Grand County, Utah, by J. M. Hill.

The Turquoise copper-mining district, Arizona, by F. L. Ransome.

Notes on the vanadium deposits near Placerville, Colo., by F. L. Hess.

Vanadium in the Sierra de los Caballos, N. Mex., by F. L. Hess.

Carnotite near Green River, Utah, by F. L. Hess.

Zirconiferous sandstone near Ashland, Va., by T. L. Watson and F. L. Hess.

Alunite in the San Cristobal quadrangle, Colorado, by E. S. Larsen.

Notes on the clays of Delaware, by G. C. Matson.

Clay in the Portland region, Maine, by F. J. Katz.

Developed deposits of fuller's earth in Arkansas, by H. D. Miser.

Gypsum along the west flank of the San Rafael Swell, Utah, by C. T. Lupton.

Geology of the salt and gypsum deposits of southwestern Virginia, by G. W. Stose.

A geologic reconnaissance in southeastern Idaho, by A. R. Schultz and R. W. Richards.

Some further discoveries of rock phosphate in Montana, by J. T. Pardee.

The search for potash in the desert basin region, by H. S. Gale.

The occurrence of potash salts in the bitterns of the eastern United States, by W. C. Phalen.

Explorations of salines in Silver Peak Marsh, Nev., by R. B. Dole.

A sulphur deposit in the San Rafael Canyon, Utah, by F. L. Hess.

Sulphur deposits of Sunlight Basin, Wyo., by D. F. Hewett.

Two sulphur deposits in Mineral County, Colo., by E. S. Larsen and J. F. Hunter.

Graphite near Raton, N. Mex., by W. T. Lee.

Mica in Idaho, New Mexico, and Colorado, by D. B. Sterrett.

BULLETIN 531. Contributions to economic geology (short papers and preliminary reports), 1911, Part II, Mineral fuels; advance chapters as follows:

Bulletin 531-A. The Menifee gas field and the Ragland oil field, Kentucky. M. J. Munn. 1913. 20 pages, 4 plates.

A brief account of the history, topography, and geology of these fields, with sketch maps and suggestions to future prospectors.

Bulletin 531-B. Oil and gas development in north-central Oklahoma, by R. H. Wood. 1912. 31 pages, 1 plate.

The region considered in this report includes lands formerly within the Pawnee, Otoe, Ponca, Kaw, and Tonkawa Indian reservations, comprising about 82 miles from north to south and 60 miles from east to west in Grant, Kay, Osage, Pawnee, Noble, Garfield, Logan, Payne, and Lincoln counties. Localities where producing wells and test holes have been sunk were visited and an effort was made to get the exact location of all borings, the depth of each hole, the character of the product and the amount obtained, if any, and wherever possible a detailed log or record of the formations passed through by the drill.

Bulletin 531-C. Geology and petroleum resources of the De Beque oil field, Colorado, by E. G. Woodruff. 1913. 17 pages, 1 plate, 1 text figure.

A sketch of the topography and geology of this field with reference especially to its petroleum resources. The pamphlet contains a map of the field showing geologic boundaries and structure.

Bulletin 531-D. Geologic structure of the Punxsutawney, Curwensville, Houtzdale, Barnesboro, and Patton quadrangles, central Pennsylvania, by G. H. Ashley and M. R. Campbell. 1913. 23 pages, 2 plates, 1 text figure.

A discussion of the geologic structure of the area covered, designed to aid the prospector in drilling for oil or gas.

BULLETIN 532. The Koyukuk-Chandalar region, Alaska, by A. G. Maddren. 1913. 119 pages, 9 plates, 2 text figures.

This report gives a general account of the geography and geology of the drainage basins of upper Koyukuk and Chandalar rivers, but its special purpose is to describe that part of this region in which gold placers have been developed. Since 1899 the Koyukuk has produced gold to the value of \$2,500,000 and some promising gold-bearing veins have been found in the Chandalar district. The bulletin is illustrated by reconnaissance maps of the region and plates showing geologic features.

BULLETIN 534. The Yentna district, Alaska, by S. R. Capps. 1913. 75 pages, 13 plates, 7 text figures.

Describes the geography and geology of the Yentna district, an area of about 2,050 square miles in the drainage basin of Yentna River. The economic value of the district lies in its placer gold, and this paper sets forth briefly the conditions at the placer mines and the more important facts about the surface distribution of the different rock formations. Topographic and geologic maps of the district and plates showing geologic and mining conditions accompany the report.

BULLETIN 535. A geologic reconnaissance of a part of the Rampart quadrangle, Alaska, by H. M. Eakin. 1913. 38 pages, 8 plates.

This is one of a series of reports on the Yukon-Tanana region, Alaska. Although a reconnaissance report, it will be useful in outlining the general features of geology and in affording information about the mineral resources of the region, chiefly placer gold. The illustrations include reconnaissance and geologic maps of the Hot Springs and Rampart districts and maps showing distribution of placer gold.

BULLETIN 537. The classification of the public lands, by G. O. Smith and others. 1913. 197 pages, 8 text figures.

A full statement of the policy of land classification for the purpose of highest utilization and a detailed description of the procedure and methods so far found necessary to carry out that policy are presented in this bulletin. This information is of value both to students of government and to geologists and engineers interested in the application of scientific investigation to practical business. The historical and legal phases of the discussion may be of greatest interest to the citizen concerned in his country's highest development, while the description of field methods should be of immediate value in indicating new requirements imposed upon scientific education, for details of this business policy of the Government are already being adopted in private and

corporate land examinations. The text figures include diagrams and sketch maps illustrating some of the methods of land classification.

**BULLETIN 540.** Contributions to economic geology (short papers and preliminary reports), 1912, Part I, Metals and nonmetals except fuels; one advance chapter, namely:

**Bulletin 540-R.** Sulphur deposits in Park County, Wyo., by D. F. Hewett. 1913. 6 pages.

A brief account of an investigation of the sulphur deposits of Park County, Wyo., the author concluding that, because of the meagerness of the deposits, their economic importance is not great.

**WATER-SUPPLY PAPER 259.** The underground waters of southwestern Ohio, by M. L. Fuller and F. G. Clapp, with a discussion of the chemical character of the waters by R. B. Dole. 1912. 228 pages, 9 plates, 11 text figures.

The district covered by this report is an area in southwestern Ohio extending from Ohio River on the south to the southern portions of Darke and Miami counties on the north, and from the Indiana State line on the west to central Adams and Highland counties on the east. The topography, climate, and geology are described with special reference to the water-bearing formations, and the underground waters are discussed by counties. The paper contains also a chapter on the chemical character of the waters, showing the qualities required for domestic, industrial, and medicinal uses and methods of purification. The illustrations comprise a geologic map of the district, maps showing Quaternary deposits, thicknesses of water-bearing surface deposits, and artesian conditions, sections and halftone plates showing ground-water conditions in the district.

**WATER-SUPPLY PAPERS 281, 283, 284, 289, 290, 291, 292.** Parts of "Surface-water supply of the United States, 1910," prepared under the direction of M. O. Leighton:

**Part I.** Water-Supply Paper 281. North Atlantic coast, by C. C. Babb, C. C. Covert, and R. H. Bolster. 1912. 305 pages, 2 plates.

**Part III.** Water-Supply Paper 283. Ohio River basin, by A. H. Horton, M. R. Hall, and H. J. Jackson. 1912. 158 pages, 2 plates.

**Part IV.** Water-Supply Paper 284. St. Lawrence River basin, by C. C. Covert, A. H. Horton, and R. H. Bolster. 1912. 125 pages, 2 plates.

**Part IX.** Water-Supply Paper 289. Colorado River basin, by W. B. Freeman, E. C. La Rue, and H. D. Padgett. 1912. 233 pages, 4 plates.

**Part X.** Water-Supply Paper 290. The Great Basin, by E. C. La Rue, F. F. Henshaw, and E. A. Porter. 1912. 264 pages, 3 plates.

**Part XI.** Water-Supply Paper 291. Pacific coast in California, by W. B. Clapp, F. F. Henshaw, and H. D. McGlashan. 1912. 218 pages, 4 plates, 1 text figure.

**Part XII.** Water-Supply Paper 292. North Pacific coast, by F. F. Henshaw, E. C. La Rue, and G. C. Stevens. 1913. 685 pages, 3 plates.

These reports contain descriptions of the drainage basins named and the results of stream measurements in them, namely, gage-height records, results of current-meter measurements, and daily and monthly discharges. Illustrations showing typical gaging stations, current meters, and rating curves accompany each book.

WATER-SUPPLY PAPER 293. Underground water resources of Iowa, by W. H. Norton, W. S. Hendrixson, H. E. Simpson, O. E. Meinzer, and others. 1912. 994 pages, 18 plates, 6 text figures.

A report setting forth in detail the results of an investigation, made in cooperation by the United States Geological Survey and the Iowa Geological Survey, of the underground water resources of Iowa. The topography, geology, and water supply of each county are considered and the chemical and industrial qualities of all ground waters are discussed. The object of the investigation is to furnish to each community data showing whether artesian water can be found at that locality, at what depths water may be reached, through what formations the drill must pass, what mineral compounds—healthful or harmful—the water is likely to contain, how high it will rise, how large will be its discharge, and how such a supply will compare in cost, purity, permanence, and general availability with that from other sources. The book contains a geologic map showing the geology and artesian conditions of Iowa and geologic sections between certain cities and towns in the State.

WATER-SUPPLY PAPER 294. An intensive study of the water resources of a part of Owens Valley, Cal., by C. H. Lee. 1912. 135 pages, 30 plates, 8 text figures.

Presents the results of studies made by the Department of Public Works, Bureau of the Los Angeles Aqueduct, city of Los Angeles, in cooperation with the United States Geological Survey and the State of California, for the purpose of determining the available underground water supply of Owens Valley. The city of Los Angeles plans to develop a municipal water supply from the surplus surface waters reaching the lower end of the valley and from the underground sources, which have so far remained untouched. Investigations were made especially in the Independence region, an isolated portion of the valley. The data obtained are discussed under the following heads: Physical features of the region, precipitation, stream flow, evaporation and transpiration, percolation, and ground water. The book contains numerous tables showing precipitation and depth of evaporation, in inches, at certain stations, and monthly and seasonal discharges of streams tributary to the region, as well as maps and halftone plates illustrating drainage features.

WATER-SUPPLY PAPER 296. Gazetteer of surface waters of California, Part II, San Joaquin River basin, prepared under the direction of J. C. Hoyt by B. D. Wood. 1912. 102 pages.

WATER-SUPPLY PAPER 297. Gazetteer of surface waters of California, Part III, Pacific coast and great basin streams, prepared under the direction of J. C. Hoyt by B. D. Wood. 1913. 244 pages.

WATER-SUPPLY PAPER 298. Water resources of California, Part I, Stream measurements in Sacramento River basin, prepared under the direction of J. C. Hoyt by H. D. McGlashan and F. F. Henshaw. 1912. 411 pages, 8 plates, 3 text figures.

WATER-SUPPLY PAPER 299. Water resources of California, Part II, Stream measurements in San Joaquin River basin, prepared under the direction of J. C. Hoyt by H. D. McGlashan and H. J. Dean. 1912. 439 pages, 7 plates.

WATER-SUPPLY PAPER 300. Water resources of California, Part III, Stream measurements in the Great Basin and Pacific coast river basins, prepared under the direction of J. C. Hoyt by H. D. McGlashan and H. J. Dean. 1912. 956 pages, 4 plates.

Five of a series of six reports on the surface waters of California, prepared by the United States Geological Survey under cooperative agreement with the State Water Commission and the State Conservation Commission. Water-Supply Papers 295, 296, and 297 are gazetteers in which is listed every stream and gaging station in the river basins of California. (Water-Supply Paper 295, Gazetteer of surface waters of the Sacramento River basin, was published during the fiscal year ended June 30, 1912.) Water-Supply Papers 298, 299, and 300 describe the streams that have been measured in California and the stations at which the work has been carried on and give tables covering all the measurements and estimates made by the Geological Survey in these basins. The investigations of the flow of water in the streams have been supplemented by studies of the climatic and other factors affecting stream flow, so that these reports afford valuable data for all phases of hydraulic work.

**WATER-SUPPLY PAPERS 301, 304, 305, 310, 311.** Parts of "Surface water supply of the United States, 1911," prepared under the direction of M. O. Leighton:

Part I. Water-Supply Paper 301. North Atlantic coast, by C. C. Babb, C. C. Covert, and R. H. Bolster. 1912. 221 pages, 4 plates.

Part IV. Water-Supply Paper 304. St. Lawrence River Basin, by C. C. Covert and R. H. Bolster. 1912. 98 pages, 4 plates.

Part V. Water-Supply Paper 305. Hudson Bay and upper Mississippi River, by Robert Follansbee, A. H. Horton, and H. J. Jackson. 1913. 197 pages, 4 plates, 2 text figures.

Part X. Water-Supply Paper 310. The Great Basin, by F. F. Henshaw, H. D. McGlashan, and E. A. Porter. 1913. 210 pages, 4 plates.

Part XI. Water-Supply Paper 311. Pacific coast in California, by H. D. McGlashan and R. H. Bolster. 1912. 304 pages, 4 plates.

These reports present briefly the results of measurements of flow made on 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, Gauge, Channel, Discharge measurements, Accuracy, and Cooperation. The book also contains 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 313.** Water powers of the Cascade Range, Part II, Cowlitz, Nisqually, Puyallup, White, Green, and Cedar drainage basins, by F. F. Henshaw and G. L. Parker. 1913. 170 pages, 16 plates, 12 text figures.

The second of a series of reports dealing with the water powers on rivers flowing from the Cascade Range in Washington and Oregon. Descriptions and maps of the several drainage areas are given, together with plans and profiles of the streams, discharge data, outlines of present hydraulic development, summaries of available power, and short discussions of undeveloped possibilities. The report was prepared in cooperation with the Washington State Board of Geological Survey.

**WATER-SUPPLY PAPER 314.** Surface water supply of Seward Peninsula, Alaska, by F. F. Henshaw and G. L. Parker, with a sketch of the geography and geology by P. S. Smith and a description of methods of placer mining by A. H. Brooks. 1913. 317 pages, 17 plates, 12 text figures.

Presents in detail the results of stream-flow measurements made in Seward Peninsula during the years 1906 to 1910, inclusive. The geography and geology of the peninsula are first briefly described, inasmuch as they have a controlling influence on the run-off, and the occurrence and distribution of the gold placers are summarized in the section devoted to geology. At present the mining of the placer gold is the only incentive to the utilization of the stream flow. Methods and costs of mining are also briefly considered. The illustrations include topographic and geologic maps of Seward Peninsula and plates showing methods of hydraulic mining.

**WATER-SUPPLY PAPER 315.** The purification of public water supplies, by G. A. Johnson. 1913. 84 pages, 8 plates, 1 text figure.

This paper gives a simple and direct statement of the principles governing the purification of water used for domestic purposes and seeks to indicate how best to deal with the various problems involved. It includes a brief account of the sources of water supply, the development of waterworks, water consumption, and the reduction of typhoid fever in the United States. Methods of filtration, sterilization, and softening of municipal waters are discussed in full. Halftone plates and zinc etchings show filtration plants in several cities.

**WATER-SUPPLY PAPER 316.** Geology and water resources of a portion of south-central Washington, by G. A. Waring. 1913. 46 pages, 1 plate, 1 text figure.

The area considered in this report comprises about 5,000 square miles in south-central Washington, including Benton County, the eastern parts of Yakima and Klickitat counties, and the western part of Franklin County. The book contains a reconnaissance map of the area, showing the location of wells and springs and the approximate extent of geologic formations.

**WATER-SUPPLY PAPER 317.** Geology and underground waters of the Wichita region, north-central Texas, by C. H. Gordon. 1913. 88 pages, 2 plates.

This report deals with an area of about 11,000 square miles in north-central Texas, comprising Montague, Clay, Wichita, Wilbarger, Hardeman, Foard, Knox, Baylor, Archer, Jack, Young, Throckmorton, and Haskell counties. It presents the results of an investigation made to determine the geologic conditions with a view to locating water-bearing formations that might be available sources of water, and includes a brief description of the geology and water resources of each county and a geologic sketch map of the area.

**MINERAL RESOURCES OF THE UNITED STATES, calendar year 1911.** Part I, Metals, 1018 pages, 16 text figures; Part II, Nonmetals, 1224 pages, 9 plates, 14 text figures. 1912.

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 56 advance chapters, each covering a single mining industry or group of allied industries.

**MINERAL RESOURCES OF THE UNITED STATES, calendar year 1912; advance chapters as follows:**

Fuel briquetting, by E. W. Parker. 1913. 10 pages.

The production of slate, by A. T. Coons. 1913. 20 pages.

- The production of mica, by D. B. Sterrett. 1913. 15 pages.  
 The production of abrasive materials, by F. J. Katz. 1913. 15 pages.  
 The production of feldspar and quartz, by F. J. Katz. 1913. 11 pages.  
 The production of graphite, by E. S. Bastin. 1913. 11 pages.  
 The production of sand-lime brick. 1913. 7 pages.  
 The production of chromic iron ore, by J. S. Diller. 1913. 10 pages.  
 The production of anthracite, by E. W. Parker. 1913. 19 pages.  
 The production of bauxite and aluminum, by W. C. Phalen. 1913. 16 pages.  
 The production of fluorspar and cryolite, by E. F. Burchard. 1913. 9 pages.  
 Statistics of the pottery industry in the United States, by Jefferson Middleton. 1913. 16 pages.  
 Potash salts: Summary for 1912, by W. C. Phalen. 1913. 36 pages.  
 Gems and precious stones, by D. B. Sterrett. 1913. 42 pages.  
 Precious and semiprecious metals in the Central States (mine production), by B. S. Butler and J. P. Dunlop. 1913. 87 pages.  
 The production of barytes, by J. M. Hill. 1913. 8 pages.  
 The production of peat, by C. A. Davis. 1913. 7 pages.  
 The production of fuller's earth, by Jefferson Middleton. 1913. 8 pages.

GEOLOGIC FOLIO 184. Description and maps of the Kenova quadrangle, comprising 938 square miles in Boyd, Carter, Elliott, Greenup, and Lawrence counties, Ky., Lawrence County, Ohio, and Wayne County, W. Va., by W. C. Phalen. 1912. 16 folio pages of text, 3 maps, 13 text figures. Published also in octavo form, 122 pages; maps in pocket.

GEOLOGIC FOLIO 185. Description and maps of the Murphysboro and Herrin quadrangles, comprising 471 square miles in parts of Williamson, Jackson, Franklin, and Perry counties, Ill., by E. W. Shaw and T. E. Savage. 1913. 15 folio pages of text, 6 maps, 13 text figures.

GEOLOGIC FOLIO 186. Description and maps of the Apishapa quadrangle, comprising 944 square miles in Las Animas, Pueblo, Otero, and Huerfano counties, Colo., by G. W. Stose. 1913. 12 folio pages of text, 3 maps, 13 plates, 21 text figures. Published also in octavo form, 87 pages; maps in pocket.

GEOLOGIC FOLIO 187. Description and maps of the Ellijay quadrangle, comprising 980 square miles in Dawson, Fannin, Gilmer, Lumpkin, Pickens, and Union counties, Ga., Cherokee County, N. C., and Polk County, Tenn., by Laurence La Forge and W. C. Phalen. 1913. 17 folio pages of text, 4 maps, 1 columnar section sheet, 7 text figures.

#### TOPOGRAPHIC MAPS as follows:

Alabama (State).	Barnes Bridge, Tex. <sup>1</sup>
Alaska, showing mineral deposits.	Brandywine, Md. <sup>1</sup>
Antlers, Okla. <sup>1</sup>	Buckfield, Maine.
Arkansas (State).	Buckholtz, Tex.
Ashby, Minn.	Buena Vista Lake, Cal.
Ashton Bridge, Tex.	Canton, Ill.
Aurora, Mo.	Carrollton, Ohio.
Bald Knob, W. Va.	Castle Rock, Colo. <sup>1</sup>
Ballarat, Cal.-Nev. <sup>1</sup>	Cedar Lake, Wash.
Bishop, Cal.	Central City, Colo. <sup>1</sup>
Boston sheet (K 19) of international map of world.	Chelsea, Mont.
	Chico Landing, Cal.

<sup>1</sup> New edition.

Chokio, Minn.	Millikin, La.
Coalinga, Cal.	Missoula, Mont.-Idaho.
Colchester, Ill.	Mogollon, N. Mex.
Columbus, Ohio.	Monterey, Cal.
Courtney, Tex.	Moon Lake, Miss.
Crossville, Tex.	Morris, Minn.
Delaware (State).	Moses Lake, Wash.
Durham, Cal.	Mount Hood, Wash.
Flagstaff, Ariz.	Newell, S. Dak.
Galena, Ill.	New Jersey (State).
Georgia (State).	Nord, Cal.
Gettysburg battlefield and vicinity, Pa.-Md.	North Carolina (State).
Hagerstown, Md.-Pa.	Nortonville, Ky.
Hahns Peak, Colo.	Oak Hill, Ohio.
Halsey, Oreg.	Ohio (State).
Hay Creek, Mont.	Palermo, Cal.
Hilliards, Pa.	Panoche, Cal.
Holden, W. Va.	Pella, Iowa.
Hollywood, Miss.	Pennington, Cal.
Hot Springs and vicinity, Ark. <sup>1</sup>	Petrified Forest, Ariz.
Howth, Tex.	Point Lookout, Md.-Va. <sup>1</sup>
Indiana (State).	Poplar, Mont.
Iowa (State).	Prairie Creek, Cal.
Jaegar, W. Va.	Priest Lake, Idaho-Mont.
Kauai, Hawaii.	Queen City, Mo.
Kimmswick, Ill.	Randolph, Utah-Wyo.
Lake Cormorant, Miss.-Tenn.	Rockwall, Tex.
Lansing, Mich.	Roosevelt, Ariz. <sup>1</sup>
Lowville, N. Y.	Salinas, Cal.
Lula, Miss.	Skowhegan, Maine.
McCall's Ferry, Pa.-Md.	Smoke Creek, Mont.
Magdalena district, N. Mex.	Tennessee (State).
Marias Pass, Mont.	Waterloo, Ill.
Mariposa, Cal.	Weaverville, Cal.
Marysville Butte, Cal.	Wendell, Minn.
Matewan-Williamson, W. Va.	Williamsport, Md.-Pa.
Michigan (State).	Wilson Point, La.
Milan, Ill.-Iowa.	Wisconsin (State).
Millican, Tex.	Zurich, Mont.
Millikens Bend, La.	

#### CHANGES IN ORGANIZATION.

The principal formal change in organization during the year was the separation, in August, of the division of disbursements and accounts into two divisions—the division of disbursements and the division of accounts. J. D. McChesney remains as the chief of the former division and B. S. Favorite was designated as chief of the division of accounts.

On November 16, 1912, Waldemar Lindgren resigned as chief geologist to accept the Rogers professorship of economic geology in the Massachusetts Institute of Technology, and David White, previously in charge of the section of eastern fuel investigations, was appointed to fill the position. Mr. Lindgren continues to give a portion of his time to the work of the Survey. Since the resignation of Mr. Lindgren from continuous service in the Survey the section of metalliferous deposits has been in charge of F. L. Ransome, geologist, and the section of metal resources has been in charge of H. D. Mc-

<sup>1</sup> New edition.

Caskey. Since the resignation of F. B. Van Horn, July 31, 1912, to engage in private work, the section of nonmetalliferous deposits has been in charge of Hoyt S. Gale, geologist.

Early in the fiscal year G. H. Ashley was appointed administrative geologist, although still retaining his connection with land-classification work. He continues to act as chairman of the coal board, C. E. Leshner having been named as vice chairman of this board.

On June 3, 1913, M. O. Leighton resigned as chief hydrographer in charge of the water-resources branch to engage in private practice. N. C. Grover, previously chief engineer of the land-classification board, was appointed to fill the vacancy, as chief hydraulic engineer. During the year district offices have been opened in Tacoma, Wash., with Glenn L. Parker in charge, and in Santa Fe, N. Mex., with Glenn A. Gray, engineer in charge. No appointment as chief engineer of the land-classification board has been made, but the greater part of Mr. Grover's former duties have devolved upon Herman Stabler.

On account of the increase in work in the Pacific division of the topographic branch, due to increase in State cooperation in water-power investigations and in other features, a reorganization of that division was made in July, 1912, into two divisions—the northwestern division, including Washington, Oregon, and Idaho, and the Pacific division, including California, Arizona, Utah, Nevada, and Hawaii. T. G. Gerdine was made geographer in charge of the northwestern division and G. R. Davis geographer in charge of the Pacific division.

On December 26, 1912, W. D. Wirt, the clerk in charge of the section of distribution, was assigned to special work of local sales of maps and folios and J. P. Benfer was placed in temporary charge of the section. On March 12, 1913, H. L. Hill, chief of the executive division, was transferred to temporary service in charge of the section of distribution and Guy E. Mitchell, the Director's secretary, was placed in temporary charge of the executive division.

## GEOLOGIC BRANCH.

### ADMINISTRATION.

The geologic branch embraces four divisions—(1) geology, David White 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 these divisions is well established, and although they are 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 especially familiar with the several subjects. During the field season members of the land-classification board are enrolled in the field parties of the geologic branch that are engaged in work in the public-land States.

The chief geologist gives consideration to the needs of the various regions; makes arrangements, subject to the approval of the Director, for geologic investigations 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. On November 16 Waldemar Lindgren resigned as chief geologist to accept the Rogers professorship of economic geology in the Massachusetts Institute of Technology, and David White, previously in charge of the section of eastern fuel investigations, was appointed to fill the position. Mr. Lindgren continues to give a portion of his time to the work of the Survey, which thus still has the benefit of his distinguished professional learning and experience.

The administrative duties of the chief geologist leave 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 inspecting the work of the parties, in planning future examinations, in field conferences for the determination of questions in dispute, and in supervising the work of the section of eastern fuels.

#### PUBLICATIONS.

The publications of the fiscal year 1913 prepared in the geologic branch consisted of 1 monograph, 5 professional papers, 18 bulletins, 5 advance chapters from 2 economic bulletins, 1 water-supply paper, 1 annual report on mineral resources (1911), 18 advance chapters from Mineral Resources for 1912, and 4 geologic folios. Titles and brief notices of these publications are given on pages 14-22, 26-27.

Besides these publications, 69 papers were, with the permission of the Director, published in scientific journals and in the transactions of scientific societies. In view of the importance of many of these shorter papers and the generally overtaxed capacity of the professional periodicals and scientific-society publications of high rank, provision was made at the close of the year for the publication of the more important of these scientific papers, including such 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 "Contributions to general geology." It is expected that the publication of these papers, many of which contain very valuable scientific material, some of it a by-product of investigations that are primarily economic, will greatly stimulate the scientific work of the Survey

by encouraging broader and more thorough observation and deduction on the part of the geologist, and by affording a very prompt and adequate means for the dignified publication of valuable scientific results.

The areas covered by geologic maps published by the Survey to date and the general nature of the work are indicated on Plate I. It is to be borne in mind that in a number of cooperating States of the East the reports, with maps, have been transmitted for publication by the States.

#### DIVISION OF GEOLOGY.

##### ORGANIZATION.

The scientific force at the beginning of the year consisted of 59 geologists, 25 associate geologists, 39 assistant geologists, and 17 junior geologists. During the year three members of the scientific staff resigned to take places elsewhere at higher salaries and three members were appointed, the total number of geologists of various grades employed at the end of the year being 140. Of this number, 75 were continuously employed, 30 were carried on the per diem roll, giving only a part of their time to the Survey work, and 35 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 was reorganized July 1, 1912, in sections as follows:

1. Section of eastern areal and structural geology (east of the one hundredth meridian). Subsection, investigation of the geology of the Coastal Plain.
2. Section of western areal and structural geology (west of the one hundredth meridian). Subsection, investigations relating to petrography.
3. Section of glacial geology.
4. Section of paleontology and stratigraphic geology.
5. Section of economic geology, metalliferous deposits.
6. Section of economic geology, nonmetalliferous deposits.
7. Section of economic geology, eastern mineral fuels (east of the one hundredth meridian).
8. Section of economic geology, western mineral fuels (west of the one hundredth meridian).

##### ALLOTMENTS.

The total appropriations available for geologic work of the Survey in the United States for the fiscal year 1912-13 were:

Geologic surveys .....	\$300,000
Statutory salaries .....	17,700
Search for potash deposits (part of appropriation for chemistry and physics) .....	18,000
	<hr/>
	335,700

The allotments of the appropriations were as follows:

Section of eastern areal geology-----	\$31, 500
Subsection of geology of coastal plain-----	15, 000
Section of western areal geology-----	36, 500
Section of glacial geology-----	7, 000
Section of paleontology and stratigraphy-----	24, 000
Section of geology, metalliferous deposits-----	36, 500
Section of geology, nonmetalliferous deposits, including potash-----	28, 000
Section of economic geology, western fuels-----	34, 000
Section of economic geology, eastern fuels-----	21, 000
Débris investigations and inspection-----	2, 500
Supervision, administration, salaries of clerical, technical, and skilled-labor force, supplies, and contingent fund---	74, 700
	<hr/> 310, 700

The above table shows that \$236,000 was expended directly for geologic work, including the search for potash. Of this amount \$100,732, or 42.5 per cent, was expended east of the one hundredth meridian and \$135,268 west of that line. The allotment for supervision, etc., was divided in the same proportion between the eastern and the western work. The balance of the appropriations (\$25,000) was allotted by the Director to the land-classification board, and as the work of the board relates to the Western States only the total amount expended on account of the public-land States was 60.4 per cent of the total appropriation.

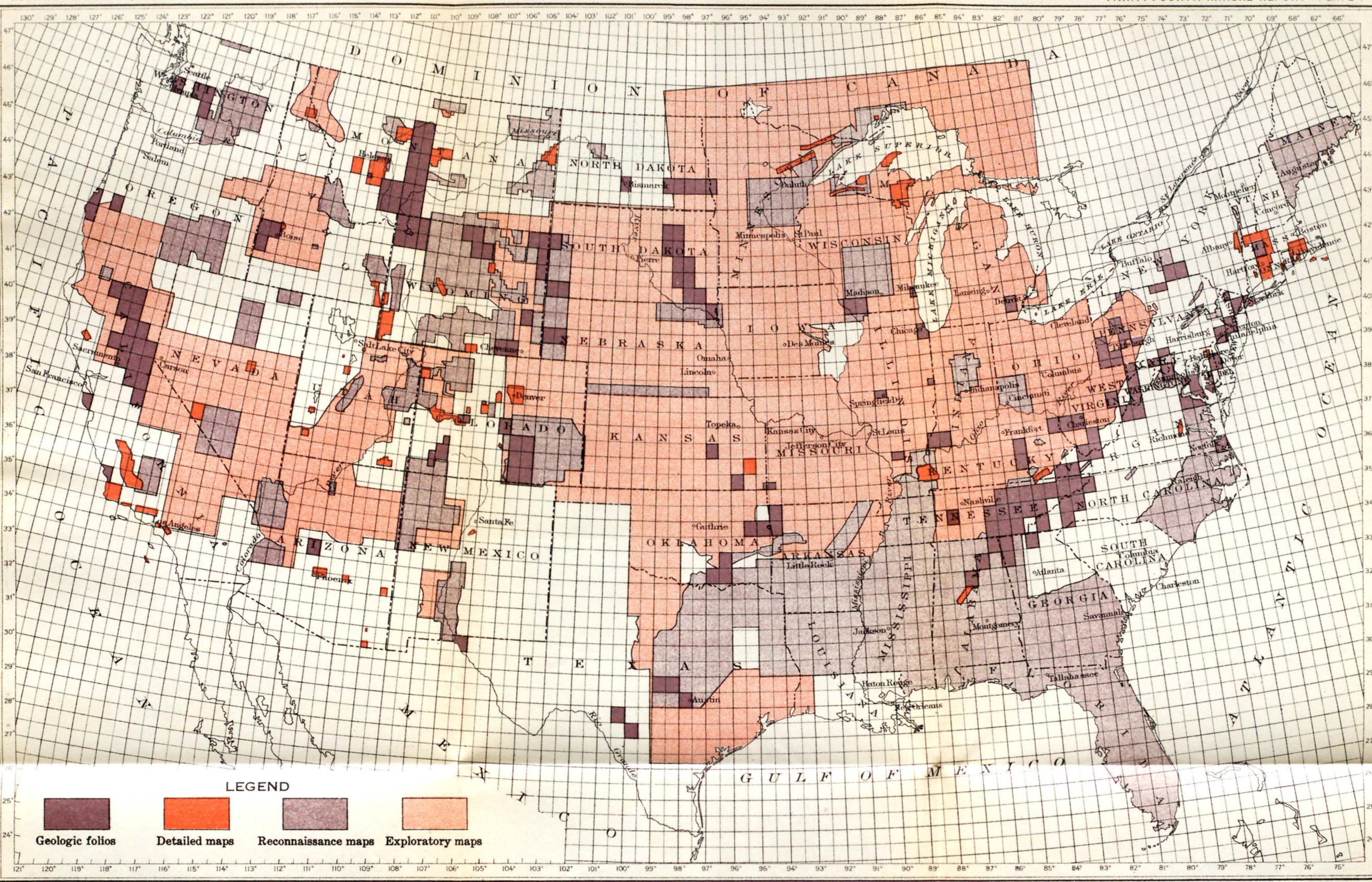
#### COOPERATION WITH FEDERAL BUREAUS AND STATE SURVEYS.

The cooperative funds expended during the fiscal year 1912-13 were as follows:

General Land Office, for coal classification-----	\$35, 000. 00
General Land Office, classification of Northern Pacific land grant-----	155. 64
Indian Office, classification of land in Indian reserva- tions, Montana, Washington, Oklahoma, California, and Idaho -----	11, 024. 25
Department of Justice (reimbursements)-----	556. 12
Cooperation with States and official organizations-----	3, 750. 00
	<hr/> 50, 486. 01

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 coal and oil lands.

Since last year, agreements for cooperation in geologic investigations have been entered upon by the State geological surveys of Virginia and Minnesota and by the Oregon Bureau of Mines and Geology. Cooperation in the collection and study of deep-well records



MAP OF THE UNITED STATES, SHOWING AREAS COVERED BY GEOLOGIC MAPS PUBLISHED PRIOR TO JULY 1, 1913

Scale 1:4,000,000  
100 0 100 200 300 400 500 Miles

and drill samples is carried on by the State Geological Survey of Illinois and by the Bureau of Economic Geology and Technology of the University of Texas. An arrangement with the Bureau of Mines for cooperation in the metallographic study of ores is effective July 1, 1913. In the cooperative agreements for geologic work with the States of Maryland, Alabama, Illinois, Minnesota, and Missouri it is provided that the funds contributed by the States shall be handled by the local organization. In the cooperative agreements with Oklahoma, Oregon, Maine, Virginia, and Tennessee the cooperative funds contributed by the States have been disbursed by the United States Geological Survey.

This Survey also cooperates with the Smithsonian Institution and the Isthmian Canal Commission in the study of geologic problems of the Canal Zone under arrangement by which the Survey makes chemical analyses, makes paleontologic investigations and reports, and provides thin rock sections for petrologic examination. In several lines of research there is informal cooperation with the Carnegie Geophysical Laboratory.

#### GENERAL FEATURES OF THE WORK.

The general duty of the division is to prepare a geologic map of the United States, to classify public lands, to make investigative surveys of mineral deposits, and to undertake such geologic and paleontologic researches as may be connected with this work. The preparation of a geologic map includes both detailed and reconnaissance investigations. Research work in petrology, mineralogy, and paleontology is absolutely indispensable, for without it the geologic work degenerates and the product becomes weak and superficial. It is suicidal to separate the so-called scientific work from work of immediate practical utility.

Many problems that arise must be solved by specialists; such are, for instance, those concerning coal deposits or metalliferous deposits and questions of physiography, paleontology, petrology, or glaciology. It would, however, be most unwise to limit too strictly the scope of the work of those chiefly interested in one subject. Thus a geologist studying the mineral deposits of a given area should be expected not to confine himself to this narrow subject, but to extend his investigations into stratigraphy and structure. He may require the aid of other specialists if the problems should prove to be unusually complex. The geologists of the Survey, even those who specialize in certain subjects, must be men of general experience and such breadth of view as to enable them to handle satisfactorily the various problems in one area.

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 scientific 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 both of these distinguished senior geologists of the Survey is reported directly to the chief geologist.

The relations between the ten sections and subsections of the division of geology are to some extent difficult to define with accuracy because their fields of operation overlap in various ways. The points of overlap are, however, places of teamwork rather than of discordance or conflict, the spirit of the organization being admirable.

During the year services, varying in extent, have been rendered by the geologists of 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 establishment of Appalachian forest reserves in accordance with the provisions of the Weeks Act; to the Isthmian Canal Commission with respect to the geologic structure, stability, and resources of the Canal Zone; to the War Department as to depth and adequacy of possible underground water supplies at several points in Texas; and to the Post Office Department in connection with the investigation of fraudulent mining promotion. The Department of Justice has made frequent demands on the services of the geologists of the Survey in connection with the prosecution of suits regarding the public lands.

#### SCOPE OF THE WORK OF THE SECTIONS.

The scope of each of the several sections of the division of geology may briefly be outlined in the following synopsis. The demands made by administrative and committee work, conferences and inspection of field work in different regions, leave to the geologists in charge of the sections very little opportunity for individual work on independent projects, yet some such investigation has been carried forward by each chief of section, as will be noted in the description by States of the work of the division.

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 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 work in the section of eastern areal geology has been carried on by Arthur Keith, D. B. Sterrett, L. M. Prindle, F. B. Laney, B. K. Emerson, F. Bascom, F. J. Katz, C. D. Smith, W. B. Clark, B. L. Miller, R. H. Wood, H. D. Miser, and others, on projects affecting the States of Alabama, Arkansas, Delaware, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Vermont, and Virginia.

2. The subsection of Coastal Plain investigations—T. W. Vaughan, geologist in charge—was restored in June to its former rank of section. It is occupied primarily with the study of the numerous geologic formations of the Atlantic and Gulf Coastal Plain, their character, extent, equivalence, general structure, conditions of deposition, and history, and 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 reconnaissance work. Its office investigations are comprehensive and broadly scientific as well as economic.

In connection with the study of the formations and fossils of the Coastal Plain region and of the Isthmian Canal Zone it has been found possible, through the cooperation of several organizations and individuals, including the Carnegie Institution, the Smithsonian Institution, the Bureau of Fisheries, J. B. Henderson, and others, to accumulate and coordinate very important data that are indispensable for the correlations of the eastern formations with those of the Pacific coast, and invaluable in working out the geologic history not only of the Gulf Coastal Plain but of the Central American and Antillean regions. In addition to the work of the geologists, T. W. Vaughan, W. H. Dall, L. W. Stephenson, G. C. Matson, Alexander Deussen, E. W. Berry, and C. W. Cooke, who have given at least a part of their time to the work of this section, the section has received cooperative aid from J. A. Cushman, who has continued his studies of the Cretaceous and Tertiary Foraminifera of North America; from R. S. Bassler, of the National Museum, and F. Canu, of Versailles, France, who are monographing the Tertiary Bryozoa of the Coastal Plain; from Miss M. J. Rathbun, of the National Museum, who is describing the Crustacea of the same formations; from the Bureau of Fisheries, in the examination of the sediments about the Mississippi Delta; and from the Smithsonian Institution, in the investigations of the Canal Zone, the calcareous algæ of which are being studied by M. A. Howe, of New York, the echinoids by W. B. Clark, of Johns Hopkins

University, and the fossil vertebrates by J. W. Gidley, of the National Museum.

The field and office researches of the section concern all the coastal States from Virginia to Texas, inclusive, together with Arkansas, Tennessee, Kentucky, Indiana, and Illinois, also the Canal Zone.

3. 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.

On account of the wide distribution and the great diversity of igneous and metamorphic rocks requiring petrologic study for classification and correlation in this province, the subsection of petrologic investigations—E. S. Larsen, jr., associate geologist in charge—is attached to the section of western areal geology, although it is responsible for the petrologic examinations of rocks, revision of manuscripts relating to petrology, and all other petrologic work for the division of geology.

The following geologists, among others, have done work in the section of western areal geology during the year: F. L. Ransome, Whitman Cross, J. S. Diller, Sidney Paige, N. H. Darton, Adolph Knopf, G. B. Richardson, Geo. I. Finlay, F. C. Calkins, W. H. Emmons, A. C. Lawson, Eugene Stebinger, L. G. Westgate, J. B. Umpleby, R. W. Richards, G. R. Mansfield, D. F. Hewett, E. L. Jones, jr., P. V. Roundy, E. S. Larsen, J. F. Hunter, W. W. Atwood, and H. G. Ferguson.

The activities of the section have concerned the States of California, Colorado, Idaho, Montana, New Mexico, South Dakota, Texas, Utah, Wyoming, and the Hawaiian Islands.

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 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 responsible for the classification and mapping of the Pleistocene deposits of the glaciated regions.

The work of this section during the year has engaged the services of W. C. Alden, Frank Leverett, F. W. Sanderson, F. B. Taylor, N. M. Fenneman, and Eugene Stebinger, and has comprised field studies and mapping and the preparation of reports touching areas in the States of Maine, Massachusetts, Minnesota, Montana, and New York.

5. The section of paleontology and stratigraphy—T. W. Stanton, geologist in charge—is responsible for the determination of the relative ages of the various sedimentary formations, for the correlation of the strata in different areas, and for the reference of the forma-

tions to a geologic time scale. The paleontologists are engaged also incidentally in working out the sequence and characters 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. This is accomplished through the patient study of the remains of animals and plants of innumerable kinds found fossilized in the different sedimentary formations. 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 in this section, which includes the services, for at least portions of the year, of T. W. Stanton, W. H. Dall, E. O. Ulrich, F. H. Knowlton, G. H. Girty, E. M. Kindle, H. S. Williams, J. P. Smith, E. T. Kirk, and others, is practically coextensive with that of the division 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.

The reports of the paleontologists are usually comprehensive. A single manuscript may embody the results of portions of the work done in aid of geologists in several sections scattered over a wide area of the country. Very often fossil material from several States and regions will be under examination at once by a paleontologist; hence, in the account of the work of the branch by States, mention will be made only of those in which the paleontologist is making a special and somewhat circumscribed study.

6. The section of metalliferous deposits not only studies metalliferous deposits and mines and investigates the conditions and methods of ore deposition, but also carries on reconnaissance geologic examinations of many 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.

Since the resignation of Waldemar Lindgren from regular service in the Survey, November 16, 1912, this section has been in charge of F. L. Ransome, geologist. The numerous duties attached to the administration of this section and the section of western areal geology leave little opportunity to the geologist in charge for original investigation. Valuable scientific work has, nevertheless, been accomplished in connection with the field conferences and inspections of the work in different areas. Field and office work in this section has been done by Waldemar Lindgren, F. L. Ransome, A. C. Spencer, W. H. Emmons, F. B. Laney, C. E. Siebenthal, E. F. Burchard, E. S. Bastin, B. S. Butler, F. C. Calkins, E. L. Jones, jr., H. G. Ferguson, F. L. Hess, Adolph Knopf, Edwin Kirk, G. F. Loughlin,

F. C. Schrader, J. M. Hill, J. F. Hunter, jr., J. B. Umpleby, J. T. Pardee, R. W. Stone, and J. D. Irving on projects which will be referred to in the description of the investigations of the division in the States of Alabama, Arizona, California, Colorado, Georgia, Idaho, Missouri, Montana, Nevada, New Jersey, Oklahoma, Tennessee, Utah, Washington, and Wyoming, and Dutch Guiana.

7. The section of nonmetalliferous deposits 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 or ores are of paramount importance. Among the more important of the mineral resources with which the section is especially concerned are clay, cement rock, limestone, salt, borax, phosphate, sand, and building stone.

This section is administratively like the section of metalliferous deposits or the fuel sections. Since the resignation of F. B. Van Horn, July 31, 1912, to engage in private work, the section has been in charge of H. S. Gale, geologist.

During the year the greater 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 classification of the phosphate-bearing lands withdrawn from entry in Idaho, Wyoming, and Montana.

Work in this section has been performed by H. S. Gale, W. C. Phalen, R. W. Richards, G. R. Mansfield, J. H. Hance, E. H. Finch, Eliot Blackwelder, and C. E. Watson as described on later pages, in the States of Arizona, California, Georgia, Idaho, Montana, Nebraska, Nevada, New Mexico, Tennessee, and Utah.

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 often 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 in 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, Tennessee, Missouri, and Oklahoma. Noncooperative work has been carried on in Ohio, Kentucky, Kansas, Alabama, West Virginia, Massachusetts, Louisiana, and Texas. The following geologists participated in the activities of the section: David White, G. H. Ashley, Charles Butts, M. J. Munn, E. W. Shaw, G. C. Matson, Henry Hinds, R. H. Wood, D. D. Condit, C. A. Davis, and F. C. Green, the aid of the two last named being given respectively through the courtesy of the Bureau of Mines and the Bureau of Geology and Mines of Missouri.

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 in North Dakota, South Dakota, Montana, Wyoming, Colorado, New Mexico, Utah, Washington, Oregon, Idaho, and California. Work in this section, a part of which 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, has been performed by the following geologists: M. R. Campbell, E. G. Woodruff, M. A. Pishel, F. A. Herald, C. M. Bauer, E. M. Parks, D. E. Winchester, E. R. Lloyd, C. J. Hares, G. S. Rogers, H. M. Robinson, C. F. Bowen, H. S. Bassler, Eugene Stebinger, V. H. Barnett, D. F. Hewett, C. H. Wegemann, A. L. Beekly, E. T. Hancock, W. T. Lee, F. R. Clark, C. T. Lupton, M. W. Ball, J. H. Hance, C. A. Bonine, G. B. Richardson, Robert Anderson, R. W. Pack, R. G. Davies, and C. E. Leshner.

#### ASSISTANCE TO OTHER DIVISIONS.

In addition to the work done in their 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 of a large number of mineral resources with which they are especially familiar. Portions of the salaries of some of these geologists are paid from the funds of the division of mineral resources; for others the traveling and field expenses necessary for the collection of data are paid 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 in the report of the chief of 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 industry.

The paleontologists of the division of geology report on all fossil collections for the division of Alaskan mineral resources, and a part of the time of several of the geologists is given to the land-classification board. Constant interchange of information is made with the water-resources branch.

#### COMMITTEE ON GEOLOGIC NAMES.

An important standing committee of the geologic branch is the committee on geologic names, which consists 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 clerical work of the committee is performed by Miss M. G. Wilmarth, who is designated secretary.

According to the Director's instructions of January 30, 1909, "It is the duty of the committee on geologic names to consider all geologic names used by members of the Geological Survey in both official and unofficial publications. When manuscripts are received by the committee they shall be examined as soon as practicable and the committee shall decide whether the names employed are permissible or not."

The chief objects of the committee are to insure uniformity in geologic classification and nomenclature in survey publications, to prevent unnecessary duplication of geologic names, and to reduce if possible the number of names employed, through correlation of the formations from one area to another. The main criteria on which the decisions of the committee are based are priority of publication, significance acquired by usage, and adequacy of definition and type locality. No one of these criteria is relied on to the exclusion of the others.

The records of the committee comprise (1) a catalogue of geologic names considered by the committee, arranged alphabetically, the action taken for each manuscript being recorded; (2) a catalogue of American geologic names in the literature, also arranged alphabetically, each published description of a formation being recorded (this catalogue is the work of J. M. Nickles, of the library staff); (3) a catalogue of the geologic names in the literature, arranged by States; (4) a catalogue of geologic columnar sections approved by the committee, arranged by States, the area to which each columnar section applies being located on the appropriate State map diagram; and (5) a catalogue of geologic columnar sections in the United States, classified by States, compiled from existing literature, the areas being located on a set of State maps. The last catalogue is not complete, but is being brought up to date as rapidly as possible. It is designed to prevent unnecessary duplication of geologic names. All these records, except as noted above, have been prepared and are kept up to date by the secretary of the committee.

During the year the committee on geologic names has considered 181 manuscripts, comprising 15,207 pages and involving about 2,600 geologic names.

#### WORK OF THE DIVISION BY STATES AND COUNTRIES.

The work done by the division of geology during the year affected the 45 States listed below, the Canal Zone, Dutch Guiana, and the Hawaiian Islands:

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

## ALABAMA.

The field investigations of the red-ore deposits of northeastern Alabama were completed by E. F. Burchard in June. This work connects that done in the Birmingham region, described in Bulletin 400, with the studies of the red iron ores of eastern Tennessee, recently contributed for publication by the Tennessee State Geological Survey, and a short preliminary report on the work was prepared for "Contributions to economic geology, 1912, Part I" (Bulletin 540-G).

A brief inspection of the formations and structure in the Columbian quadrangle was made early in the spring by Arthur Keith and Charles Butts, who found the "Ocoee" strata thrust many miles over the younger Paleozoic formations. The manuscripts and maps for the Bessemer-Vandiver and Montevallo-Columbiana folios have been prepared by Mr. Butts and submitted for publication.

A brief examination was made of several reported oil prospects in the northern part of the State. The conclusions will be reported in a bulletin on the southern Appalachian oil and gas fields now in preparation by M. J. Munn.

The manuscript for a professional paper on the fossil floras of the Tuscaloosa, Eutaw, and Ripley formations of the eastern Gulf region has been transmitted by E. W. Berry.

A special report on the prospects for underground water at Troy was prepared by L. W. Stephenson and transmitted to the municipal executive of that city.

## ARIZONA.

A short paper on the Superior copper district, Ariz. (in Bulletin 540-D), has been completed by F. L. Ransome, who has made progress on the report on the Ray and Miami copper districts. Mr. Ransome has also prepared brief papers on the Bisbee, Globe, Miami, Ray, and Jerome districts for inclusion in the bulletin by W. H.

Emmons on sulphide enrichment (Bulletin 529), and has in hand a report on the Tombstone district and a folio on the Ray quadrangle. Mr. Ransome is accumulating material for a paper on the geology and ore deposits of Arizona.

The deposits of celestite in Maricopa County was examined by W. C. Phalen and has been described in a paper submitted for publication in "Contributions to economic geology, 1912, Part I" (Bulletin 540-T).

The mineral deposits of the Santa Rita and Patagonia mountains in the Patagonia and Nogales quadrangles have been somewhat fully described by F. C. Schrader in a bulletin submitted for publication.

Two short papers, one by J. M. Hill, entitled "Copper deposits of the White Mesa district, Arizona" (in Bulletin 540-D), and the other by F. C. Schrader, describing a newly recognized occurrence of alunite near Patagonia (in Bulletin 540-I), have been submitted for publication.

#### ARKANSAS.

The geology of the DeQueen quadrangle, Ark., was areally mapped for folio publication by H. D. Miser, assisted by R. D. Messler. Portions of the maps of the Caddo Gap and Hot Springs quadrangles were revised by Mr. Miser, the work being necessary for the completion of folios for these two quadrangles under joint authorship of Mr. Miser and A. H. Purdue. Mr. Miser also prepared for publication in the "Contributions to economic geology, 1912, Part I" (Bulletin 540-U), a short description of the new diamond localities in Arkansas.

A bulletin on the fauna of the Batesville sandstone was submitted by G. H. Girty for publication, and paleontologic examinations of the older Paleozoic formations in the Ozark region were made by E. O. Ulrich.

Additional studies of the stratigraphy, structure, and physiography of parts of eastern and northeastern Arkansas were made by L. W. Stephenson, who also made supplemental studies of the Cretaceous rocks in southwestern Arkansas. A report on the underground waters of the eastern part of the State, by Mr. Stephenson and A. F. Crider, formerly a geologist of the Survey, is now practically complete, though its submittal is delayed pending the preparation of a chapter by R. B. Dole, of the water-resources branch, on the chemistry of the waters.

#### CALIFORNIA.

During the field season of 1912 a large part of the Weaverville quadrangle, Cal., was mapped by J. S. Diller, assisted by H. G. Ferguson, for folio publication. Field work in this quadrangle was re-

sumed in June, when incidentally Mr. Diller examined and reported on the classification of the Igo town site, in Shasta County. A preliminary report on the auriferous gravels of the Weaverville quadrangle was prepared and submitted by Mr. Diller, and a report on the gold lodes of the same area was completed by Mr. Ferguson, both for publication in Bulletin 540-A. A reconnaissance study of the gold deposits near Allegheny and Forest, in Sierra County, was made by Mr. Ferguson in May.

The report on the geology and ore deposits of the Randsburg quadrangle, on which F. L. Hess has been engaged, has been much delayed on account of the demand on him for statistical reports on the rare metals for inclusion in the reports of the division of mineral resources.

A detailed reconnaissance of the southern 70 miles of the White Mountain Range, in Inyo County, was made by Adolph Knopf, assisted by Edwin Kirk, who together mapped an area of about a thousand miles on the 1:250,000 scale. A preliminary account of the geology and a detailed description of the mineral resources were embodied in a paper submitted for publication in "Contributions to economic geology, 1912, Part I" (Bulletin 540-B). Two papers by Mr. Knopf on ore deposits were submitted to scientific journals during the year. The paleontologic materials of the region are being studied by Mr. Kirk. A reconnaissance examination of the Darwin silver and lead district was made by Mr. Knopf in May.

As a result of the examinations of several mining camps in the northern part of the State adjacent to Nevada, studied by J. M. Hill, he submitted for publication as a bulletin a short paper entitled "Some mining districts in northeastern California and northwestern Nevada."

The new developments in the magnesite industry in the State were examined by H. S. Gale, who also made a brief study of the borate deposits in Ventura County. Papers embodying the results of this work have been submitted for "Contributions to economic geology" (Bulletin 540, chapters S and O).

In connection with the search for potash, a study of the saline deposits in several of the desert basins of southern California and Nevada was made by Mr. Gale. This review included the region about Carrizo Plain, Owens Valley, Saline Valley, Indian Wells Valley, Searles Lake, Panamint Valley, and Death Valley. Some of the results of these examinations are included in two papers entitled "Notes on the Quaternary lakes of the Great Basin with special reference to potash and other salines" (in Bulletin 540-N) and "Origin of colemanite deposits" (Professional Paper 85-A). These papers have been submitted for publication by the Survey.

The solar salt plants on the California coast were examined by W. C. Phalen and the results of the examination will be included in a paper on the saline deposits of the country. A deposit of celestite in San Bernardino County was also investigated by Mr. Phalen, who has described the occurrence in Bulletin 540-T.

A brief visit to the region north of the Coalinga oil field to obtain data on recent drillings was made in September by Robert Anderson, who spent a few days also in the Elk Hills district investigating the land recently withdrawn as an oil reserve for the Navy.

A detailed study of the geology of the foothills at the south end of the San Joaquin Valley between the Kern River and Temblor Range oil fields was completed by R. W. Pack, assisted by R. G. Davies. Messrs. Pack and Davies also made a reconnaissance examination of an area near Barstow, in the Mohave Desert, and a brief report on this area was submitted for publication as Bulletin 541-E. Near the close of the field season Mr. Pack made a brief reconnaissance of the area lying north of the Kern River oil field and previously withdrawn as possible oil land. A part of this area that is of doubtful value as oil land but of considerable value as agricultural land has been restored to entry. Some time was also spent by Mr. Pack in the Temblor Range and in the Kern River oil fields, obtaining data on recent developments.

A report on the geology and possible oil resources of a part of the Diablo Range by Robert Anderson and R. W. Pack has been submitted for publication. A report on the Kern River oil field is now in preparation by Mr. Pack, who, since the resignation of Mr. Anderson on January 20, has had sole charge of work in the oil fields of the State.

Progress has been made in the study and description of the marine Triassic faunas of California and other Western States by J. P. Smith.

#### COLORADO.

The comprehensive studies of the San Juan Mountain region that for several years have been carried on by Whitman Cross and his associates have this year been continued in the field by E. S. Larsen, jr., assisted by J. F. Hunter, jr. The work consisted in continuing the geologic mapping of a portion of the Ignacio quadrangle, on the south side of the mountains, with a revised topographic base; completing the geologic map of the San Cristobal quadrangle, in the central part of the San Juan Mountains; and surveying the geology of the Uncompahgre quadrangle. Within the area last named are the iron-bearing deposits adjacent to Cebolla Hot Springs. The geology of this district proved to be unusually complex. In conjunction with the investigations by Mr. Cross, office work on reports dealing with the

Pleistocene deposits and history of the Ignacio and San Cristobal quadrangles was performed by W. W. Atwood and his assistant, K. F. Mather.

In the autumn the study of the pre-Cambrian formations adjacent to the Gunnison Canyon, in the northern part of the Uncompahgre quadrangle, was continued by Mr. Hunter. In November Mr. Larsen completed his study of the mining camp at Creede, and in the latter part of June he made an examination of the geology of Wagon Wheel Gap, on the Rio Grande, for a report to the Forest Service on certain areas selected for experiments on the relation of forest cover to run-off. The report on the areal geology of the Creede district has been nearly completed by Mr. Larsen, who, assisted by Mr. Hunter, has been engaged in the preparation of the Uncompahgre folio, working especially on the pre-Cambrian rocks. A paper on the hot springs and mineral deposits of Wagon Wheel Gap was prepared by Mr. Larsen and W. H. Emmons for publication in one of the scientific journals.

Additional observations about the mines at Creede were made by W. H. Emmons, who is preparing a report on the ore deposits of that district. Mr. Emmons is also gathering material for an enlarged and illustrated edition of Bulletin 529, "The enrichment of sulphide ores."

The report on the ore deposits of Leadville, on which J. D. Irving had been engaged with S. F. Emmons at the time of the latter's death in 1911, has been continued under contract by Mr. Irving, but, owing to its interruption by illness and other unfortunate contingencies, this task, which has proved unexpectedly difficult, is still far from complete.

The report on the economic geology of the Central City district, by E. S. Bastin, is now nearly complete. Some time was spent by Mr. Bastin, in collaboration with Chase Palmer, of the division of physics and chemistry, in research on the precipitative action of metallic minerals upon gold and sulphur in solution. A short paper containing some of the results of this investigation was printed in the *Journal of Geology*.

A very brief examination of a portion of the Hardscrabble mining district, in Custer County, was made by J. F. Hunter, jr.

For several years a study of the stratigraphy of the coal-bearing formations of the southern part of the Rocky Mountain region has been prosecuted by W. T. Lee, who has obtained much valuable information regarding the age and correlation of the various formations and the physical conditions under which they were deposited. This work is so important that it was extended northward in the spring of 1913, when Mr. Lee, in association with E. T. Hancock, made a special examination of the geologic formations of the Yampa

coal field. The fossil plants of the region have been studied by F. H. Knowlton, who has submitted reports on the floras of the Raton Mesa coal field of Colorado and New Mexico and on the flora of the Miocene deposits near Florissant.

The southwestern Colorado coal field, a considerable area of which was studied in 1911 by M. A. Pishel for the purpose of mapping the workable coal in the Dakota sandstone, was not visited by Mr. Pishel in 1912, on account of the short period available for field work, but some time has been devoted by him in the office to the preparation of a report on this region which is now well advanced toward completion. Mr. Pishel also contributed to the Coal Age a short paper entitled "The Pishel coking test."

The detailed surveys begun in the Meeker quadrangle in 1911 were continued northward and eastward in 1912 in the Axial and Monument Butte quadrangles, lying partly in the Yampa coal field, in Routt and Moffat counties, the geologic work being done from the camp of the party making a topographic survey of the same area. Although, on account of the great number of coal beds and the voluminous exact data gathered regarding both vertical and horizontal locations and outcrops, the work was laborious and difficult, an area of 298 square miles was examined in great detail by E. T. Hancock, who completed the work on the Axial quadrangle and has prepared a portion of a folio text covering the quadrangle.

A careful reconnaissance survey of North Park was made in order to determine, if possible, the extent of the coal beds and the quality of the coal in the North Park coal field, concerning which the data available had previously been found to be inadequate. Special examinations of the park were therefore made by A. L. Beekly, assisted by George I. Finley, R. S. Bassler, and E. H. Finch, in order to supply necessary material for a report, which was submitted by Mr. Beekly for publication prior to his resignation from the Survey in June. The general stratigraphy and invertebrate paleontology of the region mapped by Mr. Beekly were examined by T. W. Stanton, who also reviewed for the purpose of correlation the formations in several portions of southern Colorado.

A small area in Middle Park was examined by M. R. Campbell to determine whether or not it should be classified as coal land.

The work in the Colorado Springs and Castle Rock quadrangles, for which folios by G. I. Finlay and G. B. Richardson are nearly ready for publication, was inspected by Mr. Ransome.

#### DELAWARE.

The study of the detailed stratigraphy and areal geology of the Elkton and Wilmington quadrangles, Del., has been completed by B. L. Miller, assisted by M. I. Goldman. Through the cooperation

of the Maryland Geological Survey the gneisses and related rocks of these quadrangles have been examined by Florence Bascom.

A paper discussing the underground water supply of the State is under revision.

#### FLORIDA.

The study of the corals and the reefs of Florida, by T. W. Vaughan, has given results of great scientific value. The observations on the rate of growth of these corals are now sufficiently complete to afford accurate information regarding practically all the known Florida reef species, so that it is possible to estimate the rate at which the reefs are growing. Mr. Vaughan discovered that the food of corals, concerning which little was previously known, consists entirely of animal plankton.

Studies of the mode of formation of oolite and of the oolitic limestones, which are abundant in southern Florida and in the Bahamas, have been successfully prosecuted by Mr. Vaughan.

The Foraminifera discovered in various rock sections and in a large number of the samples collected in the course of the Coastal Plain work in the State have been identified by J. H. Cushman. In addition, he has made a preliminary study of the Foraminifera of certain deep wells of Bermuda and of Key West.

The report on the fauna of the "silex beds" of the Tampa formation, which throw much light on the distribution of land animals in the Central American and Carribean regions, as well as in North America, has been completed by W. H. Dall and submitted for publication.

#### GEORGIA.

The red iron ores of northwestern Georgia have been examined by E. F. Burchard and are described in a paper on the red iron ores of east Tennessee, northeast Alabama, and northwest Georgia (Bulletin 540-G).

A very brief examination of the bauxite deposits in the State was made by W. C. Phalen for the purpose of obtaining information for inclusion in a report on the production of bauxite for the division of mineral resources. Some work was done by Mr. Phalen in editing and revising his contribution to the section on economic geology in the *Ellijay folio*.

A report on the underground water resources of the Coastal Plain of the State was prepared by L. W. Stephenson and Otto Veatch, the latter representing the State Geological Survey, in cooperation with which the work was done.

## IDAHO.

Thirteen mining districts in southeastern Idaho, north of Snake River, were covered in a geologic reconnaissance in the summer of 1912 by J. B. Umpleby, who has submitted a preliminary paper on the Dome district (in Bulletin 540-E). Administrative duties in connection with the section of metalliferous deposits and the claims of service on the metalliferous section of the land-classification board have delayed the completion of Mr. Umpleby's final report, which is, however, well advanced. He resumed the study of the ore deposits in June, when he visited the mining districts of the Middle Fork drainage basin, in the central part of the State.

The areal and economic geology of the northeastern part of the area known provisionally as the Taff quadrangle was mapped and studied for folio publication by F. C. Calkins, assisted by E. L. Jones, jr., the work being done from the camp of the party engaged in the topographic survey of the quadrangle. Incidentally opportunity was found to review the mining developments which have taken place since the publication of the report on the Cœur d'Alene district (Professional Paper 62) in the vicinity of Mullan and Wallace, in the area that is common to both the Taff and Cœur d'Alene quadrangles. A preliminary report containing some results of the field work of the season has been prepared by Messrs. Calkins and Jones for publication in "Contributions to economic geology, 1912, Part I" (Bulletin 540-E).

The classification of Northern Pacific Railroad grant lands in T. 49 N., R. 3 W., Boise meridian, listed in 1911, was accomplished by E. L. Jones, jr., who submitted a report. While awaiting the passage of the sundry civil bill, F. C. Calkins spent a short time in adjusting the geologic evidence relating to the contested classification of a part of the Northern Pacific land grant in this State. Later he examined additional areas in the Northern Pacific land grant for classification.

The geologic mapping of the Hailey quadrangle was begun in June, 1913, by L. G. Westgate, who will study the areal and structural geology. The ore deposits of the quadrangle are being examined by J. B. Umpleby, who will extend his work to other mining camps of the region.

A folio to cover the Montpelier quadrangle was completed by R. W. Richards, assisted by G. R. Mansfield, the field work being done in connection with the investigation of the phosphate deposits of the region.

Detailed land-classification surveys in southeastern Idaho have been made by G. R. Mansfield, assisted by E. H. Finch, and reports covering this work have been submitted to the land-classification board

At the request of the Commissioner of Indian Affairs for the classification of the lands in the Fort Hall Indian Reservation the examination of the lands underlain by phosphate-bearing formations was begun by G. R. Mansfield in June.

The invertebrate faunas of the Carboniferous formations in several of the areas under investigation were examined in the field by G. H. Girty, the correlative results being communicated for the use of the areal geologists.

The Hayden coal field, lying southeast of St. Anthony, in Fremont County, was geologically studied by E. G. Woodruff, who collected data sufficient for the classification of the land and who prepared for publication a brief account of its geology and coal resources.

#### ILLINOIS.

In the course of the study of the Illinois coal fields in cooperation with the State Geological Survey the geology of the Centralia quadrangle was mapped by E. W. Shaw and that of the Colchester and Macomb quadrangles by Henry Hinds, who near the close of the field season was assisted by G. S. Rogers. A short report on the economic resources of the two latter quadrangles by Mr. Hinds has been transmitted for publication by the State survey. As a part of the cooperative work the Pleistocene formations in the Waterloo quadrangle were mapped for a geologic folio by Mr. Shaw, who also inspected the Pleistocene of the Colchester and Macomb quadrangles. Later Mr. Shaw extended his studies of the surficial geology and physiography to the south end of the State and to the lower reaches of the Mississippi Valley with a view to correlating the Pleistocene features and formations of the upper Mississippi basin with those of the Gulf embayment. He also prepared a folio manuscript to cover the Carlyle and Centralia quadrangles.

G. H. Girty and E. O. Ulrich made special examinations of the Mississippian formations at several points in the southern part of the State in conferences with cooperating geologists of the Illinois and Missouri geological surveys in order to establish more definitely the interstate correlations of several of the formations.

#### INDIANA.

The Pleistocene deposits of the northern part of Indiana were examined by E. W. Shaw in order to trace the terraces and individual formations southward into the Gulf embayment.

#### KANSAS.

The Pleistocene formations in the vicinity of Leavenworth, Kans., have been examined by E. W. Shaw for mapping in the Leaven-

worth-Smithville folio, now in preparation under a cooperative agreement with the Missouri State Bureau of Mines and Geology.

The zinc deposits in the extreme southeast corner of Kansas have been further investigated by C. E. Siebenthal, and will be discussed in the Wyandotte folio and in a bulletin on the genesis of the ores of the Joplin district.

The fossil floras accompanying the lower coals worked in the vicinity of Mulberry were examined in the field by David White for use in the correlation of the lower Cherokee coals of Kansas and Missouri, and in the determination in this region of the equivalent of the Pottsville in the Cherokee shale.

#### KENTUCKY.

The northwestern third of the Pound quadrangle, recently surveyed in the southwestern Virginia coal field, overlaps across the eastern border into Kentucky. This area, which includes newly opened mines near Jenkins, was surveyed by Charles Butts, who has prepared a description of the structure and coal resources of the quadrangle to be submitted for publication by the Geological Survey of Virginia.

The Mississippian rocks at several points in western Kentucky were visited in a brief reconnaissance by G. H. Girty and E. O. Ulrich, for purposes of correlation, and the Pleistocene deposits of the Mississippi Valley were examined by E. W. Shaw.

A folio (No. 184) covering the Kenova quadrangle was issued early in the year.

#### LOUISIANA.

A preliminary examination of the composition, structure, and mode of growth of the Mississippi Delta was made by E. W. Shaw for the purpose of determining, if possible, the nature and cause of the "mud lumps" which occasionally rise in the mouths of the Mississippi and seriously obstruct navigation. The origin of this phenomenon has not been fully explained. The mud volcanoes and their gas emanations were also considered by Mr. Shaw and have been described by him in a paper in "Contributions to economic geology, 1912, Part II" (Bulletin 541-A). A short description of the mud lumps is soon to be issued in the "Contributions to general geology, 1913" (Professional Paper 85-B). In June, 1913, an opportunity was given, through the courtesy of the Bureau of Fisheries, to Mr. Shaw to collect samples of the bottom muds of the Gulf in the region of the Delta. Representative sediments were selected from a large number of samples for complete chemical analyses.

In the later part of the year the geologic structure in the vicinity of Shreveport, Caddo Lake, Pine Prairie, and several other points in

the northern part of Louisiana was examined by G. C. Matson for the purpose of determining more exactly the relations of the oil and gas to the structure of the rocks, and to discover, if possible, new areas structurally favorable for the occurrence of oil. Reports on this work, which was carried on in connection with studies of the Coastal Plain formation in the State, are now in preparation by Mr. Matson.

A report on the fossil floras of the Oligocene in the State was submitted by E. W. Berry for publication by the Survey.

## MAINE.

The areal and economic surveys of the Portland and Casco Bay quadrangles, Maine, carried on in cooperation with the State Water Storage Commission, were completed by F. J. Katz, who has made good progress in the preparation of the folio text for these quadrangles. In November he was joined by W. C. Alden for a conference on the Pleistocene deposits in the Portland quadrangle. A preliminary paper by Mr. Katz describing the geology of the Portland region has been prepared for publication in the report of the State commission.

In connection with the areal mapping of the geology of the above-mentioned quadrangles, studies of the extent and quality of the peat in the region have been made by C. A. Davis, who, by the courtesy of the Bureau of Mines, was transferred to the Survey for a short time for the purpose of examining peat bogs along portions of the southern New England coast. These examinations promise to afford most interesting evidence of changes of level of the land now in progress in these regions.

Pending the publication of the Eastport folio a short paper on the geology of the Eastport quadrangle, also surveyed in cooperation with the State, was prepared by E. S. Bastin for submission to the State Commission. The fossils of the Silurian formations of this quadrangle are described in a paper now being prepared by H. S. Williams.

A reconnaissance examination of the geology of the Boothbay quadrangle and an inspection of the mapping of the Portland and Casco Bay quadrangles have been made by Arthur Keith.

## MARYLAND.

Manuscript maps and folio descriptions of the Tolchester quadrangle, Md., surveyed in cooperation with the State Geological Survey, have been submitted for publication by B. L. Miller, and the areal mapping and study of the Coastal Plain in the Elkton and Wilmington quadrangles, also carried on under cooperation, have been completed by Mr. Miller, assisted by M. I. Goldman. The folio manuscript for these quadrangles is well advanced.

The gneisses of the Havre de Grace and Elkton quadrangles have been studied by Florence Bascom, who has nearly completed the maps and descriptions of the gneisses and similar rocks of the Elkton and Wilmington quadrangles for folio publication.

The fossil floras of the Upper Cretaceous formations of Maryland have been described in detail by E. W. Berry, and the fossil faunas and the character of the sediments are under investigation by Julia Gardner and M. I. Goldman.

The detailed study of the Carboniferous rocks of the Frostburg and Flintstone quadrangles has been nearly completed by C. K. Swartz, of the cooperating State Geological Survey, and the maps and descriptions of the remaining formations in the quadrangles have been completed by G. W. Stose for folio publication.

#### MASSACHUSETTS.

Substantial progress in the description of the complicated geology of the Boston and Boston Bay quadrangles, Mass., for the Boston folio, has been made by Laurence La Forge, who is engaged in the survey of the Framingham quadrangle, in order to include the results in the same folio. The Pleistocene deposits of these quadrangles were inspected by W. C. Alden early in November.

The geology of portions of the Becket quadrangle, in the western part of the State, has been reexamined by B. K. Emerson, who has submitted for publication, in joint authorship with T. N. Dale, the maps and text for a folio covering the Pittsfield and Becket quadrangles.

Folios covering the Belchertown, Barre, Palmer, and Brookfield quadrangles, of central Massachusetts, are now in preparation by Prof. Emerson. The eastern half of the Sheffield quadrangle has been mapped and described by Joseph Barrell in form available for later use in a folio.

Reconnaissance examinations were made by Arthur Keith in the Dedham, Salem, Andover, and Framingham quadrangles and special studies of the peat bogs in portions of the Boston and Framingham quadrangles have been carried on by C. A. Davis.

#### MICHIGAN.

The manuscript maps and descriptions for a folio on the Detroit quadrangle, Mich., prepared in cooperation with the State Geological Survey, have been completed and submitted for publication by W. H. Sherzer.

The results of recent exploration in the iron ranges have been assembled and compiled under the direction of C. R. Van Hise.

## MINNESOTA.

The field investigations necessary for the completion of the folio to cover the Herman and Barrett quadrangles, Minn., were carried out by F. W. Sardeson.

The collection of statistics and information regarding developments in the Lake Superior iron districts was continued under the direction of C. R. Van Hise.

Under a cooperative agreement entered into with the State Geological Survey in the autumn of 1912, the mapping of the Pleistocene deposits in the northern part of the State was begun by Frank Leverett, the study of the clays of the State was undertaken by F. F. Grout, and an investigation of the other building materials was begun by Oliver Bowles and A. W. Johnston.

## MISSISSIPPI.

The Pleistocene deposits and terraces in the region of Mississippi River have been studied by E. W. Shaw for the purpose of working out the Quaternary history of the region and of correlating the Quaternary features of the lower Mississippi Valley with the glacial and other Quaternary deposits of the upper part of the valley.

The marine invertebrate fossils of the Midway and associated formations in Mississippi are being investigated by C. W. Cooke for use in correlation with the formations in other parts of the Coastal Plain.

A report on the lower Oligocene floras of this State, Louisiana, and Texas has been submitted by E. W. Berry.

## MISSOURI.

After the publication by the Missouri Bureau of Geology and Mines of a general report by Henry Hinds on a reconnaissance economic examination of the coal fields of Missouri, made in cooperation with the State, the Queen City, Green City, and Smithville (formerly Mecca) quadrangles were cooperatively mapped in detail by F. C. Greene and M. Albertson, of the State bureau, under the supervision of Mr. Hinds. A brief economic report on the Novinger and Mendota coal fields, parts of which are included in the Green City and Queen City quadrangles, was prepared, through the courtesy of the State geologist, by Mr. Greene for publication by the Federal Survey.

During the winter and spring Messrs. Hinds and Greene were engaged in preparing a report upon the stratigraphy of the Pennsylvanian formations of the State, to be published by the Missouri Bureau of Geology and Mines, and material for the Leavenworth-Smithville and Green City-Queen City folios. Points of critical

interest in the Pleistocene deposits of these quadrangles were examined by the authors in conference with E. W. Shaw.

A report upon the genesis of the lead and zinc ores of the Joplin district has been completed by C. E. Siebenthal. The discussion of the origin of these ores has been reviewed after a study of the ores in the Wyandotte quadrangle in Oklahoma, and is contributory to the completion of the folio, and economic report on that quadrangle. The delay in work on this folio is due to large demands on Mr. Siebenthal's time for preparation of reports on the production of lead, zinc, and cadmium for publication as advance chapters of Mineral Resources.

In company with the representatives of the State, the stratigraphy and correlations of the older Paleozoic formations in the Ozark region were briefly examined by E. O. Ulrich, assisted by R. D. Mesler. The faunas of the Boone limestone (Mississippian) were also considered.

The Pleistocene formations of the southeastern part of the State were examined in a reconnaissance by E. W. Shaw in order to trace them southward for correlation with the deposits of the Mississippi embayment.

#### MONTANA.

The survey of the Blackfeet Indian Reservation, begun in 1911 by M. R. Campbell and Eugene Stebinger, was continued in 1912 by Mr. Stebinger, who completed the mapping of those parts of the Cutbank, Blackfeet, and Browning quadrangles lying within the reservation, 702 square miles being examined in detail and 400 square miles in careful reconnaissance. Portions of the area were reviewed for paleontologic correlation by T. W. Stanton. A rapid reconnaissance was made by Mr. Stebinger over about 500 square miles in Tps. 32 to 35 N., Rs. 4 to 8 E. Work in this Indian reservation was done under the joint auspices of the section of western fuels and the section of western areal geology, only a part of the region being coal-bearing. The land was classified and a report on the low-grade iron ores of the reservation has been submitted for publication (in Bulletin 540-H), while another report on the general geology of the region is in preparation. The Pleistocene geology of the area was studied by W. C. Alden, who spent a short time in the field with Mr. Stebinger.

In connection with this work a reconnaissance trip\* was made by Mr. Alden and Mr. Stebinger in southern Alberta northward to and including the valley of Oldman River and to Lethbridge on Belly River. On this trip they obtained important information concerning the pre-Wisconsin glacial drift in the region of Glacier National Park and its relations to the Albertan drift of Dawson and McDon-

ald. A paper on this subject was submitted by Messrs. Alden and Stebinger for publication in the Bulletin of the Geological Society of America.

An examination of the Plentywood lignite field north of the Fort Peck Indian Reservation, in Valley County, was made by C. M. Bauer, work being limited to several townships which had been surveyed by the General Land Office. For the territory, including 302 square miles examined in reconnaissance, Mr. Bauer submitted data for classification and a geologic report for publication (in Bulletin 540-K).

The Tullock Creek coal field, which lies just east of the junction of Yellowstone and Bighorn rivers, was examined by G. S. Rogers, assisted by H. M. Robinson, and Mr. Rogers made a reconnaissance survey of the country traversed from Sheridan, Wyo., to the field of operations. The area examined in detail consists in part of what are known as the ceded lands of the Crow Reservation, which were surveyed at the request of the Office of Indian Affairs. The territory examined embraces 450 square miles surveyed in detail and 123 square miles surveyed in reconnaissance, the land being so classified that it could be sold at auction in September. Subsequently a geologic report on the region was submitted by Mr. Rogers for publication.

In order to obtain information regarding the geologic structure and the formations exposed in the region between Musselshell and Judith, at the mouth of Judith River, a reconnaissance, embracing an accurate planetable survey covering an area of about 1,410 square miles, was made by C. F. Bowen, assisted by H. S. Bassler, the geologic boundaries being tied to public-land corners. The reconnaissance established the presence of a small coal field east of Judith. Part of this area was classified by Mr. Bowen, who prepared for publication a report describing the important geologic features of the region, though there was not sufficient time in the field to complete the examination in detail.

In Chouteau County an area of 350 square miles, including the Big Sandy coal field, near Big Sandy, on the west side of the Bearpaw Mountains, was geologically mapped in detail by Mr. Bowen, assisted by Mr. Bassler, and Mr. Bowen has classified the lands in this field and prepared a geologic report for publication.

A brief examination of the Broadview coal field was made by E. G. Woodruff for the purpose of determining whether the land should be classified as coal or noncoal. Sufficient data were procured for the classification of the land, but no geologic report is contemplated, the general geology having been described in reports published by the Survey.

In Blaine County, the Cleveland coal field, embracing 423 square miles between the Bearpaw Mountains and the Fort Belknap Indian Reservation, was examined by Mr. Bowen, assisted by Mr. Bassler. The land has been classified by Mr. Bowen, who has also prepared a geologic report thereon for publication.

The Taff quadrangle, a portion of which lies in Idaho, was surveyed for folio publication by F. C. Calkins and E. L. Jones, jr., and the text of the Philipsburg folio has been revised and submitted for publication by Mr. Calkins.

Some progress in the metallographic study of the Butte copper ores has been made by F. B. Laney in the intervals between other studies. It is expected that the metallographic investigations of these and other ores will be more vigorously prosecuted jointly by the Geological Survey and the Bureau of Mines.

Two townships near Missoula were examined at the request of the Department of Justice by J. T. Pardee in connection with the case of the United States *v.* A. B. Hammond.

At the request of the Office of Indian Affairs, the classification of the lands in the former Flathead Indian Reservation was undertaken, about 1,300 square miles, or three-fourths of the reservation, being examined and reported on by R. W. Stone. In addition to his work in collecting mineral statistics for the reports on the gypsum, lime, and sand industries for the division of mineral resources, and in completing and editing the manuscript of a bulletin on the occurrence of useful minerals in the United States, Mr. Stone also prosecuted an inquiry regarding the water supply of the Pablo division of the Flathead Reservation reclamation project.

Four townships in the vicinity of Melrose were examined in detail by R. W. Richards in connection with his classification of the lands with reference to the possible occurrence of workable phosphate deposits. Classification reports covering this area have been transmitted by Mr. Richards.

The Northern Pacific Railroad grant, comprising all the odd-numbered sections in T. 5 N., R. 2 W., was examined for purposes of classification and reported on by J. T. Pardee.

#### NEBRASKA.

Late in the field season of 1912 a brief reconnaissance examination of the sand-hill area in northwestern Nebraska was made by J. H. Hance for the purpose of examining evaporation areas that might possibly be favorable for the deposition of potash in commercial quantities. The results of the explorations have been briefly reported by Mr. Hance.

## NEVADA.

Reconnaissance examinations of a large number of the lesser mining districts of Nevada and adjacent parts of northern California have been made by J. M. Hill, who has submitted for publication in "Contributions to economic geology, 1912, Part I" a short paper entitled "The Yellow Pine mining district, Clark County, Nev." (Bulletin 540-F); also a bulletin on "Some mining districts in north-eastern California and northwestern Nevada" and a note on "Zinc-lead ore dressing at Good Springs, Nev.," for publication in Mineral Resources.

The geology and mineral resources of the Ely quadrangle have been made the subject of a monographic report by A. C. Spencer, which will probably be completed at an early date.

A report on the National district by Waldemar Lindgren is now nearly ready to submit for publication.

A paper on a newly recognized occurrence of alunite at Bovard has been prepared by F. C. Schrader for publication in Bulletin 540-I.

A reconnaissance examination of the Rochester, Fairview, Rawhide, and neighboring mining districts was made in May and June by F. C. Schrader, and a press bulletin on the Rochester district was issued in June.

In the course of the examination of the old lake basins for the purpose of discovering possible occurrences of potash in commercial quantities, visits were made by H. S. Gale to the alkali marshes near Rawhide, Luning, Minor, Rhodes, Teels Marsh, Columbus Marsh, the valleys north and south of Goldfield, and the valley of Amargosa River south of Rawhide. The Carson Sink was examined in connection with the deep drilling in that basin. Boring operations near Fallon were carried on under the immediate supervision of J. H. Hance. The deepest boring penetrated to a depth of 985 feet. Artesian flows of fresh or slightly saline waters were obtained at various depths, but no concentrated deposits of salines were found. Funds for deeper boring, which is very expensive, were not available at the time, and the test can not be regarded as conclusive.

Prospecting for buried saline deposits with a lighter boring equipment was continued throughout most of the year by a party in charge of C. E. Watson as driller. Wells were bored in the playa of Luning, Minor, Rhodes, Columbus Marsh, and Death Valley, and the samples were submitted to the chemical laboratory in Washington for testing.

Late in the season Mr. Hance made reconnaissance trips into Dixie Valley and portions of New Mexico and Arizona. A short report by him, entitled "Potash in western saline deposits," was submitted for

publication in "Contributions to economic geology, 1912, Part I" (Bulletin 540-P).

The Coaldale coal field, lying mainly in T. 2 N., R. 37 E., Esmeralda County, was examined and classified by J. H. Hance, who submitted a short report thereon for publication (Bulletin 531-K).

#### NEW HAMPSHIRE.

The examinations of the geology in the Milford and Petersboro quadrangles, N. H., have been continued by B. K. Emerson in connection with his work in the border areas of Massachusetts.

A portion of the final report embodying the results of the investigations made by the Survey with reference to the acquisition by the Government of lands in the White Mountains, in order to protect the headwaters of navigable streams, has been prepared by A. C. Spencer.

#### NEW JERSEY.

In order to inspect some recent developments in the zinc mines at Franklin Furnace, N. J., a brief visit was paid to this mine in May, on invitation from the State geologist, by F. L. Ransome and A. C. Spencer.

Inspection of the Easton quadrangle, geologically mapped by H. B. Kummel and W. S. Bayley, was made in conference by Arthur Keith.

#### NEW MEXICO.

In response to a request from the Office of Indian Affairs that the Geological Survey examine and classify as coal or noncoal the lands in the Zuni Indian Reservation, D. E. Winchester, assisted by C. A. Bonine, examined in detail the entire reservation, embracing an area of 415 square miles. The preparation of a geologic report is deferred, in the hope that additional field work may be done in order to prepare a folio based on a 30-minute quadrangle.

A detailed examination of a small area of coal land near the town of White Oaks, known as the White Oaks coal field, and a reconnaissance of a larger coal-bearing area adjacent to the Sierra Blanca were carried out by C. H. Wegemann, who classified the lands and submitted a brief geologic report covering the areas.

Some of the results of the studies of coal-bearing formations of southern Colorado and northeastern New Mexico, by W. T. Lee, are included in the stratigraphic part of a report on the Raton Mesa region of Colorado and New Mexico. This report, which contains also descriptions of the very interesting fossil floras of the same region, by F. H. Knowlton, has been submitted for publication as a bulletin of the Survey. In connection with the field

work in this area a reconnaissance section was traversed by Mr. Lee and T. W. Stanton, from Albuquerque to Lumberton, via Rio Puerco, Cabezón, and Cuba, for the purpose of studying the Cretaceous and Tertiary stratigraphy.

The geology of the vicinity of Dayton, where drilling for petroleum is in progress, was preliminarily examined in March by G. B. Richardson, who has submitted a short paper on petroleum near Dayton (in Bulletin 541-D).

The geologic work by Sidney Paige in the Silver City quadrangle, and by N. H. Darton in the Deming quadrangle, was inspected by F. L. Ransome, and the folio manuscripts for these quadrangles are now practically completed.

#### NEW YORK.

The Niagara quadrangle and the environing region in the western part of New York has been further examined by F. B. Taylor, who has completed the description and mapping of the surficial formations for use in the Niagara folio (No. 190). Some additional consideration in the field has been given by E. M. Kindle, joint author of the folio, to the characters and correlations of the Paleozoic formations in the quadrangle. Mr. Taylor also made reconnaissance examinations of the surficial formations in portions of the Taconic and Hoosatic areas in eastern New York and western Massachusetts.

The areal and stratigraphic geology of the Hoosick quadrangle, situated on the Vermont boundary, has been examined by L. M. Prindle, for description, together with the Bennington quadrangle, Vermont, in a folio.

The slate quarries of the State have been reexamined in connection with the revision by T. N. Dale of Bulletin 275, on the slate industry of the United States, which is now out of print.

Prior to his resignation from the Survey, July 31, to join the Geological Survey of Canada, Mr. Kindle was engaged in preparing papers on the faunas and stratigraphy of the Allegheny region and on the Onondaga limestone in the State.

Special studies of the relations of the Medina and associated formations in New York and other Appalachian States have been made by E. O. Ulrich for purposes of correlation and chronologic classification.

#### NORTH CAROLINA.

The folios for the Lincolnton quadrangle, in North Carolina, and for the Kings Mountain and Gaffney quadrangles in North and South Carolina, have been well advanced toward completion by D. B. Sterrett. A considerable portion of Mr. Sterrett's time is, however, consumed in preparing reports on the production of mica, gems, and precious stones for Mineral Resources.

Arthur Keith made further studies of peculiar metamorphic rocks that occur near Murphy, N. C., and around Ducktown, Tenn., and presented a brief paper on these rocks at the meeting of the Geological Society of America.

A monographic study of the Cretaceous mollusks of the State was begun by L. W. Stephenson. Additional work on fossils from North Carolina has been carried on by W. B. Clarke and other members of the Maryland Geological Survey.

A report on the Coastal Plain of North Carolina, prepared cooperatively, has been published by the State Geological Survey. This report contains a paper on the physiography and geology of the central plain region, prepared by W. B. Clarke, B. L. Miller, and L. W. Stephenson, and a description of the water resources of the State by Mr. Stephenson, B. L. Johnson, and H. N. Parker.

#### NORTH DAKOTA.

The detailed examination of the northern part of the Fort Berthold Indian Reservation made in previous years for the purpose of determining whether or not the land is underlain by lignite was continued southward by C. M. Bauer, assisted by C. A. Fath, but on account of the lateness of the date at which it was possible to begin the work the survey was carried only as far south as Little Missouri River, including an area of 208 square miles. Data for the classification of this land have been submitted by Mr. Bauer, who has prepared for publication a report covering not only the area surveyed in 1912, but that previously examined by F. A. Herald. Field operations with the intention of completing the unsurveyed portion of the reservation lying south of Little Missouri River were resumed in June by Mr. Bauer, assisted by C. A. Bonine.

The examination of the Cannonball River lignite field was extended from the west line of Perkins County, S. Dak., northeastward into North Dakota by E. R. Lloyd, for the purpose of delimiting on the southeast side the great lignite field of this region. From the area examined in detail by Mr. Lloyd, assisted by B. W. Cark, embracing 980 square miles, sufficient data to classify the land were obtained and also a remarkable collection of marine fossils in beds that in this region have heretofore been called the Lance formation. It is probable that these fossils will throw considerable light on the relations and age of the Lance and Laramie formations. Besides submitting this data for classification of the land, Mr. Lloyd has prepared for publication a paper describing the geology and economic resources of the region.

The survey of what is called the Bowman County lignite field, begun by C. J. Hares in 1911, in Billings County, was in 1912 continued southward by Mr. Hares, with the assistance of E. M. Parks

and J. B. Reeside, jr., into Bowman County and on south into South Dakota, an area of 753 square miles being covered in careful reconnaissance. Complete classification data were obtained and have been submitted by Mr. Hares, together with a geologic report covering the area surveyed in 1911 and 1912.

#### OHIO.

The areal and stratigraphic survey of the Mason and Hamilton quadrangles, Ohio, was begun in June by R. S. Bassler, temporarily transferred for this work from the National Museum, and N. M. Fenneman, who, after revising the Pleistocene geology of the Cincinnati quadrangles, began the study of the Pleistocene formations and the economic geology of the Mason and Hamilton quadrangles, Mr. Bassler being responsible for the description of the Paleozoic formations. The results of the work will be put in folio form by these geologists.

The survey in detail of the structural and areal geology of the Steubenville and Cadiz quadrangles was completed by D. D. Condit, who, in connection with the revision of the earlier map showing the underground structure, submitted for publication in "Contributions to economic geology, 1912, Part II," a report on the structure and oil resources of the northern half of the Cadiz quadrangle (in Bulletin 541-A). The preparation of a folio by Mr. Condit covering these quadrangles is now in progress.

A brief reconnaissance examination of the stratigraphy in a portion of the Wellsville quadrangle was made by Mr. Condit and G. S. Rogers in the latter part of June.

The manuscript maps and descriptions for the Cleveland folio, covering the Cleveland, Euclid, and Berea quadrangles, have been discussed in the field by H. B. Cushing, the generous contributor of the geologic work, and E. M. Kindle.

The records of two deep wells penetrating the pre-Cambrian crystalline rocks near Findlay have been compiled and correlated by Mr. Condit in a short paper printed in the American Journal of Science, accompanied by a paper reporting the rock temperatures at various depths in one of the wells, as observed by John Johnston, who, through the courtesy of the Carnegie Geophysical Laboratory, has cooperated with the Survey in determining the temperatures in several deep wells in the Appalachian oil fields. The purpose of the investigations thus begun is not only to ascertain the rate of downward increase of temperature in rocks of various kinds and in different parts of the country, but also to determine whether, as is believed by some geologists, the increase of temperature is more rapid in rocks containing petroleum and natural gas.

## OKLAHOMA.

Detailed study of the geology of the Hominy quadrangle, Okla., was begun and nearly two-thirds completed by R. H. Wood, assisted by J. E. Gaughan, of the State survey, with which the work was done in cooperation. At the close of the season's work a special examination of the structure and conditions of occurrences of oil in the Cleveland field was made by Mr. Wood. A report giving the results of this work, which was not cooperative, is in preparation.

Maps and descriptions of the areal geology and structure of the Claremore quadrangle, by C. D. Smith, are now nearly ready to submit for publication, but await adjustment with work on the Nowata and Vinita quadrangles that is nearly completed but is still in the hands of D. W. Ohern, State geologist. A bulletin on the oil and gas resources of northeastern Oklahoma has been nearly completed by Mr. Ohern and Mr. Smith.

On account of the interest of many residents of Cotton and Tillman counties, southwestern Oklahoma, in the possible occurrence of oil or natural gas in that region, a reconnaissance examination of this geologically little-known area was, at the request of the State geologist, cooperatively undertaken by the Federal Survey. During the autumn and early winter a large area in these counties bordering Red River was examined by M. J. Munn, with the assistance of Jeremiah Newby. The task of determining the structure of this area proved to be exceedingly difficult, but geologic structure offering encouragement for "wildcat" prospecting was found by Mr. Munn in a portion of the area. A report with maps embodying the results of this examination has just been submitted by Mr. Munn for publication as a bulletin.

A brief description of the Ponca City oil field, by D. W. Ohern, published as a bulletin of the Oklahoma Geological Survey, is based in part on work by C. D. Smith and R. H. Wood, of the Federal Survey.

The investigation of the zinc and lead deposits of northeastern Oklahoma and adjacent parts of Missouri has been continued by C. E. Siebenthal, who will embody the results in the Wyandotte folio, now nearing completion.

Additional field work necessary to complete the mapping and to prepare folios for the San Bois and Sallisaw quadrangles, nearly finished several years ago by J. A. Taff prior to his resignation, was done by C. D. Smith, who also submitted short reports on the Glenn pool and on the Fort Smith-Poteau oil and gas pools for publication in "Contributions to economic geology, 1912, Part II" (Bulletin 541-B).

At the request of the Commissioner of Indian Affairs a small area in McCurtain County, in the southeastern part of the State, was examined by D. F. Hewett with reference to the value of the manganese deposits of the district.

In March an examination of certain alleged gold deposits in the vicinity of Albion, Pushmataha County, was made by the Survey at the request of the Office of Indian Affairs. The report by H. G. Ferguson, who found the claims of rich ores in commercial quantities to be unwarranted, was transmitted to the Secretary of the Interior in April.

## OREGON.

A brief reconnaissance examination of the Eden Ridge coal field, Coos County, Oreg., was made by M. R. Campbell in order to determine whether or not the coal is of sufficiently high grade to justify the classification of the land as coal land. For this purpose many samples of the coal were taken for analysis and detailed measurements of the beds were made.

In June a reconnaissance examination of the John Day Valley, mainly with the object of investigating reported indications of coal and oil, was, in accordance with a cooperative agreement with the new State bureau of mines and geology, begun by a party in charge of A. J. Collier.

## PENNSYLVANIA.

A detailed areal survey, by B. L. Miller, of the geology of the Allentown quadrangle, Pennsylvania, has been nearly completed, and the results will be included in a folio covering also the Easton quadrangle, surveyed by H. B. Kummel, State geologist of New Jersey, and W. S. Bayley.

Geologic maps covering the Fairfield and Gettysburg quadrangles have been prepared by G. W. Stose, and the map and description of the Bellefonte quadrangle have been revised by E. S. Moore.

A special investigation of the gneisses of the Coatesville and Westchester quadrangles was made by Florence Bascom, and a study of the gneisses in the Boyertown quadrangle was practically completed under the direction of Prof. Bascom, who also supervised the mapping of about three-fourths of the Reading quadrangle by E. T. Wherry.

Progress has been made on the Honeybrook-Phoenixville folio.

A paper on the relations of the Octoraro schist to the Wissahickon mica gneiss in the Coatesville quadrangle, prepared by E. F. Bliss and A. I. Jonas, working under the supervision of Prof. Bascom, has been submitted for publication as a bulletin.

A narrow strip in the northern portion of the Frostburg and Flintstone quadrangles, which falls in Pennsylvania, has been examined and described by G. W. Stose and C. K. Swartz for publication in the Frostburg-Flintstone folio, the project being carried out in cooperation with the Maryland Geological Survey.

Substantial progress has been made in the preparation of folio texts to cover the Punxsutawney, Curwensville, and Houtzdale quadrangles, the greater part of the field work for which was done several years ago by G. H. Ashley and others in cooperation with the State topographic and geologic survey commission. A short paper describing the geologic structure of these quadrangles, together with that of the Barnesboro and Patton quadrangles, also surveyed cooperatively, was prepared by Mr. Ashley and M. R. Campbell and published in "Contributions to economic geology, 1911, Part II" (Bulletin 531-D). Subsequently the Barnesboro-Patton folio was submitted for publication.

To gain information as to the regional changes in the composition of the coals in a single field, the northeastern borders of the bituminous coal region were visited and the coal sampled by M. A. Pishel in May.

For the purpose of obtaining data as to underground temperatures in very deep borings, the well over 6,000 feet in depth now being bored by the People's Natural Gas Co., near Candor, in Washington County, was visited and the temperature at various depths determined by John Johnston, of the Carnegie Geophysical Laboratory, in cooperation with the United States Geological Survey, in accordance with a plan by which the temperatures of several deep wells in other States have been determined.

The slate quarries of the State have been newly described by T. N. Dale in the revised bulletin on the slate industry of the United States.

#### SOUTH CAROLINA.

Folios descriptive of the geology of the Kings Mountain and Gaffney quadrangles in North and South Carolina have been brought nearly to completion by D. B. Sterrett. The work in the Gaffney quadrangle was inspected by Mr. Keith.

A report on the deep well at Charleston, S. C., has been nearly completed by L. W. Stephenson, but awaits the results of the studies of the rich foraminiferal material, by J. A. Cushman, and a report by Chase Palmer on the analyses of the water and comparisons with related underground waters of the region.

In view of projected drilling for oil or gas in Abbeville and Greenwood counties, a brief visit to the region was paid in June by F. L. Hess, who demonstrated the futility of boring for these hydrocarbons in the crystalline and ancient metamorphic rocks of the region.

## SOUTH DAKOTA.

The areal mapping of the Spearfish and Sturgis quadrangles, which form the northern half of the Deadwood 30-minute quadrangle, S. Dak., was completed by Sidney Paige, associated with N. H. Darton and assisted by Y. T. Wang. A part of the southern half of the Deadwood quadrangle also was surveyed. The mapping of the Cambrian and later formations in the Rapid quadrangle, the maps and text for which are to be combined with those for the Deadwood quadrangle in the same folio, had previously been completed by Mr. Darton. A petrographic study of the pre-Cambrian rocks of the Black Hills has been made by Mr. Paige, who has prepared several papers, including one on the structure of the Homestake ore body, for publication in scientific journals.

The work of mapping the lignite field in the northwest corner of the State was begun in 1911 by D. E. Winchester and E. M. Parks, who had time only to examine the margin without completing work in the interior. In 1912 the remainder of the area was surveyed by E. R. Lloyd and C. J. Hares, who covered, respectively, areas of 520 and 522 square miles, thus completing field work on the only known lignite field in the State. Data for classification and a geologic report for publication have been submitted. A consolidation by Mr. Winchester of the reports of the work done in 1911 and 1912 has been submitted for publication as a bulletin of the Survey.

## TENNESSEE.

A report giving the results of the examinations of the red iron-ore deposits of east Tennessee by E. F. Burchard has been submitted for publication to the Geological Survey of Tennessee, with which the work was done in cooperation. A shorter report has been prepared for publication in "Contributions to economic geology, 1912, Part I" (Bulletin 540-G).

An extensive field study of the rocks of Medina and Clinton age in east Tennessee has been made by E. O. Ulrich, who has in preparation a report on the stratigraphy and faunas of the formations, with special reference to the geologic classification of the ore-bearing formations and the Ordovician-Silurian boundary.

Collections of the Tertiary plants of Tennessee and western Kentucky were made in June by E. W. Berry for comparison and correlation of the plant beds with the Tertiary formations in other regions.

In the region near the Mississippi in Tennessee and western Kentucky the Pleistocene deposits and terraces were investigated by E. W. Shaw, six cross profiles of the Gulf embayment were compiled, and material was collected for use in the study of the problems

of Quaternary deposition and history in the region. The work promises to be of value in connection with the solution of the flood problems of the lower Mississippi.

The survey of the areal geology of the Ducktown district has been revised by F. B. Laney, who has the descriptions well advanced. The completion of this work was delayed by examinations made for a report on lands in the proposed southern Appalachian national forests and for the Department of Justice. The descriptions of the Ducktown ore deposits are in preparation by W. H. Emmons.

A paper describing the peculiar metamorphic rocks around Ducktown was presented by Mr. Keith at the winter meeting of the Geological Society of America.

Some additional work in the preparation of an economic report on the coal measures of the Pikeville and Crossville 15-minute quadrangles has been done by Charles Butts and W. C. Phalen, but the submittal of the report for publication awaits the determination of the stratigraphic equivalents of the rocks at several points in the quadrangles. The preparation of folio texts for these quadrangles is delayed until the adjoining quadrangles are surveyed for description in double folios.

The recent developments of bauxite deposits in Tennessee were examined by W. C. Phalen for description in the report on the production of bauxite for Mineral Resources.

#### TEXAS.

The geology of the Van Horn quadrangle, Tex., for which a folio is now ready for publication, was inspected by G. B. Richardson, the author, and F. L. Ransome.

The manuscript for the folio covering the Brackett quadrangle has been nearly completed by T. W. Vaughan, who, besides supervising the work of others and inspecting it in the field, has made progress on several reports of general or special scientific interest pertaining to all parts of the Coastal Plain.

The study of the Tertiary and Pleistocene formations of southwestern Texas has been continued by Alexander Deussen. This work comprised the examination of the lithology and stratigraphy of the entire series of Tertiary formations developed in the region adjacent to the Rio Grande from a point near the northern line of Maverick County southward to Samfordyce. A rapid reconnaissance was carried over an area of more than 10,000 square miles, within which collections were made of fossils, specimens of rocks, and water samples for analysis. Under Mr. Deussen's direction samples of water were taken from 200 wells and other data were obtained for about 350 wells in Bexar, Medina, Uvalde, Kinney, Maverick, Zavalla, Dimmit, Webb, Frio, La Salle, Atascosa, McMullen, Duval, Brooks, Starr, Hidalgo, Cameron, Willacy, Jim Wells, and Nueces counties.

The fossil floras of the Midway and Wilcox formations have been described and figured in a manuscript submitted by E. W. Berry. These floras are important for their value in establishing correlations between the marine Coastal Plain sections and the coal-bearing formations of the northern Rocky Mountain province.

The structure of a small area in Texas bordering the Shreveport-Caddo district of Louisiana was examined in detail with reference to oil and gas by G. C. Matson, who is preparing a report on that district, with structure maps.

A report on the geology and underground water resources of the central part of the Coastal Plain of Texas, by Mr. Deussen, is approaching completion. By direct collection and by correspondence 403 water samples were obtained from southwest Texas and analyzed. Of the analyses 190 have been transmitted to R. B. Dole, chemist of the water resources branch, for use in a report on the chemical characters of the waters.

The geology and hydrology of the region between Atascosa and Nueces rivers and a line drawn through Uvalde, Cotulla, Hebbronville, and Katherine have been examined by Mr. Deussen, who has also investigated, at the request of the War Department, the underground water prospects in the Leon Springs Military Reservation in Bexar County and at the old target range near Fort Sam Houston.

Supplementary studies were made by L. W. Stephenson of the structural relations of the Upper Cretaceous deposits exposed at several places in northeastern Texas and southwestern Arkansas and in portions of southwestern Texas, where detailed studies of the stratigraphy, structure, and paleontology of the Upper Cretaceous rocks were made in connection with Mr. Vaughan's work in the Brackett quadrangle.

Through the courtesy of J. A. Udden and the Bureau of Economic Geology and Technology of the State a set of field notes and maps, prepared by Mr. Udden and containing valuable geologic data relating to portions of Maverick, Dimmit, Zavalla, Uvalde, Kinney, and Valverde counties, were placed at the disposal of Messrs. Vaughan and Stephenson.

A brief examination of the geology and structure in the vicinity of Electra was made by M. J. Munn and David White. A close watch for structures favorable for oil and gas was maintained by G. C. Matson in connection with his field work in Coastal Plain investigations.

#### UTAH.

The completion of the report on the geology and ore deposits of the Tintic district, Utah, has been somewhat delayed by the departure of the senior author, Waldemar Lindgren, in November, to take

charge of the department of economic geology in the Massachusetts Institute of Technology, but Mr. Lindgren will devote a part of his time to Survey work and it is expected that the report will be submitted at an early date. A portion of the report, by G. F. Loughlin, junior author, has been completed.

During the field season Mr. Loughlin made reconnaissance surveys of several mining districts in Utah. He visited the Erickson, Desert Mountain, Columbia, West Tintic, North Tintic, Tintic, Bingham, Cottonwood, American Fork, Provo, Santaquin, Mount Nebo, and Sierra Madre districts, for all of which, except the last, he prepared chapters for inclusion in a general report on the geology and ore deposits of Utah, which he is writing in collaboration with B. S. Butler. Field work for these studies will be completed in 1913.

A paper entitled "A reconnaissance in the southern Wasatch Mountains" was contributed by Mr. Loughlin to the *Journal of Geology*.

A reconnaissance examination of the Ophir, Mercur, Little Cottonwood, and Bingham mining camps was made by B. S. Butler for use in a report on the ore deposits of Utah now in preparation. Professional Paper 80, "Geology and ore deposits of the San Francisco and adjacent districts, Utah," by Mr. Butler, was in press at the close of the year and has since been published.

The study of the detailed areal and structural geology of the Randolph quadrangle was completed by G. B. Richardson, assisted by P. V. Roundy, and a folio text on the area is now in course of preparation. A paper on the Paleozoic section in northern Utah was prepared by Mr. Richardson and published in one of the scientific journals.

The Carboniferous formations of the Randolph quadrangle and of several other areas in the State were paleontologically studied in the field by G. H. Girty, who was assisted in the office by Mr. Roundy.

A detailed geologic study begun in the Sunnyside quadrangle, Carbon County, by F. R. Clark in 1911 in cooperation with a topographic party, was carried westward in 1912 into the Wellington quadrangle, and though the work was seriously handicapped by unforeseeable circumstances, the coal beds were prospected and mapped within a territory covering 230 square miles, thus completing the survey of a considerable portion of the quadrangle.

The survey of the Emery coal field, Emery County, begun in 1911, was completed this year by C. T. Lupton. The mapped area includes about 215 square miles in the Emery coal field and in Salina Canyon, in the Wasatch Plateau, the examination of the latter area being made for the purpose of classifying the land. The land in the Emery coal field has also been classified by Mr. Lupton and a geologic report thereon submitted by him for publication.

Some indications of oil having been found in the region southeast of the town of Green River, in Grand County, and some drilling having been done in the hope of developing a commercial oil field, a detailed survey of the area, containing about 300 square miles, was made by Mr. Lupton, assisted by M. W. Ball. The examination afforded data adequate for the classification of the land and information as to the possibilities of obtaining oil in the field. A geologic report thereon has been submitted for publication by the Survey (in Bulletin 541-D).

A brief examination of the territory surrounding the Coalville coal field, previously mapped, was made by C. H. Wegemann in order to determine the relation of the coal-bearing rocks of the Bear River and Green River regions to the Uinta Mountain uplift, this information being required for incorporation in a folio to cover the Coalville quadrangle. A geologic report on the Coalville coal field has been completed and submitted by Mr. Wegemann for publication.

The salt industry on the shores of Great Salt Lake was examined by W. C. Phalen, who forwarded samples of the brines and bitterns and rock salts for examination in the Survey laboratory. A bulletin embodying the results of the study of the commercial saline deposits of the country is now in preparation by Mr. Phalen.

## VERMONT.

The examination of the marble districts of the eastern half of Vermont has been completed by T. N. Dale, who has submitted the results for publication as a bulletin.

Special investigations of the stratigraphic succession and structure in the faulted area of the north end of the Taconic Mountains, in the Brandon and Castleman quadrangles, were carried on by Arthur Keith, who presented a paper on the subject at the winter meeting of the Geological Society of America. In connection with these studies a conference on the stratigraphy in the vicinity of Sudbury was held by Mr. Keith, Mr. Hale, G. W. Stose, and L. M. Prindle, to determine the relation of the Cambrian and Ordovician rocks.

In connection with the revision of the bulletin on the slate industry of the United States, which is now out of print, Mr. Dale has re-examined the slate quarries of this State.

The study of the areal and structural geology of the Hoosick and Bennington quadrangles, portions of which lie in Vermont, has been continued by L. M. Prindle.

## VIRGINIA.

The detailed survey of the Abingdon quadrangle, in the southwestern part of Virginia, was continued, the work in the northern half being completed by G. W. Stose, who has prepared for publica-

tion by the State geological survey a report on the salt and gypsum deposits of the area. For purposes of geologic correlation, collections of fossils were made by T. E. Williard from several important horizons and localities in this region.

Studies of the paleontology and stratigraphy of the Tertiary formations in the Coastal Plain of the State are now being made by a number of geologists and paleontologists under the immediate direction of W. B. Clark, practical cooperation being maintained in this work with the members of the Geological Survey of Maryland. Portions of the areas examined were visited by T. W. Vaughan.

A cooperative report on the underground water resources of the Coastal Plain of Virginia, by Samuel Sanford, has been published by the Virginia Geological Survey.

A detailed areal and economic survey of the southwestern coal field was begun in cooperation with the State Geological Survey. During the season the coal measures of the Pound quadrangle were mapped by Charles Butts, assisted by D. D. Condit and by W. A. Nelson, representing the State. This work, which was done in conjunction with the topographic remapping of the region on a 15-minute scale, was carried on with a precision and detail that establish a new standard of Survey work in the eastern coal fields. A preliminary report on the coal resources of the Pound quadrangle has been prepared by Mr. Butts for publication. In June, 1913, work in the Clintwood quadrangle was taken up by Henry Hinds, with the assistance of J. H. Harnsberger for the State.

In connection with the remapping of the coal-bearing area mentioned above, the other geologic formations occurring in the quadrangles are being mapped in greater refinement. With this end in view, collections of fossils for paleontologic study and correlation were gathered by Mr. Butts and Mr. Williard from a number of sections of the Devonian and Mississippian in the vicinity of Bigstone Gap and Cumberland Gap. These collections are expected to prove of great value in the solution of certain problems concerning the stratigraphy and geologic history of the area. A paper on the Devonian black shale in Virginia was presented by Mr. Butts at the December meeting of the Geological Society of America.

#### WASHINGTON.

The field examinations for the classification of the lands in the diminished Colville Indian Reservation, Wash., were carried on from April 1 to October 11 by J. T. Pardee, who during this period, without scientific assistance, examined approximately 1,400 square miles in the eastern part of the reservation. Reports for the classification of 838,037 acres, approximately equivalent to 1,309 square miles, were prepared and submitted by Mr. Pardee prior to July 1.

Under the direction of Mr. Pardee, E. L. Jones, jr., examined lands in T. 40 N., Rs. 27, 28, 29, 30, 31, 34, and 40 E.; T. 38 N., R. 37 E.; and T. 37 N., R. 37 E., Willamette meridian, on request of the Secretary of the Interior and the Commissioner of Indian Affairs, for classification as mineral or nonmineral.

A special report on the status of certain mineral claims in conflict with power-site reserve 211, on Nespelem River, was during December prepared by Mr. Pardee for submission to the Secretary of the Interior.

At the request of the Office of Indian Affairs an examination of the Yakima Indian Reservation for the purpose of determining whether it is underlain by coal was made by M. A. Pishel, who found that the area contains no coal beds. Numerous data obtained by Mr. Pishel as to the underground water supply in this region have been incorporated in Water-Supply Paper 316.

A brief examination of the Glacier coal field, in Whatcom County, was made by E. G. Woodruff, who has submitted data for the classification of the land and a short geologic report for publication.

#### WEST VIRGINIA.

For the purpose of procuring data for the comparison of the coals of the lower Tug River district, in southern West Virginia, with those of eastern Kentucky and the northern Appalachian region, a set of coal samples was collected in this district by Eugene Stebinger for standard chemical analysis.

Observations of temperatures in a deep well in process of boring by the William Seymour Edwards Oil Co. on Slaughter Creek, in the southern part of the State, were early in the season made by John Johnston, of the Carnegie Geophysical Laboratory, in cooperation with which the work was done. Arrangements preliminary to the observations were made by Dr. I. C. White, State geologist.

Lands in the Monongahela basin were examined by A. C. Spencer, who rendered a report favoring their purchase under the act of Congress which provides for acquisition of lands to protect the headwaters of navigable streams.

#### WISCONSIN.

The manuscript on the Pleistocene and general geology of southeastern Wisconsin has been revised by its author, W. C. Alden, and an introduction to the report has been furnished by T. C. Chamberlin, under whose direction the studies therein described were carried on.

The results of continued exploration in the iron ranges have been collected and compiled under the direction of C. R. Van Hise.

## WYOMING.

The Douglas oil field, in Converse County, Wyo., was examined late in the season of 1912 by V. H. Barnett, who, though he surveyed only a small area (170 square miles), gathered sufficient data for the classification of the land and for a geologic report, which has been submitted for publication (in Bulletin 541-C).

The upper Belle Fourche Valley coal field, embracing an area of about 3,100 square miles, was examined in 1910-11 by Mr. Barnett, who during the present year has completed a full report on the geology and mineral resources of the field for publication as a bulletin of the Survey.

The increasing demand for more exact and immediate knowledge of the character of coals has made it necessary to provide the field geologist with some handy means of analysis. Accordingly, C. E. Leshner spent some time in Wyoming, North Dakota, Montana, and Colorado in testing a field apparatus devised to determine the ash and moisture content of coals. The experiments made by Mr. Leshner show that by means of a cheap, light outfit the geologist can determine the ash content of a coal within 1 or 2 per cent and can thus obtain in the field much needed information regarding the variability of the coals in the lands he examines and maps for classification.

An area of about 90 square miles in the Ilo quadrangle, Hot Springs County, was geologically surveyed by D. F. Hewett in association with a party making a topographic map of the area. The examination of the Oregon Basin and Meeteetse quadrangles, Park County, surveyed by Mr. Hewett with the Ilo quadrangle for folio publication, was undertaken to determine whether the many small structural domes and anticlines occurring in this part of the Bighorn Basin are favorable for the accumulation of oil and gas. A report covering this question is in preparation but not yet ready for publication. However, a short paper describing the geologic section exposed at Cody and discussing the relation of the structure at that place to the occurrence of oil in the vicinity has been submitted by Mr. Hewett for publication (in Bulletin 541-C).

A brief examination of the Spring Valley oil field, in Uinta County, previously described by A. C. Veatch, was made by C. H. Wegemann for the purpose of noting recent developments. As these have not thrown any new light on the occurrence of the oil an additional report is not deemed necessary at the present time.

Field work for a detailed survey of the areal and economic geology of the Fort Steele and Hanna quadrangles, in Carbon County, was begun late in the season by A. L. Beekly, who devoted about a month to the work. After the resignation of Mr. Beekly, June 1, 1913, C. F. Bowen was placed in charge of this work, which was resumed June 15.

The stratigraphy of the Oregon Basin quadrangle was reviewed by T. W. Stanton in association with Mr. Hewett. Later Mr. Stanton, with Mr. Beekly, examined the stratigraphy in several sections of the Walcott quadrangle.

The Randolph quadrangle, lying partly in Utah, was examined by G. B. Richardson, assisted by P. V. Roundy, and the greater part of the office season was devoted to the preparation of maps and text for a folio.

The gold, silver, and copper bearing veins of the Kirwin district were examined in July by D. F. Hewett, who has submitted a brief report for publication in "Contributions to economic geology, 1912, Part I" (Bulletin 540-C).

#### CANAL ZONE.

Through a cooperative agreement between the Isthmian Canal Commission, the Smithsonian Institution, and the Geological Survey, geologic investigations of wide general interest, as well as economic importance, are being prosecuted in the Isthmian region. In this work the Survey undertakes to cut thin sections of rocks, to furnish rock analyses and petrologic data, and to provide paleontologic reports. A paleontologic knowledge of the formations in this region is of prime value in unraveling the geologic history of North America and is indispensable to the successful correlation of the geologic formations of the Atlantic coast of America with those of the Pacific coast.

The paleontologic studies, arranged by T. W. Vaughan, enlist without compensation the scientific service of a number of specialists not in the employ of the Government. By this arrangement M. A. Howe studies the calcareous algæ, E. W. Berry the fossil plants of higher orders, J. A. Cushman the Foraminifera, W. B. Clark the echinoids, R. S. Bassler the Bryozoa, M. J. Rathbun the Crustacea, J. W. Gidley the fossil vertebrates, W. H. Dall the fossil Mollusca, and T. W. Vaughan the corals. Mr. Howe has submitted a report on the algæ and Mr. Cushman has prepared a preliminary report on the Foraminifera.

An examination of certain structural and physical problems in geology, concerned in the canal construction, was early in the spring made by G. F. Becker. The results of these studies have been submitted to the Canal Commission.

The building stones and other rocks transmitted by the commission have been analyzed and petrologically determined by the Survey, engineering tests of the samples have been made by the Bureau of Standards, and analyses and calorimetric tests of coals have been furnished by the Bureau of Mines.

## HAWAIIAN ISLANDS.

A report on the lavas of the Hawaiian Islands was completed by Whitman Cross and will be submitted for publication during the coming year.

## DUTCH GUIANA.

In response to an application from the Department of Justice H. G. Ferguson was, early in October, detailed to proceed to Dutch Guiana in order to examine certain mining properties whose promoters had been charged with making improper use of the mails. The results of the examination were promptly transmitted to the Department, which instituted proceedings against the offenders.

## DIVISION OF ALASKAN MINERAL RESOURCES.

## CLASSES OF WORK.

In the last fiscal year the appropriation for the "continuation of investigation of the mineral resources of Alaska" was not made until August 24, 1912, and was reduced from \$100,000 to \$90,000. The general effect of this delay has been mentioned earlier in this report. Under this authority, as in previous years, work of the following classes was carried on: Reconnaissance and detailed geologic surveys, special investigations of mineral resources, reconnaissance and detailed topographic surveys, investigations of water resources with reference to the supply available for placer 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 on account of temporary employment of technical assistants. On July 1, 1912, there were employed in the division 1 geologist in charge, 9 geologists, 4 topographers, 2 engineers, 3 clerks, and 1 draftsman on annual salaries, and 2 geologic field assistants. On June 30, 1913, the personnel of the division included 1 geologist in charge, 11 geologists, 4 topographers, 2 engineers, 1 draftsman, and 3 clerks on annual salaries, 2 geologic field assistants, and 31 camp hands and recorders. One geologist employed for nine months during the year and one employed for four months are not included in the above enumeration.

## FIELD OPERATIONS IN SEASON OF 1912.

*Allotments and areas covered.*—In spite of the late date of the passage of the appropriation act it was deemed best, in view of the large number of investigations for which there was urgent need, to

undertake certain pieces of work. It was, however, fully realized that this work would be very expensive, considering the results which could be achieved.

Twelve parties in all were engaged in surveys and investigations during 1912. Of these, two started in April, one in May, two about the first of July, and the others between the 10th and 29th of August. The average length of the Alaska field season in the past has been 110 days, but in 1912 it was only 53 days. Moreover, in 1912 the parties worked late into the fall, when much time was lost owing to rain and snow.

The areas covered by geologic reconnaissance surveys, on a scale of 1:250,000 (4 miles to the inch), amount to 2,000 square miles; those covered by detailed geologic surveys, on a scale of 1:62,500 (1 mile to the inch), to 525 square miles. Much of the time of the geologists was devoted to the investigation of special field problems in the important mining districts, the results of which can not be presented areally. No topographic reconnaissance surveys were made in 1912. Detailed topographic surveys, on a scale of 1:62,500 (1 mile to the inch), covered 298 square miles. Sixty-nine gaging stations were maintained in the Yukon-Tanana region in 1912 for an average of 14 weeks each, furnishing data on the water resources of the Fortymile, Eagle, Seventymile, Birch Creek, and Fairbanks districts. The following table shows the allotments of the appropriation to the different districts of Alaska. These figures include the cost of both field and office work, as well as inspection. The unallotted balance will be used in the preliminary work necessary to carry on the surveys planned for 1913.

*Allotment to Alaska surveys and investigations in 1912.*

Southeastern Alaska .....	\$2, 000
Copper River region.....	20, 500
Prince William Sound and Kodiak Island.....	23, 800
Yukon basin .....	15, 000
Northeastern Alaska.....	5, 000
General investigations.....	7, 700
Unallotted .....	16, 000
Total .....	90, 000

In the following table 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 party or even the same man may have carried on two different kinds of work, but this statement will help to elucidate a later table, which will summarize the complete areal surveys. This, like the previous table, includes an unallotted balance, which will be used for moving supplies and other service in preparation for field work in 1913.

*Approximate allotments to different kinds of surveys and investigations in 1912.*

Detailed geologic surveys.....	\$15,600
Geologic reconnaissance surveys.....	3,500
Special geologic investigations.....	12,000
Detailed topographic surveys.....	18,200
Investigation of water resources.....	5,000
Collection of statistics of mineral production.....	1,100
Miscellaneous, including clerical salaries, administration, inspection, instruments, office supplies, and equipment..	18,600
Unallotted .....	16,000
<b>Total .....</b>	<b>90,000</b>

*Allotments for salaries and field expenses, 1912.*

Scientific and technical salaries .....	\$36,970
Field expenses.....	18,370
Clerical and other office and miscellaneous expenses.....	18,660
Unallotted .....	16,000
<b>Total .....</b>	<b>90,000</b>

The following table exhibits the progress of investigations in Alaska and the annual grant of funds since systematic surveys were begun, in 1898. It should be noted that a varying amount is expended from year to year on special investigations, yielding results which can not be expressed areally.

*Progress of surveys in Alaska, 1898-1912.*

Year.	Appropriation.	Areas covered by geologic surveys.			Areas covered by topographic surveys. <sup>a</sup>					Investigations of water resources.	
		Exploratory (scale, 1:625,000, or 1:1,000,000).	Reconnaissance (scale, 1:250,000).	Detailed (scale, 1:62,500).	Exploratory (scale, 1:625,000 or 1:1,000,000).	Reconnaissance (scale, 1:250,000; 200-foot contours).	Detailed (scale, 1:62,500; 25, 50, or 100 foot contours).	Lines of levels run.	Bench marks set.	Gaging stations maintained part of year.	Stream volume measurements.
		<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Miles.</i>			
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	5,450					
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
	1,061,189	68,700	73,085	3,891	47,680	114,045	3,355	459	72		
Percentage of total area of Alaska.....		11.72	12.46	0.66	8.16	19.45	0.57				

<sup>a</sup> 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, was employed in office work of the Alaska division until August 31, when he was appointed vice chairman of the Alaska Railroad Commission. Most of his time to the middle of February was devoted to work of the commission. During this period the administration of the Alaska division was in the hands of George C. Martin, as acting geologist in charge.

Mr. Brooks, in company with the other members of the commission (Maj. J. J. Morrow, Engineer Corps, United States Army, chairman; L. M. Cox, civil engineer, United States Navy, and C. M. Ingersoll), left Washington for Alaska on September 2 and, returning, reached Washington November 27. About two months were devoted to investigations in Alaska, during the course of which Katalla, the Kenai Peninsula, the Willow Creek district, Valdez, Cordova, Fairbanks, Chitina, Haines, Skagway, and Juneau were visited. The commission was charged specifically with the duty of investigating the transportation problem and railway routes. Incidentally considerable data on mining developments were collected.

Of the 125 days devoted to Survey work in the office during the fiscal year 1913, the geologist in charge has spent about 15 days in reading and revising manuscripts, 16 days in preparing matter for the progress report, 4 days in miscellaneous writing, 2 days in preparing the annual press bulletin, 8 days on statistics of mineral production, 14 days on field plans, 18 days on work of the committee on the new Survey building, and the remainder on 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. Mr. Sargent devoted 54 days of office work to compilation of maps for the Alaska Railroad Commission.

E. M. Aten continued as office assistant to the geologist in charge and supervised the office work during Mr. Brooks's absence in the field. He also continued to assist in collecting statistics of the production of precious metals in Alaska.

Arthur Hollick was employed for about nine months and continued the study of the fossil flora of the coal measures of Alaska.

*Southeastern Alaska.*—E. F. Burchard left Seattle on August 29 and spent a month in visiting the deposits of marble of the Wrangell and Ketchikan districts, in southeastern Alaska. C. W. Wright was employed for some two and a half months during the summer in completing his report, "Geology and ore deposits of Copper Mountain and Kasaan Peninsula, Alaska."

*Copper River region.*—D. C. Witherspoon, assisted by S. A. Witherspoon, began topographic work in the Kotsina district on July

19 and continued until September 30, completing the areal mapping of some 80 square miles on a scale of 1 mile to the inch, with contour intervals of 100 feet. This mapping covers part of an important copper-bearing district and will be extended westward in 1913. The geologic mapping and study of the ore deposits of this district were assigned to F. H. Moffit, assisted by Theodore Chapin and J. B. Mertie. Unfortunately, there were not sufficient funds to permit putting in a separate geologic party, and therefore Mr. Chapin was detailed to accompany Mr. Witherspoon and do such work from his camp as circumstances permitted. Mr. Moffit and Mr. Mertie spent about three weeks in September in the same district but were prevented from continuing the work because of a lack of provisions and feed, the railroad to Cordova being blocked for six weeks. The Moffit party mapped in all about 65 square miles, but another season's work will be required to extend the geologic survey over the important part of the district and to investigate the many prospects and mines.

*Prince William Sound.*—The detailed topographic mapping of what was then the most important part of the Valdez district was completed by J. W. Bagley in 1911. Since that time important prospects had been discovered to the west of the mapped area, and it therefore seemed desirable to extend work in this field. Mr. Bagley was detailed for this work and was employed on it from August 30 until October 23, during which time he mapped 128 square miles, for publication on a scale of 1 mile to the inch, with 50-foot contours.

The region immediately tributary to Landlocked Bay and to Ellamar is one of the best developed of the copper-bearing districts of Prince William Sound. For this reason a detailed geologic and topographic survey seemed desirable. The topographic work was assigned to R. H. Sargent, assisted by C. E. Giffen. Work was begun on August 26 and continued until October 13, a total of 90 square miles, for publication on a scale of 1 mile to the inch, with 100-foot contours, being mapped.

S. R. Capps and B. L. Johnson were assigned to make geologic surveys of the same district. They began work on August 26 and continued until October 9. A detailed geologic survey and investigation of mineral deposits were completed to cover an area of about 60 square miles.

*Kodiak Island.*—In the aggregate there has been much prospecting for auriferous lodes on Kodiak Island, and this, together with the fact that considerable mining is done each year on the beach placers, made an investigation of the resources of the island desirable. Plans for carrying on this work systematically in the summer of 1912 were formulated, but owing to the condition of the appropriation they could not be executed. An additional deterrent was the volcanic

eruption of June 6 to 8, which covered many of the outcrops with large quantities of volcanic tuff. An investigation of this volcanic eruption was desirable, not only because of its scientific interest but also because of the bearing it had on the industrial advancement of this part of the Territory. Unfortunately, the Geological Survey had no funds that could be devoted to this purpose. The National Geographic Society, however, offered a grant which made it possible to dispatch George C. Martin to this field. Mr. Martin spent about a month in investigating the distribution of the volcanic tuff, and from July 4 to September 4 made observations on the occurrence of metalliferous deposits in the island.

*Yukon Basin.*—The investigation of the water resources in the Yukon-Tanana region, which was begun at Fairbanks in 1907, was continued in 1912. C. E. Ellsworth and R. W. Davenport began work in the Fortymile district on May 20. Later Mr. Ellsworth extended the investigation through the Circle and Fairbanks districts, while Mr. Davenport continued stream gaging in the Fortymile district. This work was continued until September 15, 20 gaging stations being maintained in the Fortymile district for an average of 11 weeks each and 106 measurements being made. The results give information regarding the run-off of about 6,000 square miles. In the Eagle and Seventymile districts 13 gaging stations were maintained for an average of 15 weeks each and 70 measurements were made. The results give data relating to the run-off of about 600 square miles. Some 20 gaging stations were maintained in the Birch Creek district for an average of 14 weeks each and 123 measurements were made. This investigation indicates the run-off from about 2,150 square miles. In the Fairbanks district 16 gaging stations were maintained for an average of 14 weeks each and 82 measurements were made. The data thus obtained give information in regard to the run-off of about 2,000 square miles.

The rapid development in lode mining in the Fairbanks district since the detailed surveys were completed two years ago made further investigations desirable. For this reason P. S. Smith was detailed to go to Fairbanks as soon as money was available and investigate the auriferous lode deposits in such detail as time permitted. Mr. Smith spent from September 7 to 25 in this investigation.

There have been many demands made on the Survey for investigation of the Ruby placer district. Unfortunately the circumstances already recounted made it impossible to put a large party in this field. H. M. Eakin, however, was detailed to investigate the Ruby district and also to supplement previous investigations in the Innoko and Iditarod districts. Mr. Eakin reached Ruby on July 18, and after examining this district made an overland trip to Innoko and the Iditarod, traveling on foot and without pack horses.

*Northwestern Alaska.*—By courtesy of the boundary commissioner, Mr. O. H. Tittmann, the Survey was enabled to continue its geologic investigations along the international boundary north of Porcupine River. A. G. Maddren, assisted by J. M. Jessup and G. L. Harrington, was detailed for this work. Field work was begun on June 14 and continued until August 25. The topographic maps of the boundary surveyors (scale, 1:45,000) were used as a basis, and the areal mapping covered 400 square miles. The work was carried northward to the shores of the Arctic Ocean. In the course of two seasons Mr. Maddren has carried a geologic survey from Porcupine River northward to the Arctic, covering an area of about 800 square miles. This will do much to help elucidate some of the general geologic problems of Alaska. Dr. R. W. Brock, Director of the Geological Survey of Canada, had agreed to carry the work southward from the Porcupine to the Yukon. As this work also has been finished, fairly complete information has thus been collected regarding the geology of a belt stretching northward from the Yukon near Eagle to the Arctic Ocean, a distance of nearly 400 miles.

#### FIELD OPERATIONS FOR SEASON OF 1913.

The field work in 1913 was again delayed because no funds were available until the approval of the sundry civil act on June 23, 1913. With the available funds it was possible to take up only some of the more urgent work at the opening of the field season.

P. S. Smith, who was detailed to investigate the gold deposits and stratigraphy of the eastern part of the Ketchikan district, began work in May.

J. W. Bagley was dispatched to carry a topographic reconnaissance survey westward from Valdez Creek along the base of the Alaska Range to Broad Pass. F. H. Moffit, assisted by J. E. Pogue, undertook a geologic reconnaissance survey of the same region. These parties left Seattle May 24.

C. E. Ellsworth and R. W. Davenport were detailed to make a reconnaissance of the water supply of the lower Copper River Basin of the eastern part of the Prince William Sound region and of Kenai Peninsula. They began field work at Valdez in May.

H. M. Eakin was dispatched to make an exploratory survey from the mouth of Dall River to the lower Koyukuk River. He left Seattle on June 6.

C. E. Giffen was sent to Valdez to begin a survey of the region adjacent to the military road as far as Thomas Pass. He began work on June 2.

The delayed party chiefs, who started for the field after the new appropriation became available, are as follows:

Theodore Chapin undertook a geologic reconnaissance of the Yakutaga district. D. C. Witherspoon was sent to complete the detailed topographic survey of the Kotsina district. To R. H. Sargent was assigned the task of making a detailed topographic survey of the eastern part of the Matanuska coal field. G. C. Martin, assisted by J. B. Mertie and R. M. Overbeck, undertook a geologic survey of the same field. To C. E. Giffin was assigned the task of making a detailed topographic survey of the Willow Creek district, while S. R. Capps is to map the geology of the same area. A. G. Maddren was detailed to study the placer deposits tributary to the lower Matanuska. The continuation of the study of the geology and mineral resources of Prince William Sound was assigned to B. L. Johnson.

Mr. Brooks left for Alaska on June 28, with the purpose of visiting south-central Alaska and studying the geology in the vicinity of Ellamar, Prince William Sound, with B. L. Johnson.

#### 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 1912 was completed in June, 1913, and is in press as Bulletin 542. Figures on mineral production, which were also included in the report, were transmitted in June for inclusion in the Survey's annual volume "Mineral Resources of the United States" for the calendar year 1912.

#### OFFICE WORK.

During the year seven bulletins (Nos. 498, 501, 502, 520, 532, 534, and 535) and one water-supply paper (No. 314) relating to Alaska have been issued. Five bulletins are in press (Nos. 525, 526, 533, 536, and 538). All these publications contain maps. In addition, a map of Alaska showing the distribution of mineral resources (Alaska map B) has been issued as a sale publication. The following reports have been completed, and illustrations for them are being prepared:

The Hanagita-Bremner region, Alaska, by F. H. Moffit (Bulletin —); including topographic and geologic reconnaissance maps.

Geology and ore deposits of Copper Mountain and Kasaan Peninsula, Alaska, by C. W. Wright (Professional Paper —); including detailed geologic and topographic maps.

The surface water supply of the Yukon-Tanana region, by C. E. Ellsworth and R. W. Davenport (Water-Supply Paper —); including topographic reconnaissance map.

The Ruby-Iditarod region, by H. M. Eakin (Bulletin —); including geologic and topographic reconnaissance maps.

Contributions to the geology of Kenai Peninsula, by G. C. Martin, U. S. Grant, and B. L. Johnson (Bulletin —); including geologic and topographic reconnaissance maps.

Mineral resources of Alaska: Report on progress of investigations in 1912, by Alfred H. Brooks and others (Bulletin 542).

The following reports are in hand:

Geology of Glacier Bay and Lituya region, by F. E. Wright and C. W. Wright; including geologic reconnaissance maps.

The geology and mineral resources of the Ellamar district, Prince William Sound, Alaska, by S. R. Capps and B. L. Johnson; including geologic and topographic detailed maps.

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

The office work on 13 topographic maps was completed during the year, as follows:

Chitina quadrangle (new edition), by T. G. Gerdine, D. C. Witherspoon, and others; scale, 1:250,000; contour interval, 200 feet.

Moose Pass and vicinity, by J. W. Bagley; scale, 1:62,500; contour interval, 50 feet.

Kenai Peninsula (reconnaissance map), by R. H. Sargent and J. W. Bagley; scale, 1:250,000; contour interval, 200 feet.

Fortymile quadrangle (new edition), by E. C. Barnard; scale, 1:250,000; contour interval, 200 feet.

Circle quadrangle (new edition), by D. C. Witherspoon, J. W. Bagley, and others; scale, 1:250,000; contour interval, 200 feet.

Fairbanks quadrangle (new edition), by T. G. Gerdine, D. C. Witherspoon, and R. H. Sargent; scale, 1:200,000; contour interval, 200 feet.

Rampart quadrangle (new edition), by D. C. Witherspoon and R. B. Oliver; scale, 1:250,000; contour interval, 200 feet.

Ruby-Iditarod region (reconnaissance map), by C. G. Anderson; scale, 1:250,000; contour interval, 200 feet.

Middle Kuskokwim and lower Yukon region (reconnaissance map), by C. G. Anderson and others; scale, 1:500,000; contour interval 200 feet.

Noatak-Kobuk region (reconnaissance map), by C. E. Giffin and D. L. Reaburn; scale, 1:500,000; contour interval, 200 feet.

Koyukuk-Chandalar region (reconnaissance map), by T. G. Gerdine and A. G. Maddren; scale, 1:500,000; contour interval, 500 feet.

Nome quadrangle (new edition), by T. G. Gerdine; scale, 1:62,500; contour interval, 25 feet.

Grand Central quadrangle (new edition), by T. G. Gerdine; scale, 1:62,500; contour interval, 25 feet.

The following maps are in hand:

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

Valdez Bay and vicinity, by J. W. Bagley and C. E. Giffin; scale, 1:62,500; contour interval, 50 feet.

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

Yukon-Tanana region (compiled map); scale, 1:500,000; contour interval, 400 feet.

## SCIENTIFIC RESULTS.

Mr. Moffit and Mr. Chapin found a limestone carrying Carboniferous fossils, the first Paleozoic rocks found on the north side of the Chitina Valley. Mr. Chapin and Mr. Johnson found evidence of extensive thrust faulting in the Ellamar district of the Prince William Sound region.

Mr. Martin collected a large amount of data relating to the eruption of Mount Katmai, June 6 to 8. His work indicates that the geology of Kodiak Island is very similar to that of Kenai Peninsula. Mr. Maddren obtained evidence of a great thickness of Carboniferous sediments in the vicinity of the boundary north of the Porcupine. These rocks are divisible into at least five formations, three of which are probably Mississippian and two Pennsylvanian.

Hydrometric data obtained by C. E. Ellsworth, R. W. Davenport, and E. A. Porter during 1911 and 1912 show that the discharge of Yukon River at Eagle, Alaska, varied from a minimum of 10,100 second-feet on April 24, 1911, before the ice had gone out, to a maximum of 253,000 second-feet on May 22, 1911. Using the best climatic data available, they compute the run-off at 68 per cent of the precipitation.

## DIVISION OF MINERAL RESOURCES.

The most important change in the work of the division of mineral resources that has been made during the last two years has been in the more comprehensive treatment of the sources from which the mineral products of the country are obtained and the application of these products in the useful arts. The report "Mineral resources of the United States, calendar year 1912," will complete the third decade of the work of this division, which was first authorized by Congress August 7, 1882, by a provision added to the general appropriation for the Geological Survey to the effect that "not to exceed ten thousand dollars of the amount appropriated in this paragraph may be applied under the direction of the Secretary of the Interior to the procuring of statistics in relation to mines and mining other than gold and silver and in making chemical analyses of iron, coal, and oil." With the meager appropriation available at that time it was possible to print in the reports only statistical estimates prepared by experts on the various subjects, with more or less extended reviews of market conditions and some special contributions on mining localities, mining methods, and technical progress. This plan prevailed during the first two decades after the organization of the work. During the last ten years most of the reports have been prepared 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 it to classify the public

lands and to examine the geologic structure, mineral resources, and products of the national domain.

The statistical treatment has now been developed to a high degree of exactitude, and the statements of production, consumption, etc., presented in the volume are the results of an annual census of the entire mineral industry. The statistical tables are compiled from reports received from over 60,000 operators and represent the output of between 75,000 and 100,000 mines, quarries, and wells. An instance of the more comprehensive study of the sources of the Nation's mineral wealth is presented in the report on the production of iron ores, pig iron, and steel in 1908, containing maps and brief descriptions of the different fields, showing the occurrence of the ores and the location of the blast furnaces. A map showing the geographic distribution of the production of precious and semiprecious metals in the Western States was published in 1908. The report on the production of coal in 1910 contains maps of the various coal areas of the United States, and the report on the stone industry in 1911 contains maps showing the localities of the quarrying operations, by varieties of stone, in the Eastern States, and similar maps covering the Central States will be published in the reports on this subject for 1912 and 1913. It is proposed that the clay resources shall be similarly treated, for it is recognized that in no other branch of the mining industry is the economic and sociologic progress of a country better illustrated than in the development of those products which are used in the construction of buildings and in civic improvements. An accurate knowledge of nature's storehouse from which future supplies are to be drawn and the tracing of these supplies from crude to finished products are recognized as of paramount importance. To obtain this knowledge as well as to record the history of past achievement is the purpose and aim of the division of mineral resources.

The chapter on the distribution of the useful minerals of the United States, which was referred to in the last annual report and which was prepared under the direction of the division of mineral resources, was found on completion to be too voluminous for publication in the annual volume of mineral resources and will be issued as a bulletin.

The plan of cooperation between the Geological Survey and the State surveys in the collection of most of the mineral statistics continued in force in connection with the report for 1912. The 15 States which cooperated were Alabama, Georgia, Iowa, Kansas, Maryland, Michigan, Missouri, New Jersey, North Carolina, Oklahoma, Oregon, Pennsylvania, Virginia, Washington, and Wisconsin. As this cooperation becomes better appreciated, both by the force of the division of mineral resources and by the State surveys, and is better understood by the producers, it works more and more smoothly,

the experience in 1912 having been the most satisfactory yet obtained. It obviates the duplication of a considerable amount of work and, so far as applied, it saves the producers the annoyance of preparing two sets of statistical reports.

During the fiscal year the work of the division consisted of the preparation of reports on the mineral production of the United States in the calendar years 1911 and 1912. The report for 1911 was published early in the calendar year 1913 (the latter half of the fiscal year), and the work on the report for 1912 was well advanced at the close of the fiscal year. This indicates that work on two different reports on the mineral resources of the United States was carried on during the fiscal year 1913. Although the report for 1911 was not published until early in the calendar year 1913, the separate chapters on all the subjects except one were published during the calendar year 1912. The energies of the entire force of the division have been directed toward the more prompt publication of the reports, as well as toward obtaining more complete information regarding the mining industries, and especially the sources of production. At the close of the fiscal year 1912 the manuscript of 30 chapters from the report for the calendar year 1911 had been completed and transmitted to the printer. On June 30, 1913, 34 chapters for the report for 1912 had been completed and transmitted to the printer.

The following table gives the estimated percentage of schedules returned at the close of the fiscal years 1909, 1910, 1911, 1912, and 1913 for some of the more important products, the period covered by the returns being the preceding calendar year:

*Percentage of schedules returned from producers at the end of fiscal years 1909, 1910, 1911, 1912, and 1913.*

Industry.	June 30, 1909.	June 30, 1910.	June 30, 1911.	June 30, 1912.	June 30, 1913.
Building stone.....	97	26	90	95	100
Clay working.....	98	35	95	100	100
Coal.....	98	26	99	100	100
Coke.....	100	15	100	100	100
Iron ore.....	100	24	100	100	100
Natural gas.....	90	43	80	95	100
Quicksilver.....	99	33	100	100	100

Preliminary estimates of the production of the following minerals in 1912, with reviews of the conditions which prevailed during the year, were given to the press in the form of special press bulletins during the latter part of December, 1912, and in January, 1913:

Cement.	Lead.	Uranium.
Coal.	Petroleum.	Vanadium.
Copper.	Rutile.	Western metal mining.
Gold and silver mining.	Quicksilver.	Zinc.
Iron ores.	Tungsten.	

Advance statements giving the final official figures covering the production of copper, lead, and zinc in 1912 have also been published. Advance chapters from the report for 1912 on the following subjects (34 in all) have been published or are in press:

Chromic iron ore.	Pottery.
Fuel briquetting.	Silver, copper, etc., in the Central States (mine report).
Graphite.	Talc and soapstone.
Slate.	Asphalt.
Abrasives.	Coke.
Anthracite.	Fuller's earth.
Asbestos.	Peat.
Feldspar and quartz.	Barytes.
Fluorspar and cryolite.	Gypsum.
Mica.	Antimony, etc.
Sand-lime brick.	Manganese.
Bauxite and aluminum.	Quicksilver.
Cement.	Gold, silver, etc., in South Dakota and Wyoming (mine report).
Gems and precious stones.	Sand and gravel.
Gold, silver, etc., in the Eastern States (mine report).	Phosphate rock.
Potash salts.	Borax.
Commercial qualities of the slates of the United States and their localities.	Sulphur and pyrite.

The plan of assigning to geologists the study of the mineral products and the preparation of the reports thereon, which was adopted several years ago, was continued in 1913 and has brought eminently satisfactory results. As stated in the report for 1911, this plan gives to the statistical work the benefit of the cooperation of the geologist trained in economic work and gives to the geologist the opportunity to study the industrial and commercial conditions which affect the demand for the minerals. This method is also economical because the division of mineral resources does not usually require the entire time of the geologist but allows him opportunity to engage in his scientific pursuits, thus obligating the division to pay simply for the actual cost of its work.

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, 17 members of other divisions of the Survey, chiefly geologists, devote a portion of their time to the work of the division of mineral resources, making a total of 56 persons who devote the whole or a portion of their time to the work.

During the year 156,880 pieces of first-class mail matter (chiefly statistical inquiries) were sent out by the division, and 64,405 pieces were received.

E. W. Parker continued as administrative head of the division and chief of the section of nonmetallic resources. Waldemar Lindgren was chief of the section of metallic resources during a portion of the year and was succeeded in November, 1912, by H. D. McCaskey. Besides performing administrative duties Mr. Parker prepared the introductory chapter on mineral products and the reports on the production of coal, the manufacture of coke, and the briquetting industry. E. S. Bastin was in charge of the preparation of the report on 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 (mine 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, chromite, talc, and soapstone; J. P. Dunlop, silver, copper, lead, and zinc in the Central States (mine report), secondary metals and metallic 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, and quartz; H. D. McCaskey, gold and silver (general report), precious and semiprecious metals in the Eastern States (mine report), quicksilver; G. C. Matson, mineral waters; 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 reports); 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, borax and magnesite (with H. S. Gale).

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. These offices are under the direct charge of the following persons: Denver, C. W. Henderson; Salt Lake City, V. C. Heikes; San Francisco, C. G. Yale. These persons prepare the various mine reports on gold, silver, copper, lead, and zinc in the Western States.

#### DIVISION OF CHEMICAL AND PHYSICAL RESEARCH.

In the chemical laboratory 560 quantitative analyses were reported during the year, and also 874 qualitative determinations, chiefly of minerals sent for examination by persons not connected with the Survey.

F. W. Clarke was largely occupied by the usual administrative routine. He also prepared two bulletins, one on the water analyses

made in the Survey laboratory, the other on the constitution of the natural silicates, and two short papers for outside publication—"An aluminum arsenate from Utah" and "Notes on chemical stability."

George Steiger's time was mostly given to routine analytical work but included some research on heavy metals in deep-sea deposits. He assisted Mr. Clarke in the administrative work, in ordering supplies for the laboratory, and in examining civil-service papers.

R. C. Wells was engaged chiefly in experimental work involving the application of physico-chemical methods to geochemistry, such as the determination of the colloidal matter in bentonite, the pore space in the ore-bearing rocks at Leadville, the behavior of maximum thermometers for taking earth temperatures, the solubility of sphalerite in solutions resembling natural waters, the preparation of gold-lead junctions by electrolysis for the purpose of studying the diffusion of gold in lead, and the electrochemical behavior of conducting ores. He contributed to outside publications papers on "The interpretation of mineral analyses" and "The electrical potentials between conducting minerals and solution," and prepared the data on the latter subject for publication as a bulletin.

Chase Palmer devised a method for determining relative proportions of sulpharsenides in arsenides and diarsenides, introduced a chemical reagent for recognition of certain metallic minerals in metallographic studies, and did experimental work on a natural occurrence of gold associated with selenium. He prepared papers in cooperation with E. S. Bastin, of the division of geology, as follows: "The rôle of certain metallic minerals as precipitants of silver and gold," published in the Bulletin of the American Institute of Mining Engineers; and "Metallic minerals as precipitants of silver and gold," published in Economic Geology. A third paper, in the form of an address, entitled "A new classification of natural waters" was read at the annual meeting of the Geological Society of America in New Haven, Conn.

W. T. Schaller was reinstated in the Survey October 1, on his return from Europe, where he had spent the summer studying mineralogy. His paper on the mineral tourmaline, based on work done in this laboratory, was accepted by the University of Munich as a doctorate dissertation. Most of his time has been devoted to routine analytical work consisting of chemical and mineralogical determinations and quantitative rock and mineral analyses. He studied the minerals bloedite, melilite, and custerite (a new mineral) and began an investigation of several apparently new borates from California, a new aluminum phosphate from Utah, a new titanium mineral from Colorado, a new zinc silicate from New Jersey, and a new alteration product of melilite. Crystals of pisanite from Ducktown, Tenn., were measured and described for Prof. Van Horn, of

the Case School of Applied Science in Cleveland. Mr. Schaller's report on the gem tourmaline field of California was finished and submitted for publication. He made a visit to New York to obtain material for illustrating this report. He obtained for study the entire collection of schneebergite from the Vienna Hof Museum and has procured specimens of atopite from Brazil and of romeine from Italy for comparative study. He has begun a study of the mineral composition of phosphate rock and has obtained numerous samples of such minerals from England, France, Germany, Russia, and the United States.

The following papers by Mr. Schaller have been published in outside journals: "Immense bloedite crystals from California," "Calculation of mineral formulas," "Refractive indices of strengite," "Crystallography of natramblybonite," and "The tourmaline group." He also prepared several other minor papers for publication.

During Mr. Schaller's absence in Europe his position was filled by a substitute, Prof. W. F. Hunt, of Ann Arbor, Mich.

J. G. Fairchild left the Survey on leave of absence on August 26, and W. C. Wheeler was appointed to fill the supposed temporary vacancy. On November 23, 1912, Mr. Fairchild resigned and Mr. Wheeler received the permanent appointment. Mr. Wheeler's entire time has been given to routine analytical work.

Two chemists were added to the force on account of the potash appropriation, W. B. Hicks in October, 1912, and R. K. Bailey in December, 1912. They are engaged in routine analytical work relating to the potash investigation.

In the physical laboratory C. E. Van Orstrand designed and supervised the construction of apparatus for measuring the temperature of deep wells. Some preliminary observations were made in the field by Mr. Van Orstrand, in cooperation with G. F. Becker, during the month of June. Experiments on elasticity and plasticity were resumed after the probationary appointment on March 1 of A. F. Melcher, of Chicago, Ill., as assistant physical geologist. The following papers by Mr. Van Orstrand, the first two of which are of the nature of preliminary reports, were published in the Journal of the Washington Academy of Sciences: "A table of the circular functions to radian argument," "Tables of the exponential function," and "The determination of the order of agreement between observations and theory in mineral analyses" (in cooperation with F. E. Wright).

G. F. Becker was employed in studying finite flexure, extension and torsion of elastic bodies, and thermometric indications of bubbles in fluid inclusions, and in devising thermometric appliances for taking earth temperatures in bore holes. He spent the month of February, 1913, in Panama, observing the slides in the Culebra Cut,

and has since been occupied in studying the mechanics of the phenomena. He published a paper (which has a geophysical bearing) on the "Gudermannian complement and imaginary geometry."

### TOPOGRAPHIC BRANCH.

#### ORGANIZATION.

A reorganization of the field service of the topographic branch was effected on July 1 last, as outlined in the annual report for the last fiscal year. The present organization 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. Renshaw, geographer; W. M. Beaman, topographic engineer.

#### PERSONNEL.

The technical corps of the topographic branch was increased during the year by the appointment of 1 topographic engineer, 1 assistant topographer, 16 junior topographers, and 1 draftsman. It was reduced 25 by transfers, resignations, and deaths. With these changes the technical force now includes 1 chief geographer, 11 geographers, 17 topographic engineers, 36 topographers, 37 assistant topographers, 54 junior topographers, and 10 draftsmen—a total of 166. In addition, 54 technical field assistants were employed during a whole or a part of the field season. One geographer, 1 topographer, and 1 assistant topographer are on leave without pay.

#### PUBLICATIONS.

The published work of the topographic branch for the fiscal year consists of 101 maps and 6 book publications, namely, Bulletins 514, 515, 516, 517, 518, and 519, titles and brief summaries of which are given on page 18; also the "Topographic instructions," two prints of which have been received, and a book for facilitating primary traverse computations entitled "Logarithms and factors for converting latitudes and departures in feet to seconds of latitude and longitude for latitudes  $0^{\circ}$  to  $72^{\circ}$ ," prepared by D. H. Baldwin. The manuscripts for 17 bulletins have been assembled and transmitted for publication as results of spirit leveling, namely, Oregon, 1896 to 1911 (Bulletin 556); Washington, 1911, containing also the elevations published in Bulletin 457 affected by the 1912 adjustment (Bulletin

557); Wyoming, 1896 to 1911 (Bulletin 558); Michigan, 1911 (Bulletin 559); Minnesota, 1897 to 1912 (Bulletin 560); Hawaii, 1910 to 1912 (Bulletin 561); Virginia, 1911 and 1912 (Bulletin 562); Maryland, 1896 to 1911 (Bulletin 563); Oklahoma, 1895 to 1912 (Bulletin 564); Colorado, 1896 to 1912 (Bulletin 565); Utah, 1897 to 1912 (Bulletin 566); Idaho, 1896 to 1912 (Bulletin 567); Missouri, 1896 to 1912 (Bulletin 568); Iowa, 1896 to 1912 (Bulletin 569); Wisconsin, 1897 to 1912 (Bulletin 570); Kansas, 1896 to 1912 (Bulletin 571); and Nebraska, 1896 to 1912 (Bulletin 572). These publications also include, in addition to the results of the Geological Survey's leveling, similar data from other organizations, which have been added as appendices. In each publication is also given, where the number warrants it, a list of secondary elevations taken from the records of this Survey. The leveling data for Illinois and Kentucky for 1912 have been added to their respective manuscripts, which were submitted during the fiscal year 1911-12 for publication; and the results of primary triangulation and primary traverse in 1912 have been added to the manuscript containing the data for 1911, which was also transmitted for publication last year.

## ALLOTMENTS.

The total appropriations for topographic surveys for the fiscal year 1913 were:

Topographic surveys.....	\$359, 200
Surveying national forests.....	75, 000
	<hr/> 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 1913.*

	Topo- graphic surveys.	Surveying national forests.
Administrative expenses of Survey.....	\$22, 896	\$4, 500
Clerical assistance and supervision.....	16, 268	3, 332
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, District of Columbia, Georgia, Maine, Maryland, New York, Pennsylvania, Virginia, and West Virginia.....	73, 495	.....
Central division, field work in Illinois, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.....	56, 495	.....
Rocky Mountain division, field work in Colorado, Montana, Nebraska, Missouri, New Mexico, Oklahoma, and Wyoming.....	51, 692	19, 761
Pacific division, field work in Arizona, California, New Mexico, Nevada, Utah, and Hawaii.....	50, 292	25, 112
Northwestern division, field work in Idaho, Oregon, Montana, Wyoming, and Washington.....	39, 595	16, 012
Work by land-classification board.....	10, 000	2, 500
	<hr/> 359, 200	<hr/> 75, 000

## 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 work.*

California .....	\$14, 000. 00
California river surveys, not met by Federal allotment.....	3, 600. 00
Idaho .....	700. 00
Illinois .....	8, 000. 00
Iowa .....	2, 650. 00
Kentucky .....	10, 000. 00
Maine .....	3, 726. 42
Michigan .....	2, 000. 00
Minnesota .....	10, 362. 48
Missouri .....	2, 500. 00
Nebraska .....	2, 000. 00
New York .....	10, 000. 00
Ohio .....	25, 000. 00
Oklahoma .....	1, 000. 00
Oregon .....	15, 000. 00
Pennsylvania .....	5, 528. 19
Virginia .....	4, 250. 00
Washington .....	13, 750. 00
West Virginia .....	12, 000. 00
Hawaii .....	15, 200. 00
	<hr/>
	161, 267. 09

In addition to the amounts above listed the State of Oregon made an allotment, not met with Federal funds, for a profile survey of Deschutes River in that State, in connection with a special report on that river by the water-resources branch. An informal cooperative arrangement was also made with the Canadian Geological Survey for a special resurvey of the Niagara gorge, the work on both sides being done by members of the topographic branch, but the entire expense of the work on the Canadian side being borne by that Government.

## GENERAL OFFICE WORK.

Progress maps were kept up to date and new ones were compiled when necessary; for States of which the new millionth-scale maps were available, new progress maps were made; field notes in connection with vertical and horizontal control work were copied and catalogued; 92 civil-service examination papers for the positions of assistant topographer and topographic aid were rated.

The computations of control positions 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, L. S. Leopold, F. J. McMaugh, and A. C. Roberts, the work being done 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 heretofore mentioned.

#### SUMMARY OF RESULTS.

The condition of topographic surveys to June 30, 1913, distinguished as to scale, etc., is shown on Plate II.

As 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 18,578 square miles, making the total area surveyed to date in the United States 1,178,974 square miles, or 38.9 per cent of the entire country. In addition, 3,987 square miles of resurvey were completed, making the total area of actual surveys during the year 22,565 square miles.

In connection with these surveys, 4,234 linear miles of primary levels were run, making 242,042 miles of primary and precise levels run since the authorization of this work by Congress in 1896. In the course of this work 1,117 permanent bench marks were established. In addition, 884 linear miles of river surveys were run.

Triangulation stations to the number of 176 were occupied and 128 were permanently marked. Primary traverse lines aggregating 1,353 miles were run, in connection with which 173 permanent marks were set. In the course of this work 20,853 square miles were covered by primary control.

The area covered by topographic surveys in Alaska during the fiscal year, as reported in detail on page 76, was 298 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 153 square miles, for publication on the scale of 1:31,680, making the total area surveyed to date in Hawaii 1,032 square miles. In connection with the surveys in Hawaii, 51 miles of primary and precise levels were run and 13 permanent bench marks were established, making the total number of miles of primary and precise levels run by this survey in Hawaii 490.

*Present condition of topographic surveys of the United States and new areas surveyed in fiscal year 1912-13.*

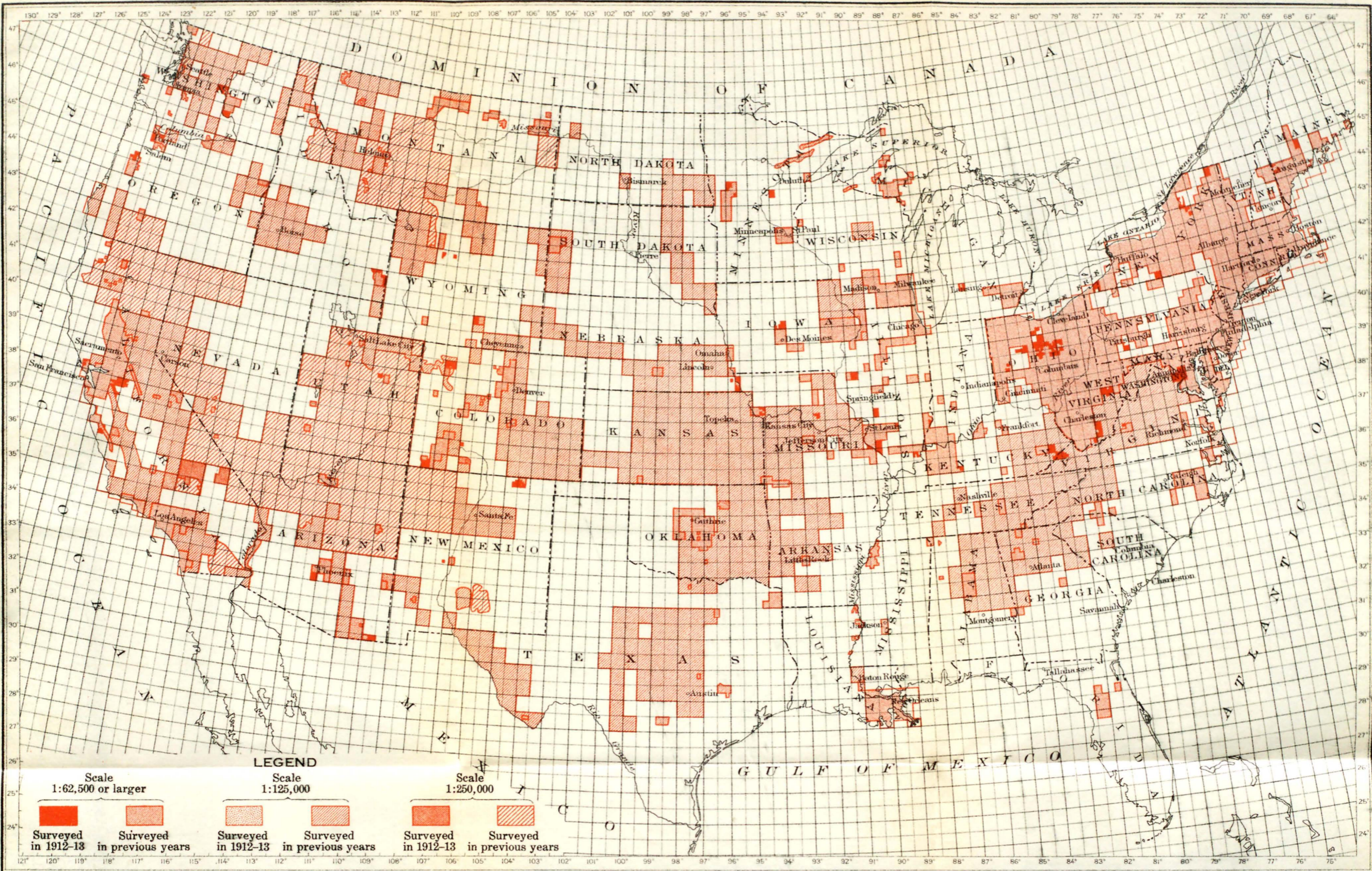
	New area surveyed in 1912-13.	Total area surveyed to June 30, 1913.	Percentage of total area of State surveyed to June 30, 1913.
	<i>Sq. mi.</i>	<i>Sq. mi.</i>	
Alabama.....		18,713	36
Arizona.....	2,299	66,760	58
Arkansas.....		21,380	40
California.....	6,133	109,444	69
Colorado.....	1,131	45,226	43
Connecticut.....		4,965	100
Delaware.....		1,202	51
District of Columbia.....		70	100
Florida.....		2,080	4
Georgia.....		17,337	29
Idaho.....	382	24,462	29
Illinois.....	1,018	13,128	23
Indiana.....		3,041	8
Iowa.....	305	11,371	20
Kansas.....		64,159	78
Kentucky.....	67	17,654	43
Louisiana.....		8,311	17
Maine.....	294	8,914	27
Maryland.....		12,327	100
Massachusetts.....		8,266	100
Michigan.....	206	5,591	9
Minnesota.....	434	5,572	6
Mississippi.....		1,889	4
Missouri.....	185	35,664	51
Montana.....	794	55,965	38
Nebraska.....	217	26,311	34
Nevada.....	7	50,682	46
New Hampshire.....		3,380	36
New Jersey.....		8,224	100
New Mexico.....	320	35,850	29
New York.....	622	42,227	85
North Carolina.....		17,661	34
North Dakota.....		9,716	14
Ohio.....	1,739	34,727	84
Oklahoma.....	397	39,612	56
Oregon.....	930	20,742	21
Pennsylvania.....	291	24,167	55
Rhode Island.....		1,248	100
South Carolina.....		5,640	18
South Dakota.....		18,594	24
Tennessee.....		20,911	50
Texas.....		67,387	25
Utah.....		67,905	79
Vermont.....		3,753	39
Virginia.....		29,980	70
Washington.....	650	23,269	33
West Virginia.....		24,170	100
Wisconsin.....		11,789	21
Wyoming.....	157	27,538	28
Hawaii.....	18,578	1,178,974	38.9
	153	1,032	16

## ATLANTIC DIVISION.

## FIELD WORK.

## SUMMARY.

During the season topographic mapping was carried on in Alabama, the District of Columbia, Maine, Maryland, New York, Pennsylvania, Virginia, and West Virginia. This work comprised the completion of the survey of five quadrangles and of the resurvey of five quadrangles and two special areas, in addition to which four



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

Scale 1:14,000,000

100 0 100 200 300 400 500 Miles

quadrangles were partly surveyed and seven quadrangles were partly resurveyed. The total new area mapped was 1,207 square miles for publication on the scale of 1:62,500. The area resurveyed was 1,920 square miles—1,444 square miles for publication on the scale of 1:62,500, 465 square miles for publication on the scale of 1:24,000, and 11 square miles for publication on the scale of 1:12,000. In connection with this work 769 miles of primary levels were run and 174 permanent bench marks were established.

Primary triangulation and primary traverse were carried on at different times by nine parties, the work being distributed over portions of Alabama, Georgia, Maine, Maryland, Tennessee, Virginia, and West Virginia. The total area covered by this primary control was about 3,218 square miles, of which 675 square miles were controlled by primary traverse, 174 miles being run and 15 permanent marks set. Thirty-six triangulation stations were occupied and 33 were permanently marked. The result of this work was to make control available in fourteen quadrangles.

*Topographic surveys in Atlantic division from July 1, 1912, to June 30, 1913.*

State.	Contour interval.	For publication on scale of—				Total area surveyed.	Primary levels.		Primary traverse.	
		1:62,500		1:24,000	1:12,000, new.		Distance run.	Bench marks.	Distance run.	Permanent marks.
		New.	Resurvey.	Resurvey.						
	<i>Feet.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Miles.</i>		<i>Miles.</i>	
Alabama.....	10			70		70	12	1	50	6
District of Columbia.....	20	294				294	89	23		
Maine.....	10			245		245	35	7	47	6
Maryland.....	10-20	622			11	633	199	50		
New York.....	20	291	13			304	63	15		
Pennsylvania.....									35	3
Tennessee.....	10-20-50		467	150		617	150	29	42	
Virginia.....	50		964			964	221	49		
West Virginia.....		1,207	1,444	465	11	3,127	769	174	174	15

DETAILS OF WORK, BY STATES.

*Alabama.*—For the control of the Searles quadrangle, in Tuscaloosa and Jefferson counties, F. W. Crisp and C. W. Arnold ran 50 miles of primary traverse and set 6 permanent marks.

*District of Columbia-Maryland-Virginia.*—A special resurvey was made of the area around Washington, D. C., the map to be published as "Washington and vicinity," on the scale of 1:24,000, with a contour interval of 10 feet. The area resurveyed comprised 465 square miles, of which 70 covered the District of Columbia, 245 were in Maryland, and 150 were in Virginia. For the control of this area D. H. Baldwin, F. J. McMaugh, and R. C. Seitz ran 104 miles of

primary and precise levels and established 17 permanent bench marks, and G. W. Hawkins, C. B. Kendall, and J. R. Ellis ran 89 miles of primary traverse and set 6 permanent marks. Of this control, 35 miles of primary levels and 7 permanent bench marks and 47 miles of primary traverse and 6 permanent marks were in Maryland, 57 miles of primary levels and 9 permanent bench marks and 42 miles of primary traverse were in Virginia, and 12 miles of primary levels and 1 permanent bench mark were in the District of Columbia.

*Georgia.*—The Talking Rock and Waleska quadrangles, in Gilmer, Pickens, Gordon, and Cherokee counties, were controlled by triangulation, 6 stations being occupied and 5 permanently marked. This work was done by G. T. Hawkins.

*Maine.*—For the continuation of cooperative topographic surveys in Maine the State Survey Commission allotted \$3,650, which was met by the United States Geological Survey with an allotment of \$3,850, the reason for the larger Federal allotment being that during the previous fiscal year the State had contributed \$200 toward cooperative surveys not met by the Federal Government. In addition, the State Survey Commission contributed \$76.42 for the preparation of a special edition of a map of the Great Moose Lake for State use. The survey of the Bethel and Skowhegan quadrangles in Oxford and Somerset counties was completed by Hersey Munroe, Olinus Smith, and K. E. Schlachter, and that of the Waldoboro quadrangle, in Lincoln and Knox counties, was begun by W. H. Griffin and J. H. Le Feaver, the total area mapped being 294 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 Washington Pond and Burnham quadrangles, in Waldo and Kennebec counties, G. T. Hawkins occupied 13 triangulation stations and permanently marked 11, and Mr. Schlachter, J. M. Perkins, and C. H. Davey ran 89 miles of primary levels and established 23 permanent bench marks.

*Maryland.*—For work in Maryland see pages 95–96 (map of Washington and vicinity).

*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 Federal Survey allotted a like sum for the same purpose. The survey of the Number Four, Churubusco, and Corning quadrangles, in Lewis, Herkimer, Clinton, and Steuben counties, was completed, and that of the Bonaparte quadrangle, in Lewis, Herkimer, and St. Lawrence counties, was continued by J. M. Whitman, J. F. McBeth, W. H. S. Morey, T. F. Slaughter, S. P. Floore, R. A. Kiger, Roscoe Reeves, H. S. Senseney, and E. E. Witherspoon, the total area mapped being 622 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 Gouverneur quadrangle, in St. Lawrence County, Mr. Schlachter, Mr. Senseney, K. W. Trimble, and A. J. Kavanaugh ran 199 miles of primary levels and established 50 permanent bench marks.

Under a special arrangement with the Canadian Geological Survey a resurvey of the Niagara gorge was made by C. E. Cooke, for publication on the scale of 1:12,000, with a contour interval of 10 feet, the area mapped in the United States being 11 square miles. In addition, 17 square miles on the Canadian side were mapped by Mr. Cooke, his salary and the entire expense of the work in Canada being paid direct by the Canadian Geological Survey.

*Pennsylvania.*—The Topographic and Geologic Survey Commission of Pennsylvania allotted \$5,328.19 for the continuation of the cooperative topographic survey of the State, and the United States Geological Survey allotted a like sum. The survey of the Northeast and Somerset quadrangles, in Erie, Somerset, and Westmoreland counties, was begun by Robert Muldrow, W. H. Griffin, J. F. McBeth, and C. H. Davey, the area mapped being 291 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of these areas L. F. Biggs ran 63 miles of primary levels and established 15 permanent bench marks.

In addition to the cooperative work in Pennsylvania, the resurvey of the Reading quadrangle, in Berks County, was begun by Hersey Munroe and Olinus Smith, the area mapped being 13 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet.

A special survey was also made for the Bureau of Mines of the site for the experiment station in Pittsburgh, covering an area of about 18 acres. All the expenses of this work except the salaries of the topographers were paid by the Bureau of Mines.

*Tennessee.*—For the control of the Murfreesboro quadrangle, in Rutherford County, Oscar Jones ran 35 miles of primary traverse and established 3 permanent marks.

*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. In order to take advantage of favorable weather, the State money was made available for expenditure in June of the preceding fiscal year, and a portion of the work accomplished under the allotment was included in the report for that year. The resurvey of the Virginia portion of the Pound quadrangle, in Wise and Dickenson counties, was completed, and that of the Clintwood quadrangle, in the same counties, was begun, by J. I. Gayetty, J. B. Metcalfe, jr., F. W. Crisp, C. W. Arnold, F. W. Farnsworth, and Roscoe Reeves, the area mapped

being 232 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. For the control of these areas and of the Bucu quadrangle, in Dickenson and Buchanan counties, Mr. Gayetty, Mr. Arnold, H. S. Senseney, and Mr. Metcalfe ran 89 miles of primary levels and established 19 permanent bench marks.

In addition to the cooperative work in Virginia, the resurvey of the Fairfax quadrangle (the northeast quarter of the Mount Vernon 30-foot quadrangle), in Fairfax, Prince William, and Loudoun counties, was completed by Robert Muldrow and R. C. McKinney, the area mapped being 196 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of this quadrangle R. H. Kilmer ran 4 miles of primary levels and established 1 permanent bench mark. The resurvey of the Eagle Rock quadrangle (southeast quarter of the Natural Bridge 30-foot quadrangle), in Botetourt, Alleghany, and Craig counties, the mapping of which was begun in 1907-8, was continued by T. F. Slaughter, the area mapped being 39 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. (See also pp. 95-96, map of Washington and vicinity.)

*West Virginia.*—For the continuation of cooperative surveys the State geologist allotted \$12,000 and the United States Geological Survey \$10,000. A resurvey of areas previously mapped resulted in the completion of the survey of the Crawford, Sandrun, Packs Ferry, and Meadow Creek quadrangles and of portions of the Ingle-side, Hacker Valley, and Pickens quadrangles, in Lewis, Upshur, Randolph, Webster, Summers, Mercer, Raleigh, Monroe, and Greenbrier counties, the area mapped being 964 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, J. I. Gayetty, Fred McLaughlin, S. A. Judson, J. H. Le Feaver, K. E. Schlachter, C. S. Wells, and M. A. Roudabush.

For the control of these areas and of the Peterstown, Winona, and Summersville quadrangles, in Mercer, Summers, Monroe, Fayette, Greenbrier, Clay, and Nicholas counties, Mr. Hawkins, Mr. Metcalfe, and Mr. Kendall occupied and permanently marked 17 triangulation stations, and Mr. Biggs, Mr. Metcalfe, and Mr. Trimble ran 221 miles of primary levels and established 49 permanent bench marks.

#### OFFICE WORK.

The drafting of the following sheets was completed: Seaford, Del.-Md.; Palatka, Fla.; Bethel and Skowhegan, Maine; Corning, Churubusco, Niagara Gorge, and Number Four, N. Y.; Murphy, N. C.-Tenn. (revision); Pound, Va.-Ky.; Crawford, Fairfax, Meadow Creek, Hinton, and Sago, W. Va.; Experiment Station, Bureau of Mines.

Progress in the drafting of additional sheets was made as follows: Washington and vicinity, D. C.-Md.-Va., 95 per cent; Northeast, Pa., 50 per cent; Somerset, Pa., 50 per cent; Fairfax, Va., 90 per cent.

The following computations and adjustments were made:

Primary-level circuits were adjusted and geographic positions were computed for the Adger quadrangle (Ala.). Geographic positions for the Searles quadrangle (Ala.) were adjusted.

Primary-level circuits in the Seaford quadrangle (Del.-Md.) were adjusted.

Primary-level circuits were adjusted and geographic positions were computed for the Washington and vicinity quadrangle (D. C.-Md.-Va.).

Geographic distances and positions were computed for the Cartecay, Talking Rock, and Waleska quadrangles (Ga.).

Primary-level circuits were adjusted and geodetic distances and positions were computed for the Skowhegan quadrangle (Maine). Primary-level circuits in the Anson, Bethel, and Kingsbury quadrangles (Maine) were adjusted, and geodetic distances and positions for the Burnham, Waldoboro, and Washington Pond quadrangles (Maine) were computed.

Primary-level circuits in the Crawford Notch and Mount Washington quadrangles (N. H.) were adjusted.

Primary-level circuits were adjusted and geographic positions were computed for the Bonaparte and Churubusco quadrangles (N. Y.). Primary-level circuits in the Corning quadrangle (N. Y.) were adjusted, and geographic positions for the Chateaugay, Edwards, and Gouverneur quadrangles (N. Y.) were computed.

Primary-level circuits were adjusted and geographic positions were computed for the Gastonia (N. C.) and Pleasantridge (N. C.-S. C.) quadrangles. Primary-level circuits in the Derita quadrangle (N. C.) were adjusted, and geographic positions in the Lincolnton quadrangle (N. C.) were computed.

Primary-level circuits in the Somerset quadrangle (Pa.) were adjusted.

Precise and primary level circuits in the island of Porto Rico, run by members of this Survey in connection with the work being conducted by the Porto Rico Irrigation Service, were adjusted.

Geographic positions for the Murfreesboro, Nolensville, and Woodbury quadrangles (Tenn.) were computed.

Primary-level circuits in the Burkes Garden, Coeburn, Glade Springs, Lebanon, Richlands, and Wise (Va.), Bigstone Gap, Clintwood, and Pennington Gap (Va.-Ky.), Maxwell (Va.-W. Va.), and Hagan, Middlesboro, and Sneedville (Va.-Tenn.-Ky.) quadrangles were adjusted.

Primary-level circuits in the Hinton, Meadowcreek, Pickens, and Sago quadrangles (W. Va.) were adjusted.

## CENTRAL DIVISION.

## FIELD WORK.

## SUMMARY.

During the season topographic mapping was carried on in Illinois, Iowa, Kentucky, Michigan, Minnesota, Missouri, and Ohio. This work comprised the completion of the survey of 22 quadrangles and of the resurvey of 3 quadrangles, in addition to which 12 quadrangles were partly surveyed, and 4 quadrangles were partly resurveyed. The total new area mapped was 3,820 square miles, for publication on the scale of 1:62,500; the area resurveyed was 802 square miles, for publication on the scale of 1:62,500. In addition 2 quadrangles were completely revised, the area covered being 463 square miles. In connection with this work 1,557 miles of primary levels were run and 415 permanent bench marks were established.

Primary traverse was carried on at different times by three parties, the work being distributed over portions of Illinois, Iowa, Michigan, Minnesota, Missouri, and Wisconsin. The total area covered by this primary control was about 1,935 square miles, 844 linear miles of primary traverse being run and 80 permanent marks set. The result of this work was to make control available in 34 quadrangles.

*Topographic surveys in central division from July 1, 1912, to June 30, 1913.*

State.	Contour interval.	For publication on scale of—		Total area surveyed.	Primary levels.		Primary traverse.	
		1: 62,500			Distance.	Bench marks.	Distance.	Permanent marks.
		New.	Resurvey.					
	<i>Feet.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Miles.</i>		<i>Miles.</i>	
Illinois.....	20	1,018	220	1,238	243	71	269	23
Iowa.....	20	305	.....	305	93	22	27	3
Kentucky.....	20-50	67	381	448	285	76	.....	.....
Michigan.....	20	206	.....	206	.....	.....	128	15
Minnesota.....	10	434	.....	434	378	109	99	11
Missouri.....	20	51	201	252	226	61	224	16
Ohio.....	10-20	1,739	.....	1,739	258	59	.....	.....
Wisconsin.....	.....	.....	.....	.....	74	17	97	12
		3,820	802	4,622	1,557	415	844	80

## DETAILS OF WORK BY STATES.

*Illinois.*—The governor of Illinois allotted \$8,000 for the continuation of cooperative topographic surveys in Illinois, and the United States Geological Survey allotted a like sum. The survey of the Macomb, Staunton, Centralia, and Baldwin quadrangles and of the Illinois portions of the Vincennes and Chester quadrangles, in McDonough, Schuyler, Macoupin, Marion, Clinton, Washington, Fay-

ette, Randolph, Monroe, St. Clair, Lawrence, and Wabash counties, was completed by Frank Tweedy, C. W. Goodlove, L. L. Lee, F. W. Hughes, J. H. Wilson, W. S. Gehres, S. R. Truesdell, and R. M. Herrington, the area mapped being 871 square miles for publication on the scale of 1:62,500, with a contour interval of 20 feet. The mapping of the Equality quadrangle and of the Illinois portion of the Shawneetown quadrangle, in Saline, Gallatin, Hardin, and Pope counties, was begun by O. H. Nelson, E. L. Hain, and F. B. Barrett, the area mapped being 147 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. The resurvey of the Ottawa quadrangle, in Lasalle County, was completed by L. L. Lee and L. H. Williams, the area mapped being 220 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 Litchfield, New Douglas, and Alton quadrangles, in Montgomery, Macoupin, and Madison counties, Mr. Barrett, S. R. Archer, and R. G. Clinite ran 244 miles of primary levels and established 71 permanent bench marks. For the control of the Illinois portion of the Edgington quadrangle and of the Kings, Rochelle, Shabbona, Mendota, Plano, Marseilles, Morriss, Odell, Glasford, Muscatine, Keithsburg, Goodhope, Avon, Galesburg, and Elmwood quadrangles, in Ogle, Winnebago, Lee, Dekalb, Lasalle, Bureau, Kendall, Grundy, Peoria, Fulton, Rock Island, Mercer, Warren, Henderson, McDonough, Knox, and Stark counties, E. L. McNair and A. D. Duck ran 269 miles of primary traverse and set 23 permanent marks.

*Iowa.*—The State geologist allotted \$1,750 for the continuation of cooperative topographic surveys in Iowa, and the Federal Survey allotted an equal amount. In the spring of 1913 an additional allotment of \$900 was made by the State geologist for cooperative surveys, which was not met by the Federal Survey. The survey of the Story City quadrangle was completed and that of the Boone quadrangle, in Story, Boone, Hamilton, and Webster counties, was begun by W. L. Miller and C. R. French, the total area mapped being 305 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 Chariton quadrangle in Lucas, Warren, and Marion counties, S. R. Archer and R. G. Clinite ran 93 miles primary levels and established 22 permanent bench marks. In addition to the cooperative work in Iowa, the Iowa portions of the Edgington and Durant quadrangles, in Muscatine, Scott, and Adair counties, were controlled by Mr. McNair and Mr. Duck, 27 miles of primary traverse being run, in connection with which 3 permanent marks were set.

*Kentucky.*—The Kentucky Geological Survey allotted \$10,000 for the continuation of cooperative topographic surveys in that State, and the Federal Survey allotted a like sum. The survey of the

Little Muddy quadrangle, in Warren and Butler counties, was completed by C. W. Goodlove and R. M. Herrington, the area mapped being 67 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. The resurvey of the Hindman quadrangle was completed, and that of the Oven Fork quadrangle begun, in Knott, Letcher, and Floyd counties, the area mapped being 288 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. The resurvey of the Kentucky portions of the Pound and Clintwood quadrangles, in Pike and Letcher counties, was completed by J. I. Gayetty, F. W. Crisp, C. W. Arnold, Roscoe Reeves, and H. S. Senseney, the area mapped being 93 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. The resurvey of the Virginia portions of the two last-named quadrangles was begun in cooperation with the State of Virginia. For the control of the above areas and of the Cornettsville, Laynesville, Goodloe, and Virgie quadrangles, in Martin, Pike, Floyd, Johnson, Magoffin, Breathitt, Letcher, Perry, and Leslie counties, S. R. Archer, C. W. Arnold, and H. S. Senseney ran 285 miles of primary levels and established 76 permanent bench marks. (See also p. 104, Ohio-Kentucky.)

*Michigan.*—For the continuation of cooperative topographic surveys in Michigan the State geologist allotted \$2,000, which was met by the United States Geological Survey with a like sum. The mapping of the Grand Rapids quadrangle, in Kent, Barry, and Allegan counties, was completed by A. M. Walker and L. D. Townsend, the area mapped being 192 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of the St. Charles, Carson City, Chesaning, De Witt, Elsie, Freeland, Ithaca, Merrill, Muir, Perrinton, and Saginaw quadrangles in Clinton, Gratiot, Saginaw, Eaton, and Midland counties, J. H. Wilson ran 128 miles of primary traverse and set 15 permanent marks.

In addition to the cooperative work in Michigan, the survey of the Houghton quadrangle, in Houghton County, was completed by Mr. Walker and Mr. Townsend, the area mapped being 14 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet.

*Minnesota.*—The State drainage engineer of Minnesota allotted \$10,000 for the continuation of cooperative topographic work in that State, and the United States Geological Survey made an equal allotment. A further allotment of \$362.48 was made by the State to cover additional expenditures on account of the cooperative work. The survey of the Deerwood quadrangle and the unmapped portions of the Battle Lake, Perham, and Dora quadrangles, in Aitkin, Crow Wing, Ottertail, Becker, and Clay counties, was completed by C. L. Sadler, F. B. Barrett, L. B. Roberts, E. L. Hain, O. H. Nelson, J. H. Wilson, and W. A. Reiter, the area mapped being 434 square miles,

for publication on the scale of 1:62,500, with a contour interval of 10 feet. For the control of these areas and of the Pelican Rapids quadrangle, in Ottertail and Clay counties, J. M. Ray ran 115 miles of primary levels and set 32 permanent bench marks. For the control of the Aitkin, Emily, Brainerd, Wealthwood, Sylvan, Crosslake, McGregor, Haypoint, Lastrup, Rucker, and Opstead quadrangles, in Aitkin, Crow Wing, Cass, Morrison, Mille Lacs, and Kanabec counties, Mr. McNair and Mr. Duck ran 99 miles of primary traverse and set 11 permanent marks, and E. C. Bibbee and J. M. Ray ran 263 miles of primary levels and set 77 permanent bench marks.

*Missouri.*—For the continuation of cooperative topographic surveys in Missouri the State geologist allotted \$2,500, which was met with an equal allotment by the United States Geological Survey. The resurvey of the Smithville quadrangle, in Clay, Platte, and Clinton counties, was completed by H. H. Hodgeson, J. B. Leavitt, and P. W. McMillen, the area mapped being 125 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. The survey of the Missouri portion of the Renault quadrangle, in Ste. Genevieve County, was begun by F. W. Hughes, the area mapped being 51 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 Missouri portion of the Crystal City quadrangle in Jefferson County, Mr. McMillen, R. G. Clinite, and G. W. Lucas ran 109 miles of primary levels and established 38 permanent bench marks, and J. H. Wilson ran 36 miles of primary traverse and set 2 permanent marks.

In addition to the cooperative work in Missouri, the control of the Missouri portions of the Kimmswick, Chester, and Perryville quadrangles, in Jefferson and Perry counties, was begun by Mr. Wilson, 44 miles of primary traverse being run and 3 permanent bench marks set. The resurvey of the Sturgeon quadrangle, in Boone and Howard counties, was begun by W. J. Lloyd and P. W. McMillen, the area mapped being 76 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 Moberly, Macon, Glasgow, Boonville, and Jefferson City quadrangles, in Audrain, Monroe, Randolph, Boone, Howard, Shelby, Macon, Saline, Cooper, and Chariton counties, Mr. McNair and Mr. Duck ran 144 miles of primary traverse and set 11 permanent marks, and Mr. McMillen and Mr. Bibbee ran 117 miles of primary levels and established 23 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 Shiloh quadrangle and of the unmapped portions of the Coshocton, Gambier, Fredericktown, Marengo, Millersburg, Loudonville, Perrysville, Siam,

and Troy quadrangles, in Holmes, Coshocton, Knox, Licking, Marion, Delaware, Wayne, Ashland, Richland, Miami, Shelby, Champaign, Crawford, Huron, Seneca, and Clark counties, was completed; that of the Brinkhaven and Shauck quadrangles, in Holmes, Knox, Coshocton, Wayne, Richland, Morrow, and Crawford counties, was continued; and that of the Mount Gilead, Kenton, Bucyrus, and Larue quadrangles, in Morrow, Marion, Crawford, Logan, Wyandot, and Hardin counties, was begun. The total area mapped was 1,739 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, G. S. Smith, C. W. Goodlove, W. J. Lloyd, J. R. Eakin, Fred Graff, jr., Merrill Hackett, W. L. Miller, W. N. Vance, S. G. Lunde, A. P. Meade, J. A. Duck, L. L. Lee, A. J. Ogle, F. W. Hughes, J. L. Lewis, H. W. Peabody, O. G. Taylor, J. H. Wilson, N. E. Ballmer, W. S. S. Johnson, Horace Rayner, W. A. Reiter, C. R. French, W. S. Gehres, L. B. Glasgow, R. M. Herrington, L. H. Williams, and Howard Clark.

For the control of these areas and of the Alger quadrangle, in Hardin, Logan, Auglaize, and Allen counties, E. C. Bibbee and S. L. Parker ran 258 miles of primary levels and established 59 permanent bench marks.

*Ohio-Kentucky.*—The revision of culture in the East and West Cincinnati quadrangles, in Hamilton and Clermont counties, was completed, the area mapped being 463 square miles, for publication on the scale of 1:24,000, with a contour interval of 20 feet. This work was done by J. H. Jennings and N. E. Ballmer. Of the area mapped, 140 square miles was in Kentucky and 323 square miles in Ohio.

*Wisconsin.*—For the control of the La Farge, Kendall, Rapp, and Millston quadrangles, in Monroe and Vernon counties, A. D. Duck ran 97 miles of primary traverse and set 12 permanent marks, and L. F. Biggs ran 74 miles of primary levels and established 17 permanent bench marks.

#### OFFICE WORK.

The drafting of the following sheets was completed: Baldwin, Centralia, Macomb, Ottawa, and Gillespie, Ill.; Ames, Iowa; Hindman and Little Muddy, Ky.; Houghton and Grand Rapids, Mich.; Battle Lake, Deerwood, Dora, Perham, and Underwood, Minn.; Green City and Smithville, Mo.; Marengo, Fredericktown, Gambier, Loudonville, Perrysville, Roxabel, and Troy, Ohio; East and West Cincinnati, Ohio-Ky. (revision).

Progress in the drafting of additional sheets was made as follows: Chester, Ill.-Mo., 40 per cent; Vincennes, Ill.-Ind., 50 per cent; Sturgeon, Mo., 30 per cent; Brinkhaven, Ohio, 63 per cent; Coshocton, Ohio, 95 per cent; Millersburg, Ohio, 17 per cent; Mount Gilead, Ohio, 24 per cent; Shauck, Ohio, 43 per cent; Shiloh, Ohio, 8 per cent; Siam, Ohio, 70 per cent.

The following computations and adjustments were made:

Primary-level circuits in the Baldwin, Colchester, Edwardsville, Gillespie, Litchfield, Macomb, and New Douglas (Ill.), and Alton and Chester (Ill.-Mo.) quadrangles were adjusted. Geographic positions for the Avon, Dwight, Earlville, Elmwood, Galesburg, Glasford, Goodhope, Kings, Marseilles, Monmouth, Morris, Odell, Plano, Rochelle, and Yorkville (Ill.) and Edgington and Keithsburg (Ill.-Iowa) quadrangles were computed.

Primary-level circuits were adjusted and geographic positions were computed for the Ames, Boone, Ogden and Webster City quadrangles (Iowa). Geographic positions for the Durant, Jewell, and Nevada quadrangles (Iowa) were computed.

Primary-level circuits in the Goodloe, Hindman, Laynesville, and Virgie (Ky.) and Pound and Regina (Ky.-Va.) quadrangles were adjusted.

Primary-level circuits were adjusted and geographic positions were computed for the Aitkin, Brainerd, Crosslake, Deerwood, Emily, McGregor, Seavey, and Wealthwood quadrangles (Minn.). Primary-level circuits in the Barnesville, Fergus Falls, and Pelican Rapids quadrangles (Minn.) were adjusted and geographic positions for the Haypoint, Lastrup, Mae, Onamia, Opstead, and Rucker quadrangles (Minn.) were computed.

Primary-level circuits were adjusted and geographic positions were computed for the Glasgow and Sturgeon quadrangles (Mo.). Primary-level circuits in the Smithville (Mo.) and Kansas City and Leavenworth (Kans.-Mo.) quadrangles were adjusted and geographic positions for the Jefferson City and Moberly (Mo.) and Crystal City and Kimmswick (Mo.-Ill.) quadrangles were computed.

Primary-level circuits in the Sandusky, Shiloh, Siam, Springfield, Upper Sandusky, Waynesville, West Salem, and Xenia quadrangles (Ohio) were adjusted.

Primary-level circuits were adjusted and geographic positions were computed for the La Farge and Rapp quadrangles (Wis.). Primary-level circuits in the Winona quadrangle (Wis.-Minn.) were adjusted and geographic positions for the Millston, Shamrock, and Sparta quadrangles (Wis.) were computed.

#### ROCKY MOUNTAIN DIVISION.

##### FIELD WORK.

##### SUMMARY.

During the season topographic mapping was carried on in Colorado, Missouri, Montana, Nebraska, New Mexico, Oklahoma, and Wyoming. This work comprised the survey of 2 quadrangles, 1

mining district, and 1 Government reservation, and the resurvey of 2 quadrangles, in addition to which 14 quadrangles were partly surveyed and 1 quadrangle was partly resurveyed. The total new area mapped was 2,899 square miles, 1,584 square miles for publication on the scale of 1:125,000, 1,311 square miles for publication on the scale of 1:62,500, and 4 square miles for publication on the scale of 1:12,000. The area resurveyed was 1,185 square miles, 957 square miles for publication on the scale of 1:125,000, and 228 square miles for publication on the scale of 1:62,500. In connection with this work 523 miles of primary levels were run and 136 permanent bench marks were established. A river profile survey was made of a portion of one stream, covering a distance of 95 linear miles.

Primary traverse and primary triangulation were carried on at different times by three parties, the work extending over portions of Nebraska, New Mexico, and Wyoming. The total area covered by this primary control was about 8,175 square miles, of which 457 were controlled by primary traverse, 102 miles being run and 25 permanent marks being set. Thirty-four triangulation stations were occupied and 25 were marked. The results of this work made control available in 10 quadrangles.

*Topographic surveys in Rocky Mountain division from July 1, 1912, to June 30, 1913.*

State.	Contour interval.	For publication on the scale of—					Total area surveyed.	Primary levels.		Primary traverse.	
		1:125,000		1:62,500		1:12,000		Distance run.	Bench marks.	Distance run.	Permanent marks.
		New.	Resurvey.	New.	Resurvey.	New.					
	<i>Feet.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Miles.</i>		<i>Miles.</i>	
Colorado.....	50-100	493	.....	638	.....	.....	1,131	199	61	.....	.....
Missouri.....	10	.....	.....	134	.....	.....	134	.....	.....	.....	.....
Montana.....	50-100	694	.....	.....	.....	.....	694	96	24	.....	.....
Nebraska.....	200	.....	.....	217	.....	.....	217	58	15	102	25
New Mexico.....	50	.....	.....	225	.....	.....	225	70	12	.....	.....
Oklahoma.....	50	397	957	.....	.....	.....	1,354	.....	.....	.....	.....
Wyoming.....	25	.....	.....	97	228	4	329	100	24	.....	.....
.....	.....	1,584	957	1,311	228	4	4,084	523	136	102	25

#### DETAILS OF WORK BY STATES.

*Arkansas.*—A special survey of the sewer system of Hot Springs, Ark., was made for the Department of the Interior under a provision of the sundry civil act approved August 24, 1912, the expenses of the work being borne equally by the department and the city of Hot Springs, as provided by the law.

*Colorado.*—The survey of the Axial, Monument Butte, and Soda Canyon quadrangles, in Moffat, Montezuma, and La Plata counties, was completed by R. W. Berry, Gilbert Young, R. H. Reineck, C. P. McKinley, and G. W. Lucas, the area mapped being 638 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. For the control of these areas and of the Lay quadrangle, in Moffat County, Mr. McKinley, Mr. Lucas, and C. W. Rowell ran 86 miles of primary levels and established 24 permanent bench marks. The survey of the Chromo quadrangle, lying partly in the San Juan and Rio Grande national forests, in Archuleta, Conejos, Rio Grande, and Mineral counties, was continued and that of the Longs Peak and Creede quadrangles, lying partly in the San Juan Rio Grande, Colorado, Arapahoe, and Medicine Bow national forests, in Mineral, Rio Grande, Larimer, Grand, and Boulder counties, was begun by Basil Duke, B. A. Jenkins, S. T. Penick, C. P. McKinley, R. R. Monbeck, C. W. Rowell, and L. B. Glasgow, the total area mapped being 493 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet, 379 square miles being in the national forests. For the control of these areas Mr. Rowell, C. A. Ecklund, and C. C. Holder ran 113 miles of primary levels and established 37 permanent bench marks.

*Colorado-Utah.*—The profile survey of Grand River was completed by R. C. Seitz. The total distance of the stream covered by the profile survey was 95 linear miles, in connection with which 156 miles were traversed. All of this season's work was in Grand and San Juan counties, Utah, the Colorado portion of the stream having been surveyed during the last season.

*Missouri.*—The survey of the Missouri portion of the Nemaha quadrangle, in Atchison County, was completed by B. A. Jenkins, the total area mapped being 134 square miles, for publication on the scale of 1:62,500, with a contour interval of 10 feet. The Nebraska portion of this quadrangle was mapped in cooperation with the State of Nebraska during the season of 1912.

*Montana.*—The survey of the Nyack quadrangle, lying partly in the Lewis and Clark and Blackfeet national forests, Flathead County, was completed, and that of the Marston quadrangle, in the Blackfeet National Forest, in Flathead and Lincoln counties, was begun by C. G. Anderson, C. J. Ballinger, Gilbert Young, and R. T. Evans, the total area mapped being 537 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet, of which 522 square miles is in the national forests. The survey of the Plentywood quadrangle, in Valley County, was begun by A. B. Searle and L. B. Fees, the total area mapped being 157 square miles, for publication on the scale of 1:125,000, with a contour interval of 50 feet.

For the control of these areas Mr. Fees and Mr. Ballinger ran 96 miles of primary levels and established 24 permanent bench marks. (See also p. 117.)

*Nebraska.*—The State geologist of Nebraska allotted \$2,000 for the continuation of the cooperative topographic surveys in that State during the years 1913 and 1914, to be met by the United States Geological Survey with an equal allotment. In order to take advantage of favorable weather the State money was made available for expenditure in April, 1913. The survey of the Falls City quadrangle, in Richardson County, was completed, and that of the Howe quadrangle, in Nemaha and Richardson counties, was begun by C. C. Gardner, R. H. Reineck, and R. R. Monbeck, the area mapped being 217 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 Stella quadrangle, in Nemaha County, J. R. Ellis ran 102 miles of primary traverse and set 25 permanent marks, and Mr. Monbeck ran 58 miles of primary levels and set 15 permanent bench marks.

*New Mexico.*—The survey of the Raton quadrangle, in Colfax County, was completed, and that of the Brilliant quadrangle, in Colfax County, was begun by E. P. Davis and C. C. Holder, the total area mapped being 225 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. Holder ran 70 miles of primary levels and established 12 permanent bench marks. For the control of the Orogrande, Las Curnas, Gypsum Hills, and Las Cruces quadrangles, in Otero and Dona Ana counties, R. B. Robertson established 8 triangulation stations and permanently marked 3.

*Oklahoma.*—The director of the Oklahoma Geological Survey allotted \$1,000 for the continuation of cooperative topographic surveys in that State, and the Federal Survey allotted a like sum. The survey of the Hominy quadrangle, in Osage, Pawnee Creek, and Tulsa counties, was completed by Basil Duke, S. E. Taylor, C. P. McKinley, and C. W. Rowell, the total area mapped being 397 square miles, for publication on the scale of 1:125,000, with a contour interval of 50 feet. The cooperative funds being insufficient to cover the completion of the Hominy quadrangle, the additional expenses necessary for that purpose were borne by the Federal Survey.

In addition to the cooperative work in Oklahoma the resurvey of the Nowata quadrangle, in Nowata and Washington counties, was completed by Mr. Duke, Mr. Rowell, C. J. Ballinger, G. W. Lucas, and F. L. Whaley, the area mapped being 957 square miles, for publication on the scale of 1:125,000, with a contour interval of 50 feet.

*Wyoming.*—The resurvey of the Hanna and Wolcott quadrangles, in Carbon County, was completed by J. H. Wilke and F. L. Whaley,

the area mapped being 228 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet. The survey of the Ilo quadrangle, in Park and Bighorn counties, was begun by C. C. Gardner and R. R. Monbeck, the area mapped being 97 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. Monbeck and Mr. Whaley ran 100 miles of primary levels and established 24 permanent bench marks. For the control of the Rawlins, Baggs, Creston, and Sand Creek quadrangles, in Carbon and Sweetwater counties, C. B. Kendall occupied 26 triangulation stations and permanently marked 22. A special survey of the Owl Creek mining district, covering an area of 4 square miles in Hot Springs County, was made by R. W. Berry on the field scale of 1:12,000, with a contour interval of 10 feet, the work being desired for use in connection with geologic investigations.

#### OFFICE WORK.

The drafting of the following sheets was completed: Axial, Soda Canyon, Meeker, and Monument Butte, Colo.; Grand River, Colo.-Utah; Nyack, Mont.; Nemaha, Nebr.-Mo.; Raton, N. Mex.; Hominy, Nowata, and Vinita, Okla.; Gay Hill, Tex.; Hanna, Owl Creek mining district, and Walcott, Wyo.; Hot Springs sewers, Ark.

Progress in the drafting of additional sheets was made as follows: Chromo, Colo., 79 per cent; Longs Peak, Colo., 20 per cent; Marston, Mont., 40 per cent; Plentywood, Mont., 47 per cent; Falls City, Nebr., 14 per cent; Brilliant, N. Mex., 67 per cent; Ilo, Wyo., 42 per cent.

The following computations and adjustments were made:

Primary-level circuits in the Axial, Chromo, Monument Butte, and Soda Canyon quadrangles (Colo.) were adjusted. The field notes for a single-spur line in the Central City and Longs Peak quadrangles (Colo.) were checked.

Primary-level circuits in the Plentywood quadrangle (Mont.) were adjusted, and the field data for a spur line in the Kalispell and Marston quadrangles (Mont.) were checked.

Primary-level circuits were adjusted and geographic positions were computed for the Falls City and Howe quadrangles (Nebr.). Primary-level circuits in the Hiawatha quadrangle (Nebr.-Kans.) were adjusted, and geographic positions in the Stella quadrangle (Nebr.) were computed.

Primary-level circuits in the Brilliant, Koehler, and Mount Laughlin quadrangles (N. Mex.) were adjusted, and final geodetic distances and positions for the Alamogordo, Avis, Carrizozo, Gypsum Hills, Hondo, Las Cruces, Las Curnas, Mescalero, Orange, Orogrande, Ozanne, Tonuco, and Tularosa quadrangles (N. Mex.) were computed.

Primary-level circuits in the Claremore, Hominy, Newkirk, Pawnee, Pondcreek, and Washunga quadrangles (Okla.) were adjusted.

Primary-level circuits in the Bobbin and Navasota quadrangles (Tex.) were adjusted.

Primary-level circuits in the Almond, Aspen Mountains, Maxon, Rock Springs, South Bitter Creek, Table Mountain, and Walcott quadrangles (Wyo.) were adjusted, and the field notes for a spur line of primary levels in the Ferris, Ilo, Rawlins, and Rongis quadrangles (Wyo.) were checked. Geodetic distances and positions for the Baggs, Creston, Ferris, Frewen, Rawlins, and Sand Creek quadrangles (Wyo.) were computed.

#### PACIFIC DIVISION.

##### FIELD WORK.

##### SUMMARY.

During the season topographic mapping was carried on in Arizona (with a small area in New Mexico), California (with a small area in Nevada), and Utah. This work comprised the completion of the survey of 23 quadrangles, the partial survey of 11 quadrangles, the partial resurvey of 2 quadrangles, the revision of 1 special area, and the partial revision of 2 quadrangles. The total new area mapped was 8,534 square miles—3,123 square miles for publication on the scale of 1:250,000, 4,114 for publication on the scale of 1:125,000, 551 for publication on the scale of 1:62,500, and 746 for publication on the scale of 1:31,680. The area resurveyed was 80 square miles—71 for publication on the scale of 1:62,500, and 9 for publication on the scale of 1:31,680.

In connection with this work 649 miles of primary levels were run and 168 permanent bench marks were established. In addition, profile surveys were made of three rivers, the distance traversed being 209 linear miles.

Primary triangulation was carried on in California by two parties. The total area covered by this primary control was about 2,065 square miles, 70 triangulation stations being occupied and 34 permanently marked. The results of this work made control available in 20 quadrangles.

Topographic surveys were made in the Territory of Hawaii covering portions of one island (Hawaii). The survey of one 15-minute quadrangle was completed and that of one 15-minute quadrangle was begun. The total area mapped was 153 square miles, for publication on the scale of 1:31,680, in connection with which 51 miles of primary and precise levels were run and 13 permanent bench marks were established. Primary triangulation and primary traverse were also carried on, 18 miles of primary traverse being run and 2 perma-

nent marks set and 6 triangulation stations being occupied and marked.

*Topographic surveys in Pacific division from July 1, 1912, to June 30, 1913.*

States.	Contour interval.	For publication on scale of—						Total area surveyed.	Primary levels.		Primary traverse.	
		1:250,000 New.	1:125,000 New.	1:62,500		1:31,680			Distance run.	Bench mark.	Distance run.	Permanent marks.
				New.	Old.	New.	Old.					
	<i>Fect.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Miles</i>		<i>Miles</i>	
Arizona.....	25, 50, 100	.....	1, 977	322	.....	.....	.....	2, 299	141	34	.....	.....
California.....	5, 25, 50, 100, 200	3, 123	2, 035	229	.....	746	9	6, 142	477	126	.....	.....
Nevada.....	100	.....	7	.....	.....	.....	.....	7	.....	.....	.....	.....
New Mexico.....	.....	.....	95	.....	.....	.....	.....	95	.....	.....	.....	.....
Utah.....	50	.....	.....	71	.....	.....	.....	71	31	8	.....	.....
		3, 123	4, 114	551	71	746	9	8, 614	649	168	.....	.....
Hawaii.....		.....	.....	.....	.....	153	.....	153	51	13	18	2

#### DETAILS OF WORK BY STATES.

*Arizona.*—The survey of the Arizona portion of the Douglas quadrangle, in Cochise County, was completed by Cornelius Schnurr and C. C. Holder, the area mapped being 169 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. The survey of the unmapped portions of the Mesa and Maricopa quadrangles, in Maricopa and Pinal counties, was completed by T. P. Pendleton and D. H. Watson, the total new area mapped being 153 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet. In connection with this work the culture was completely revised and brought up to date on the 346 square miles comprising the portions of these quadrangles previously mapped, for publication as a part of the completed surveys. The survey of the Benson quadrangle, lying partly in the Coronado and Garces national forests, in Pima and Cochise counties, and of the Arizona portion of the Hereford quadrangle, lying partly in the Garces National Forest, in Cochise County, was completed by H. W. Peabody, C. P. McKinley, Cornelius Schnurr, L. B. Glasgow, and C. C. Holder, the total area mapped being 1,324 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. For the control of the Douglas quadrangle Mr. Schnurr ran 45 miles of primary levels and established 10 permanent bench marks. (See below.)

*Arizona-New Mexico.*—The survey of the unmapped portion of the Boyles quadrangle, lying almost entirely in the Apache National Forest, in Greenlee County, Ariz., and in the Datil and Gila national forests, Socorro County, N. Mex., was completed by H. H. Hodgeson,

L. H. Williams, and R. R. Monbeck, the area mapped being 748 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. Of this area, 710 square miles lies in the national forests, of which 95 square miles is in New Mexico. For the control of this quadrangle Mr. Monbeck ran 96 miles of primary levels and established 24 permanent bench marks.

*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 Salinas Valley was completed, the area mapped this year comprising 10 square miles in the valley portions of the San Ardo and Bradley quadrangles, for publication on the scale of 1:31,680, with contour intervals of 5 and 25 feet. This work was done by Duncan Hannegan, Charles Hartman, jr., E. R. Bartlett, and H. S. Leicht. In the San Joaquin Valley the survey of the Union Island, Lathrop, Burnham, Banta, Vernalis, Manteca, Peters, Avena, Hospital Creek, Trigo, and Clyde  $7\frac{1}{2}$  minute quadrangles was completed and that of the Westley, Eugene, Oakdale, No. II, and Patterson quadrangles was begun by Mr. Hannegan, J. P. Harrison, H. W. Peabody, W. N. Vance, T. P. Pendleton, J. B. Leavitt, R. B. Kilgore, D. H. Watson, S. E. Taylor, L. V. Fees, F. A. Danforth, O. G. Taylor, R. M. LaFollette, C. A. Stonesifer, and Fred Rider, the total area mapped being 736 square miles, for publication on the scale of 1:31,680, with a contour interval of 5 feet.

The resurvey of the valley portion of the Midway  $7\frac{1}{2}$ -minute quadrangle (the northeast quarter of the Tesla 30-minute quadrangle) was completed by Mr. Hannegan, the area mapped being 9 square miles, for publication on the scale of 1:31,680, with a contour interval of 5 feet. For the control of the Tracy, Butlers, Modesto, Empire, Waterford, No. I, Coopertown, Sonora, No. III, Montpelier, Denair, Ceres, No. II, Westley, Hospital Creek, Patterson, Crows Landing, No. IV, Turlock, Cressy, No. V, Atwater, No. VIII, Stevinson, Gustine, Newman, Orestimba Creek, Crevison Peak, Las Garzas Creek, Ingomar, Salt Slough, Mariposa Slough, Deadman Creek, Berendo, Minturn, Chowchilla Slough, No. X, Elgin, Los Banos, and San Luis Creek  $7\frac{1}{2}$ -minute quadrangles, C. F. Urquhart, assisted by W. R. Chenoweth and R. B. Kilgore, occupied 43 triangulation stations and permanently marked 12, and D. S. Birkett ran 300 miles of primary levels and established 82 permanent bench marks. In order to extend triangulation into the valley Mr. Urquhart occupied and marked 17 triangulation stations in the Mount Boardman, Gilroy Hot Springs, Morgan Hill, Hamilton, Tesla, Hollister, Pajaro, New Almaden, and Capitola quadrangles.

In addition to the regular cooperative surveys in California the State Board of Control (Water Power) allotted \$1,100, in addition

to that reported last year, for the completion of profile surveys of Pit River and the Middle Fork of American River and \$2,500 for a profile survey of San Joaquin River, the United States Geological Survey making no allotment for the field survey but detailing its men to carry on the work and publishing the completed sheets. These river-profile surveys were completed by J. G. Staack, J. P. Harrison, and T. P. Pendleton, the total distance traversed being 209 linear miles, in Placer, Eldorado, Shasta, Lassen, Madera, and Fresno counties.

In addition to the cooperative work in California, the survey of the Petaluma, Capitola, and Soledad quadrangles, in Marin, Sonoma, Santa Cruz, and Monterey counties, was completed by J. P. Harrison, J. B. Leavitt, W. S. S. Johnson, O. G. Taylor, F. A. Danforth, R. M. La Follette, and C. A. Stonesifer, the total area mapped being 229 square miles, for publication on the scale of 1:62,500, with contour intervals of 25 and 50 feet. The survey of the Priest Valley quadrangle, lying partly in the Monterey National Forest, in Monterey, Fresno, and San Benito counties; of the Mount Morrison quadrangle, lying partly in the Sequoia National Forest, in Inyo, Mono, and Fresno counties; and of the Mohave quadrangle, lying partly in the Sequoia National Forest, in Kern County, was completed by J. G. Staack, B. A. Jenkins, W. N. Vance, S. E. Taylor, H. S. Leicht, T. P. Pendleton, F. A. Danforth, C. W. Wardle, R. M. La Follette, J. W. Muller, and C. A. Stonesifer, the total area mapped being 1,837 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. Of the area mapped, 822 square miles lies within the national forests, of which 7 square miles extends into Nevada. For the control of the Mount Morrison quadrangle Mr. Wardle ran 66 miles of primary levels and established 17 permanent bench marks. The survey of the Seiad quadrangle, in the Klamath National Forest, in Siskiyou County, was begun by J. W. Muller and H. S. Leicht, the area mapped being 170 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. The survey of the Borax Flat quadrangle, lying partly in the Sequoia National Forest, in San Bernardino and Kern counties, was completed; that of the Sawyers Bar quadrangles, in the Trinity national forests, in Trinity, Siskiyou, and Humboldt counties, was continued; and that of the Crucero quadrangle, in San Bernardino and Inyo counties, was begun, the total area mapped being 3,158 square miles, 3,123 for publication on the scale of 1:250,000, with contour intervals of 100 and 200 feet, and 35 for publication on the scale of 1:125,000, with a contour interval of 100 feet. Of the area mapped, 333 square miles lies in the national forests. This work was done by J. E. Blackburn, S. G. Lunde, J. P. Harrison, C. W. Wardle, L. V.

Fees, and H. L. McDonald. For the control of the Borax Flat and Crucero quadrangles, Mr. Urquhart and Mr. Chenoweth occupied 20 and marked 5 triangulation stations, and Mr. Fees and Mr. Wardle ran 111 miles of primary levels and established 27 permanent bench marks.

The map of the Kern River oil field (formerly published as the Oil Center special) was completely revised by Duncan Hannegan, the area revised covering 30 square miles in Kern County, for publication on the scale of 1:12,000, with a contour interval of 20 feet.

*Nevada.*—(See pp. 110, 113.)

*Utah.*—The resurvey of the Wellington quadrangle (the southeast quarter of the northwest quarter of the Price River 1-degree quadrangle) was begun by E. R. Bartlett and L. B. Glasgow, the total area mapped being 71 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. For the control of this quadrangle Mr. Glasgow ran 31 miles of primary levels and established 8 permanent bench marks.

*Hawaii.*—Cooperative topographic surveys were continued in the Hawaiian Islands, under an arrangement similar to that of the previous fiscal year, the Territory allotting \$15,000 and the United States Geological Survey allotting \$5,000. In the spring of 1913 the Territory allotted \$200 additional for cooperative surveys. The survey of the island of Hawaii was continued, the area mapped being 153 square miles, for publication on the scale of 1:31,680, with contour intervals of 10 and 50 feet. This work covered portions of the Honomu and Hilo 15-minute quadrangles and was done by C. H. Birdseye, A. T. Fowler, A. O. Burkland, J. M. Rawls, and S. H. Birdseye. For the control of these areas C. H. Birdseye and Mr. Burkland occupied and marked 6 triangulation stations, Mr. Fowler ran 18 miles of primary traverse and set 2 permanent marks, and S. H. Birdseye ran 51 miles of primary and precise levels and established 13 permanent bench marks. As it is planned to begin during the next fiscal year the topographic mapping of the island of Oahu, tracings were made of data acquired by the War Department for the preparation of the map of the entire island on the scale of 1:48,000, with a contour interval of 40 feet.

#### OFFICE WORK.

The drafting of the following sheets was completed: Phoenix (revision), Benson, Boyles, and Douglas, Ariz.; American River, Avena, Caliente, Capitola, Feather River, Lathrop, Midway, Burnham, Mount Morrison, Monterey, Manteca, Kern River oil field (revision), Petaluma, Peters, Pit River, Priest Valley, Vernalis, San Joaquin River, Tracy, Tuolumne River, and Union Island, Cal.; Hamakua, Hawaii.

Progress in drafting of additional sheets was made as follows: Hereford, Ariz., 90 per cent; Maricopa, Ariz., 60 per cent; Bradley, Cal., 9 per cent; Borax Flat, Cal., 32 per cent; Crucero, Cal., 23 per cent; Kings City, Cal., 38 per cent; Metz, Cal., 20 per cent; Mojave, Cal., 56 per cent; San Ardo, Cal., 12 per cent; Soledad, Cal., 85 per cent; Honomu, Hawaii, 98 per cent; Waipio, Hawaii, 61 per cent; Kohala, Hawaii, 60 per cent; Wellington, Utah, 28 per cent.

The following computations and adjustments were made:

Primary-level circuits in the Clifton (Ariz.) and the Boyles (Ariz.-N. Mex.) quadrangles were adjusted.

Primary-level circuits in the Butlers, Ceres, Chowchilla Slough, Cooperstown, Cressy, Crows Landing, Deadman Creek, Denair, Dry Creek, Elgin, Empire, Gustine, Hospital Creek, Ingomar, Los Banos, Madera, Mariposa Slough, Newman, Modesto, Montpelier, Nos. I, II, III, IV, V, VIII, and X, Owens Creek, Patterson, Salt Slough, Stevenson, Turlock, Vernalis, Volta, Waterford, Westley, and three unnamed  $7\frac{1}{2}$ -minute quadrangles and the Sonora 30-minute quadrangle (Cal.) were adjusted. A preliminary adjustment was made of level circuits in the Mount Morrison (Cal.) and White Mountain (Cal.-Nev.) quadrangles.

Primary-level circuits were adjusted and geodetic distances and positions were computed for the Hilo and Honomu quadrangles (Hawaii). Primary-level circuits in the Hamakua, Kilauea Crater, Kohala, Puna, and Waipio quadrangles (Hawaii) were adjusted.

Primary-level circuits in the Kyune, Ninemile Creek, and Wellington quadrangles (Utah) were adjusted.

#### 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 7 quadrangles and the partial survey of 15 quadrangles. The total new area mapped was 2,118 square miles, 99 square miles for publication on the scale of 1:31,680, 739 square miles for publication on the scale of 1:62,500, and 1,280 square miles for publication on the scale of 1:125,000.

In connection with this work 736 miles of primary levels were run and 224 permanent bench marks were established. In addition, profile surveys were made of 11 rivers, the distance traversed being 580 linear miles, in connection with which 23 square miles were surveyed for publication on the scale of 1:31,680.

Primary triangulation and primary traverse were carried on at different times by four parties, the work being distributed over portions of Idaho, Montana, Oregon, and Washington. The total area covered by this primary control was about 5,460 square miles, of which 1,100 square miles were controlled by primary traverse, 233 miles being run and 53 permanent marks set. Thirty-six triangulation stations were occupied and permanently marked. The result of this work was to make control available in 18 quadrangles.

*Topographic surveys in northwestern division from July 1, 1912, to June 30, 1913.*

State.	Contour interval.	For publication on scale of—			Total area surveyed.	Primary levels.		Primary traverse.	
		1:125,000. (New.)	1:62,500. (New.)	1:31,680. (New.)		Distance run.	Bench marks.	Distance run.	Permanent work.
	<i>Feet.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Sq. mi.</i>	<i>Miles.</i>		<i>Miles.</i>	
Idaho.....	50-100	132	250	382	256	85			
Montana.....	100	100		100					
Oregon.....	5-25-100	803	51	76	930	51	14		
Washington.....	{ 5-10-25- 50-100 }	245	382	23	650	429	125	233	53
Wyoming.....	50		56		56				
		1,280	739	99	2,118	736	224	233	53

#### DETAILS OF WORK BY STATES.

*Idaho.*—The survey of the Lanes Creek quadrangle (formerly called Wayan) and of the Crow Creek quadrangle (formerly called Preuss Range) was completed; that of the Freedom and Henry quadrangles was continued; and that of the southeast quarter of the Ammon 30-minute quadrangle and of the southwest quarter of the Irwin 30-minute quadrangle was begun, the total area mapped being 250 square miles in Bannock County, Idaho, and 56 square miles in Uinta County, Wyo., for publication on the scale of 1:62,500, with a contour interval of 50 feet, field work on 69 square miles being done on a scale of 1:31,680. This work was done by Albert Pike, J. L. Lewis, and F. A. Danforth. For the control of these quadrangles Mr. Danforth ran 46 miles of primary levels and established 14 permanent bench marks, and W. R. Chenoweth occupied 2 triangulation stations and marked 9.

A profile survey of Salmon River from the mouth of Little Salmon River to Snake River, in Idaho and Nez Perce counties, was completed by O. G. Taylor, the distance covered being 87 linear miles.

The State engineer of Idaho, from a fund subscribed by private parties, allotted \$700 for a profile survey of Snake River, which was met by the Federal Survey with a like sum. The cooperative allot-

ments were not sufficient to complete the survey, and the additional expenses necessary were borne by the Federal Survey. The profile survey covered a section of the river 242 miles in length from Minidoka Dam to Warm Springs Ferry, in Cassia, Lincoln, Twin Falls, and Owyhee counties, and 52 miles of additional traverse were run in connection with the river survey. The work was done by A. T. Fowler and A. J. Ogle.

*Idaho-Montana.*—The survey of the Taff quadrangle, in the Cœur-d'Alene National Forest, in Shoshone County, Idaho, and Missoula County, Mont., was continued by J. E. Blackburn, the area mapped being 127 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. Of this area 27 square miles lies in Idaho and 100 square miles in Montana. For the control of the Salmon, Gibbons Pass, Trappers Peak, Watchtower Peak, Sapphire, Hamilton, and Noble quadrangles, in Lemhi County, Idaho, and Ravalli County, Mont., T. M. Bannon occupied 11 and marked 13 triangulation stations, of which 5 stations were occupied and 6 were marked in Idaho. For the control of these areas and the May, Rabbit Foot, Bay Horse, Dickey, Mackay, Argo, Tilden, and Shelley quadrangles, in Lemhi, Custer, Blaine, and Bingham counties, Idaho, D. S. Birkett ran 210 miles primary levels and established 71 permanent bench marks.

*Oregon.*—The State engineer of Oregon allotted \$15,000 for the continuation of cooperative topographic surveys in that State and the United States Geological Survey allotted a like sum. The survey of the Willamette Valley was continued and resulted in the partial mapping of the Albany and Corvallis quadrangles, in Linn, Marion, and Benton counties, the total area mapped being 76 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, R. L. Harrison, and W. S. S. Johnson. The survey of the unmapped portions of the Oregon City and Boring quadrangles, in Clackamas, Multnomah, and Washington counties, was completed by Mr. Wheat, A. E. Murlin, L. R. Ebert, and Cornelius Schnurr, the total area mapped being 51 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet. The survey of the Oregon portion of the Arlington quadrangle, in Gilliam County, was begun by Oscar Jones and Mr. Ebert, the area mapped comprising 343 square miles, for publication on the scale of 1:125,000, with a contour interval of 50 feet. For the control of this quadrangle J. R. Ellis occupied 9 triangulation stations and permanently marked 7, and Mr. Ebert and Mr. Watson ran 51 miles of primary levels and established 14 permanent bench marks. For the control of the Condon quadrangle, in Gilliam and Wheeler counties, Mr. Ellis occupied and marked 2 triangulation stations. The survey of the Oregon portion of the Pine quad-

range, in Baker County, was completed by Glenn S. Smith, S. G. Lunde, and Howard Clark, the area mapped being 236 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. The survey of the Idaho portion of this quadrangle, covering 105 square miles in Washington County, was completed by Mr. Lunde for publication on the same scale, all expenses being borne by the Federal Survey.

In addition to the regular cooperative work in Oregon a profile survey of Deschutes River was made in connection with water-power investigations being carried on by the water-resources branch of the Federal Survey in cooperation with the State of Oregon. All expenses of the profile survey were paid by the State, the work being done by members of the topographic branch. The distance traversed was 36 linear miles in Crook County, in connection with which four power sites 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 Oregon the survey of the Cazadero 30-minute quadrangle, in Clackamas County (the north-west quarter of which was mapped in cooperation as the Boring 15-minute quadrangle) was continued by Mr. Murlin, Mr. Lunde, Mr. Schnurr, F. W. Crisp, and W. G. Carson, the area mapped being 224 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet.

*Washington.*—The Board of Geological Survey of Washington allotted \$13,750 for the continuation of cooperative topographic surveys in that State, and the United States Geological Survey allotted a like sum. The survey of the Malaga and Hoquiam quadrangles, in Douglas, Grant, and Chehalis counties, was completed; that of the Wenatchee quadrangle, in Chelan County, was continued; and that of the Ocosta, Mitchell, and Haven quadrangles, in Chehalis, Grant, Benton, and Yakima counties, was begun, the total area mapped being 382 square miles, for publication on the scale of 1:62,500, with contour intervals of 25 and 50 feet. The survey of the Chehalis quadrangle, in Thurston, Pierce, and Lewis counties, and of the Washington portion of the Arlington quadrangle, in Klickitat County (the Oregon portion of which is being mapped in cooperation with that State), was begun, the area mapped being 195 square miles, for publication on the scale of 1:125,000, with a contour interval of 50 feet. This work was done by A. E. Murlin, C. L. Sadler, W. O. Tufts, Charles Hartman, jr., H. L. McDonald, A. J. Ogle, O. G. Taylor, R. B. Kilgore, L. V. Fees, D. H. Watson, and C. H. King, jr. For the control of these areas and of the Gate, Olympia, Anderson, Tacoma, Pasco, Fordnah, and Beverly quadrangles, in Thurston, Pierce, Franklin, and Grant counties, C. F. Urquhart occupied 12 and marked 5 tri-

angulation stations; L. F. Biggs, J. R. Ellis, and W. B. Godfrey ran 233 miles of primary traverse and set 53 permanent marks; and E. M. Bandli, D. S. Birkett, and R. I. Thomas ran 368 miles of primary levels and established 105 permanent bench marks.

The profile surveys of Wenatchee, Chelan, Stehekin, and Methow rivers and of Railroad Creek were made by W. O. Tufts and A. J. Ogle, the distance traversed being 81 linear miles, in Chelan and Okanogan counties. In connection with this work reservoir sites covering 13 square miles were surveyed, for publication on the scale of 1:31,680, with contour intervals of 5, 10, and 25 feet, and 71 miles of additional traverse were run.

In addition to the cooperative work in Washington, the survey of the Mount St. Helens quadrangle, in the Columbia National Forest, in Cowlitz, Skamania, and Lewis counties, was begun by Albert Pike, the area mapped being 50 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. For the control of this area and of the Kalama quadrangle (Oreg.-Wash.) E. M. Bandli ran 61 miles of primary levels and established 20 permanent bench marks.

Profile surveys of Pend Oreille and Spokane rivers were made by A. P. Meade, the Pend Oreille River survey covering 70 linear miles in Pend Oreille County, Wash., and 7 linear miles in Bonner County, Idaho, and the Spokane River survey covering 34 linear miles in Lincoln and Stevens counties, Wash. In connection with this work, 27 miles of additional traverse were run.

A special profile and reservoir-site survey of San Poil River, in the Colville Indian Reservation, Perry County, was made for the Department of the Interior, all expenses being paid by the department from the appropriation for irrigation surveys of Indian reservations. This work covered 23 linear miles of river traverse, in connection with which reservoir sites covering an area of 10 square miles were mapped, for publication on the scale of 1:31,680, with a contour interval of 10 feet.

#### OFFICE WORK.

The drafting of the following sheets was completed: Lanes Creek, Salmon and Snake River, Idaho; Crow Creek, Idaho-Wyo.; Boring, Metolius River, and Oregon City, Oreg.; Pine, Oreg.-Idaho; Chelan River, Malaga, Methow River, Spokane River, and Wenatchee River, Wash.; Clark Fork, Wash.-Idaho.

Progress in the drafting of additional sheets was made as follows: Henry, Idaho, 40 per cent; Taff, Idaho-Mont., 43 per cent; Freedom, Idaho-Wyo., 30 per cent; Albany, Oreg., 64 per cent; Corvallis, Oreg., 13 per cent; Cazadero, Oreg., 62 per cent; Arlington, Oreg.-Wash., 40 per cent; and Wenatchee, Wash., 26 per cent.

The following computations and adjustments were made:

The field notes for a single-spur line and a circuit of primary levels dependent on it in the Ammon, Henry, and Lanes Creek quadrangles (Idaho) were checked. A preliminary adjustment was made of the prism-level line in the Argo, Bay Horse, Dickey, Mackay, Rabbit Foot, Shelley, and Tilden (Idaho), and May and Salmon (Idaho-Mont.) quadrangles. Preliminary computations of geodetic distances and positions for the Ammon, Hatch, Henry, Soda Springs, and Vinegar Hill (Idaho), and Gibbons Pass, Salmon, Trappers Peak, and Watchtower Peak (Idaho-Mont.) quadrangles were made.

Primary-level circuits were adjusted and geodetic distances and positions were computed for the Arlington quadrangle (Oreg.-Wash.). Geodetic distances and positions for the Moro (Oreg.) and Goldendale (Oreg.-Wash) quadrangles were computed.

Primary-level circuits were adjusted and geodetic distances and positions were computed for the Chelan and Malaga quadrangles (Wash.). Primary-level circuits were adjusted and geographic positions were computed for the Anderson, Chehalis, Gate, Olympia, and Tacoma (Wash.) and Kalama (Wash.-Oreg.) quadrangles. Primary-level circuits in the Eatonville quadrangle (Wash.) were adjusted and geodetic distances and positions for the Wenatchee quadrangle (Wash.) were computed.

#### INSPECTION OF TOPOGRAPHIC SURVEYING AND MAPPING.

J. H. Renshaw and W. M. Beaman inspected the field parties in Washington, D. C., and vicinity during portions of July and August. Mr. Renshaw spent September and October in inspecting the work of various field parties in the Atlantic and Central divisions. Mr. Beaman was engaged during September, October, November, and a portion of December in visiting river-survey and regular topographic parties in the Rocky Mountain, Northwestern, and Pacific divisions.

The office duties of Messrs. Renshaw and Beaman 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 surveys and other sheets preparatory 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.

#### INSTRUMENTS AND TOPOGRAPHIC RECORDS.

As in past years the repairs of all topographic instruments were made under the supervision of E. M. Douglas, who also has charge of the topographic records.

One transit, one 20-inch Y level, and one telescopic alidade were purchased during the year.

In the Survey instrument shop Ernest Kübel and William Hohnhaus, expert mechanics, were employed during the entire year. Work was done not only for the topographic branch, but for other branches of the Survey, for the Reclamation Service, and for the General Land Office, the topographic branch being reimbursed by transfer of funds for all work not done for it.

The principal instruments repaired consisted of 174 telescopic alidades, 39 Y levels, 10 transits, 6 theodolites, 22 Locke levels, 241 box compasses, and 45 pocket compasses; repairs, alterations, or renewals were made to nearly 2,600 other articles.

A new device was designed and constructed for testing the accuracy of the position of box compasses on alidade rulers, the use of the Baldwin solar chart necessitating greater care in their alinement than heretofore.

The only repairs of consequence to topographic instruments made outside of the Survey shop were for leveling rods and aneroid barometers, no facilities at present being provided for any but minor repairs to such articles.

Special apparatus is provided for testing and magnetizing compasses and a record is kept of each compass, so that needles which prove defective can be replaced. All aneroid barometers are tested before they are sent out, it having been found that even new instruments are often in need of adjustment.

The economy and advantage of having instruments repaired in a shop under the Survey control are so great that it is hoped to increase the facilities for such work as soon as space is available.

The additions to the topographic records consisted of 188 triangulation and primary traverse books, 181 level books, not including the rodman's books, to which were given duplicate numbers, 337 vertical-angle or stadia books, 40 plane-table sheets, and 60 miscellaneous manuscript maps, all of which have been numbered and catalogued. About 50 chainman's notebooks were filed.

The fire in the Survey office on the afternoon of May 18 damaged about 3,500 field record books, and 2,500 pounds of the damaged books have since been delivered to the contractor for the purchase of waste paper. The loss or damage by this fire to instruments was very slight.

#### 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 sheets and international sheets have been completed:

Arkansas (portions of sheets I and J 15 and 16), Maryland (portions of sheets J 17 and 18), South Carolina (portion of sheet I 17), Montana (portions of sheets L and M 11, 12, and 13), and sheets I and J 10 of California, including 50 per cent of the relief.

Additional work includes the completion of the portions of North and South Dakota and Nebraska west of longitude 102 (sheets K, L, and M 13), 25 per cent of Oregon (sheets K and L 10 and 11), and 75 per cent of Virginia, West Virginia, and Kentucky (sheets J 16, 17, and 18), and the adjustment of the township lines in Missouri (sheets J 15 and 16 and K 15), and Utah (sheets J and K 12). The base maps of sheets I 17 and L 13 are completed.

### **WATER-RESOURCES BRANCH.**

#### **ORGANIZATION AND SCOPE OF WORK.**

The water-resources branch includes three divisions—surface water, ground water, and water utilization—each division being appropriately subdivided into sections for field work. The organization of the branch was as follows:

Chief of branch, M. O. Leighton, chief hydrographer, until June 3, 1913; N. C. Grover, chief hydraulic engineer, after June 3, 1913.

Division of surface water, John C. Hoyt, engineer, in charge.

Division of ground water, O. E. Meinzer, assistant geologist, in charge.

Division of water utilization, M. O. Leighton, chief hydrographer, in charge until June 3, 1913; N. C. Grover, chief hydraulic engineer, in charge after June 3, 1913.

With the change in chief of branch the title has been changed from chief hydrographer to chief hydraulic engineer, which is more closely in accord with the designation used in commercial organizations for men engaged in similar work and is also better descriptive of the qualifications for and duties of the office, as well as more distinctive, inasmuch as the Hydrographic Office of the Navy Department has better claim to the title of hydrographer.

The appropriation (\$150,000) of Federal funds has remained the same as in the preceding year, but 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 hydrometric investigations made under the Weeks Act in the White Mountain area in New Hampshire have been completed.

## ALLOTMENTS.

The allotments of the appropriation for the fiscal year were as follows:

*Allotments of appropriation for investigation of water resources, 1912-13.*

Administrative expenses of the Survey-----	\$12, 444
Clerical assistance-----	4, 440
Computations, reports, and inspection-----	15, 500
Stream gaging in—	
New England and New York-----	5, 500
Southeastern States-----	4, 000
Ohio Valley-----	7, 500
Minnesota, Wisconsin, and North Dakota-----	6, 000
Colorado and Wyoming-----	9, 700
Montana-----	7, 000
Utah-----	3, 600
Idaho-----	7, 500
Oregon-----	5, 600
Washington-----	4, 000
California-----	5, 000
Arizona-----	3, 000
Hawaii-----	5, 000
Investigation of ground waters, including quality of waters.	16, 870
Land-classification board-----	12, 500
Water-power investigations-----	11, 846
Deschutes River investigations-----	3, 000
	<hr/>
	150, 000

## COOPERATION.

## STATES.

The cooperative funds made available by several States were 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-----	12, 466
Board of control-----	7, 140
	<hr/>
	28, 586
Connecticut-----	1, 000
Hawaii-----	20, 000
Idaho-----	5, 000
Massachusetts-----	3, 000
Minnesota-----	3, 650
Montana-----	2, 500
Nevada-----	385
New York:	
State engineer-----	\$1, 500
Conservation commission-----	10, 000
	<hr/>
	11, 500

New Mexico-----	\$14,174
Oregon-----	7,470
Utah-----	2,000
Vermont-----	1,000
Washington-----	4,200
West Virginia-----	132
Wyoming-----	265

The work performed under the cooperative agreements in the several States has been limited to stream gaging, except as follows:

*California.*—A large amount of steam-gaging work has been done in California, and investigations of ground-waters in the Sacramento and Santa Clara valleys have been made and are still in progress. Reports containing the results of hydrometric investigations within the State have been prepared and published.

*Hawaii.*—The cooperative work in Hawaii has included the measurement of precipitation and studies of water losses in irrigation canals, in addition to the stream-gaging work.

*Minnesota.*—A small amount of work in the surveying of river profiles in Minnesota has been accomplished. The measurement of stream flow has been continued throughout the year.

*Oregon.*—The survey of Deschutes River, in Oregon, to determine the possibilities of developing power on it has resulted in the preparation of special topographic maps of the river valley and of profiles of the river surface. A special report on the water supply and power possibilities of the stream has been practically completed and is proposed for publication in the near future. A large amount of stream-gaging work has been carried on throughout the year. The investigation of the chemical composition of the river waters of the State, to which reference was made in the report for the fiscal year ending June 30, 1912, to determine their utility in municipal, agricultural, and manufacturing uses, has been completed and a report thereon is now in preparation.

#### RECLAMATION SERVICE.

The Survey has maintained gaging stations at the expense of the reclamation fund and under the general direction of the Reclamation Service. These gaging stations are located on streams which are relied on to furnish water to reclamation projects under construction by that service. The field work of stream gaging is done by the Survey engineers who are engaged in such work in the locality, and payment is made by the Reclamation Service through a transfer of funds in the Treasury Department covering the actual cost of the investigations.

## OFFICE OF INDIAN AFFAIRS.

Investigations and reports have been made by the water-resources branch 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, as follows:

*Crow Reservation.*—An investigation of the power-site and reservoir possibilities of the Crow Reservation was made under authority dated July 1, 1912. The report was filed on August 12, 1912.

*Flathead Reservation.*—Under authority dated January 24, 1913, an investigation of the power-site and reservoir possibilities on the Flathead Reservation has been made, but report thereon has not been filed.

*Klamath Reservation.*—A progress report on the power-site and reservoir possibilities of the Klamath Reservation, investigation of which was authorized October 12, 1911, was made on November 21, 1912. The final report has not yet been filed.

*Moki and Navajo reservations.*—A continuation of the investigation of the occurrence and availability of underground waters in the Moki and Navajo reservations was authorized April 11, 1913, and money was made available therefor, to be expended in part prior to July 1, 1913, and in part after that date. The field work on this investigation is in progress at the end of the fiscal year.

*Warm Springs Reservation.*—The investigation of the power-site and reservoir possibilities of the Warm Springs Reservation, authorized March 16, 1912, which had not been completed at the end of the last fiscal year, has now been finished, and a report thereon was filed on August 13, 1912.

*Yakima Reservation.*—Under date of September 5, 1912, an investigation of the power-site and reservoir possibilities of the Yakima Reservation was authorized, and field work thereon has been completed, but the report has not been finished at the end of the fiscal year.

*Stream gaging.*—Stream-gaging work has been continued in the following Indian reservations in accordance with authorizations of the Indian Office: Colville, Crow, Fort Hall, Klamath, Menominee, Pine Ridge, Queniult, Rosebud, Standing Rock, Warm Springs, and Yakima.

## PUBLICATIONS.

The work of the water-resources branch is represented by the following publications issued during the year: Water-Supply Papers 259, 281, 283, 284, 289 to 294, inclusive, 296 to 301, inclusive, 304, 305, 310, 311, 313 to 317, inclusive. Titles and brief summaries of these publications are given on pages 23-26. Water-Supply Papers 303,

307, 308, 317, 319, and 320 were at the Government Printing Office at the close of the year. Nine manuscripts were in the section of texts, ready for the printer, six were in hand awaiting editorial work, and 26 reports were in various stages of preparation. Reprints of Water-Supply Papers 255 and 295, the original editions of which had been exhausted, were delivered during the year.

#### DIVISION OF SURFACE WATERS.

##### ORGANIZATION.

The work of the division of surface waters, consisting primarily of the measurement of the flow of rivers, is carried on through the offices of the 12 districts into which the United States, including Alaska and Hawaii, has been divided for the purposes of efficient administration of the field work.

Each district office is under the supervision of a district engineer and is manned with a corps of assistants. The following list gives the districts, the name of the district engineer, and the location of the district office.

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, Newport, Ky.

Upper Mississippi River district: W. G. Hoyt, district engineer, 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. Suboffice: G. A. Gray, assistant engineer, Capitol Building, Santa Fe, N. Mex.

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.

Northern Pacific coast district: Fred F. Henshaw, district engineer, Couch Building, Portland, Oreg. Suboffice: G. L. Parker, assistant engineer, Federal Building, Tacoma, Wash.

Southern Pacific district: H. D. McGlashan, district engineer, Customhouse, San Francisco, Cal. Suboffice: Federal Building, Los Angeles, Cal.

Hawaiian district: G. K. Larrison, Kapiolani Building, Honolulu, Hawaii.

Alaskan district: C. E. Ellsworth, district engineer.

##### 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 for making the regular measurements of discharge of

streams and for collecting sufficient data for determining the daily flow. At the end of the year 1,148 such stations were maintained, exclusive of those in Alaska and Hawaii. During the year 338 stations were discontinued and 261 stations established. In addition records ready for publication were received for about 240 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 various cooperating parties:

*Gaging stations and cooperating parties, June 30, 1913.*

State.	Geological Survey alone.	Reclamation Service.	Forest Service.	Indian Office.	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.	Miscellaneous gagings.
Alabama.....					1	2		5				8		2		
Arizona.....		2			2			18		2	5	19	7	1	246	12
California.....			60	1		2	3	211	10	38	121	211	24		1,416	356
Colorado.....	3	6	47			1		10			9	74	10	27	222	14
Connecticut.....						1				1	1	1				
Florida.....										1	1	1	1		4	2
Georgia.....	1					9				11	2	19	2	1	23	
Idaho.....	3	7	16	6		2		78	1	53	51	115	28	32	681	104
Illinois.....						1						1	20	41	22	1
Indiana.....						1						1				
Iowa.....						1		5		1	2	5			12	1
Maine.....														18		
Maryland.....	2											2			12	
Massachusetts.....								12		3	3	12	3	1	67	
Michigan.....								1	1	5	7	7			3	2
Minnesota.....						2	1	43		3	6	43	3	7	213	14
Mississippi.....						1						1	1	6		
Montana.....	20	56	18	7		1	2	26		4	1	133	13	14	608	7
Nebraska.....								12				12	2			
Nevada.....		2					3	32		4	8	33	23	3	41	2
New Hampshire.....										4		4		9		3
New Jersey.....						2						2				
New Mexico.....		4	7	2	1			62		22	36	62	37	10	543	
New York.....					1	4		45	1	8	14	45	11	3	253	11
North Carolina.....	3					2				6	1	10	1	1	7	
North Dakota.....	7			1								8			58	
Ohio.....	1								2			3	2	1	4	2
Oklahoma.....		3										3	3		7	
Oregon.....		7	10	7	1	3	1	28	2	38		97	12	33	273	67
Pennsylvania.....						1						1	1			
Rhode Island.....										1		1	1			
South Carolina.....						1						1				
South Dakota.....		1		4								5			23	2
Tennessee.....	2					6		2				10		1	1	6
Texas.....														9		
Utah.....			3			1		76	6	32	42	76	25	11	346	155
Vermont.....								12		2	2	12			20	
Virginia.....	9					1				3		13	1	1	16	3
Washington.....	6		9	12		1	2		2	27		59	23	49	144	73

West Virginia.....	20									2		22	3	2	25	6
Wisconsin.....				2		1				5		8	1		16	
Wyoming.....		4					4	1			1	8	4	47	100	8
	77	99	170	42	6	47	16	679	25	285	298	1,148	261	338	5,406	851

<sup>a</sup> Taken over by State Water Storage Commission.

NOTE.—Two hundred and forty stations for which either field data or completed computations are furnished by outside parties.

In order to maintain a high standard of work and to insure uniform methods in the several offices, regular inspection work is carried on from the Washington office. Each of the main district offices is annually visited and inspected. The methods that have been developed in the several districts are correlated and the efficiency of the work as a whole is thereby increased and the standards raised.

The data collected by the district offices are transmitted to the Washington office, where they are reviewed and prepared for publication in the computing section. The work of this section is important, as its examination of the records insures that the data presented to the public shall be prepared for publication with standard accuracy and in similar form. In the computing section many special hydraulic studies are also carried on, the results of which are published from time to time.

#### PUBLICATIONS.

The results of the work of the division of surface waters are published in the series of water-supply papers. These reports may be divided into two class—reports containing data in regard to stream flow, known as the progress reports of stream gaging, and special reports covering various subjects.

For convenience in publication and use of the data, the progress reports have been divided into 12 parts, as shown in the following list. Each part covers the same area from year to year. Special reports have been published as indicated in the list given on pages 125–126.

#### *Reports on surface-water supply of the United States.*

[The numbers given are the serial numbers of the water-supply papers.]

	1909	1910	1911	1912
North Atlantic coast.....	261	281	301	321
South Atlantic coast and eastern Gulf of Mexico.....	262	282	302	322
Ohio River basin.....	263	283	303	323
St. Lawrence River basin.....	264	284	304	324
Upper Mississippi River and Hudson Bay basins.....	265	285	305	325
Missouri River basin.....	266	286	306	326
Lower Mississippi River basin.....	267	287	307	327
Western Gulf of Mexico.....	268	288	308	328
Colorado River basin.....	269	289	309	329
Great Basin.....	270	290	310	330
California.....	271	291	311	331
North Pacific coast.....	272	292	312	332

Among the special reports are the following:

1. Three gazetteers covering the State of California and three volumes containing summaries of stream-flow data collected in that State, which were prepared in cooperation with the State (Water-Supply Papers 295–300).

2. A special report containing all available data collected in Minnesota, which was prepared and published by the State Drainage Commission.

3. A report covering the last two years' work in Idaho, which was prepared and published by the State engineer of Idaho.

4. A report on the flood of 1913 in the Ohio River drainage basin, which will be published as Water-Supply Paper 334.

#### DIVISION OF UNDERGROUND WATERS.

##### ORGANIZATION.

At the beginning of the fiscal year O. E. Meinzer was placed in charge of the division of underground waters, to succeed W. C. Mendenhall, whose resignation was made necessary by his duties as chief of the land-classification board. Mr. Mendenhall, however, retains advisory relation to the division. As in previous years, R. B. Dole has had supervision of the chemical investigations.

##### ALLOTMENTS AND OUTLINE OF WORK.

The allotment for the work of the division was \$16,870. Of this amount, \$11,720 was used for investigations of underground-water problems and \$5,150 for investigations of the quality of waters, including both surface and underground supplies. Most of the work was done in Connecticut, Georgia, Florida, Mississippi, Arkansas, Texas, Montana, Oregon, Utah, Nevada, California, New Mexico, and Arizona. In addition to the work in these States, the parts pertaining to water supply in a number of geologic folios and other reports prepared by the geologic branch on areas in various States were reviewed and in part written by Messrs. Dole and Meinzer, and 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 during parts of the year by G. S. Morgan and E. C. Bain.

##### WORK BY LOCALITIES.

*Coastal Plain.*—An investigation of the geology and underground waters of the Atlantic and Gulf Coastal Plain has for the last few years been conducted under the supervision of T. W. Vaughan, of the geologic branch. To this investigation \$1,400 of the funds of the water-resources branch was allotted during the fiscal year 1912-13, and the phases of the investigation relating to the quality of the water were placed in charge of Mr. Dole, of this branch. A general description of the Coastal Plain investigation is given on pages 35-36. The work by Mr. Dole was done chiefly on areas in Georgia, Florida, Arkansas, and Texas.

During the year a report on the water resources of the Coastal Plain province of Virginia, prepared in cooperation with the Virginia Geological Survey by Samuel Sanford, was issued as Bulletin 5 of the State survey, and a similar cooperative report on the water

resources of the Coastal Plain region of North Carolina, by L. W. Stephenson, B. L. Johnson, and H. N. Parker, was issued as Part II of volume 3 of the North Carolina Geological and Economic Survey.

*Connecticut.*—An intensive study of the underground water resources of the State of Connecticut, which was begun in the previous fiscal year, was continued in cooperation with the State Geological and Natural History Survey. This investigation, which is to be extended over a period of years, is being conducted by A. J. Ellis, under the supervision of H. E. Gregory. At the close of the fiscal year the report on the areas thus far covered was nearly completed.

*Iowa.*—A comprehensive report on the underground water resources of the State of Iowa, prepared in cooperation with the State Geological Survey of Iowa by W. H. Norton, W. S. Hendrixson, H. E. Simpson, O. E. Meinzer, and others, was published during the year as Water-Supply Paper 293.

*Texas.*—During the year a report by C. H. Gordon on the geology and underground waters of the Wichita region of north-central Texas was issued as Water-Supply Paper 317, and considerable work was done on the Coastal Plain of this State (pp. 66, 67).

*Montana.*—In response to urgent requests two special investigations were made in Montana; one in the vicinity of Butte, where underground water is in demand for milling operations and for irrigation of truck farms; the other on the Flathead reclamation project, where the settlers are having difficulty in obtaining domestic water supplies. Both areas were examined by Mr. Meinzer in October, 1912, and brief reports were made to the citizens of Butte and, through the United States Reclamation Service, to the settlers on the Flathead project. A water-supply paper on these two areas is in preparation.

*Washington and Oregon.*—During the last three years investigations have been made by Walton Van Winkle of the quality of the waters in Washington and Oregon to determine the availability of these waters for domestic, agricultural, and industrial purposes. The Washington report, based on work done in 1910-11 at the University of Washington in cooperation with the State Board of Health, has been submitted for publication. The Oregon investigation was begun in 1911-12 and was maintained in cooperation with the State of Oregon through the office of John H. Lewis, State engineer. It included the analyses of nearly 1,000 samples of water in a laboratory gratuitously furnished by the Willamette University, at Salem, Oreg. The laboratory work was finished in October, 1912, and on February 28, 1913, Mr. Van Winkle, after completing his report thereon, resigned from the Survey to continue his studies of the water resources of Oregon with the State engineer.

The report by G. A. Waring on the water resources of a part of south-central Washington was published during the year as Water-Supply Paper 316.

*Utah and Nevada.*—A report on the underground water resources and irrigation possibilities of a part of northwestern Utah (Water-Supply Paper 333) was completed by Everett Carpenter in August, 1912, and an investigation of the water resources of southeastern Nevada was begun by Mr. Carpenter in September. At the close of the fiscal year the report on the Nevada area is well advanced. The water analyses for this investigation were made by S. C. Dinsmore, of the experiment station and food and drug commission of Nevada.

At the beginning of the fiscal year Mr. Dole prepared for the geologic branch a report entitled "Exploration of salines in Silver Peak Marsh, Nevada." This report was based on field work done by him in the spring of 1912 and was published as Bulletin 530-R.

*California.*—A report by C. H. Lee on the results of an intensive study of the water resources of a part of Owens Valley, Cal., was published during the year as Water-Supply Paper 294, and an investigation of the amount of percolation of flood waters to the underground reservoir in certain tracts in southern California was continued by Mr. Lee, through cooperation with the California State conservation commission. The report by G. A. Waring on California springs is practically completed, and some progress has been made during the year in the preparation of reports on the underground waters of the San Joaquin Valley, by W. C. Mendenhall, R. B. Dole, and Herman Stabler, and the underground waters of San Jacinto Valley, Cal., by W. C. Mendenhall, the field work in both valleys having been done in previous years.

Two underground water investigations were begun in California in September, 1912—one in the Sacramento Valley by Kirk Bryan, the other in the Santa Clara Valley, south of San Francisco, by W. O. Clark, under the direction of Dr. J. C. Branner. Mr. Meinzer also devoted the month of September, 1912, to these two fields. At the close of the fiscal year field work is progressing in both areas.

*New Mexico.*—An investigation of the underground waters in Luna County, N. Mex., which includes most of the Mimbres Valley, has for the last few years been carried on by N. H. Darton and is now well advanced.

An investigation of the Tularosa Basin and adjacent areas, covering over 6,000 square miles in south-central New Mexico, has been made in cooperation with the New Mexico agricultural experiment station, Mr. Meinzer being in charge of the work done by the Federal Survey and Dr. R. F. Hare, chief chemist of the experiment station, being in charge of the analytical work done by the State. Mr.

Meinzer, after spending about two weeks in November, 1912, in southeastern Nevada, returned to the Tularosa Basin and devoted several weeks to an examination of the region between the Jarilla Mountains and the Rio Grande. The report on the Tularosa area was completed and transmitted for publication before the close of the fiscal year.

*Arizona.*—The report on the geology and water resources of Sulphur Spring Valley, Ariz. (Water-Supply Paper 320), prepared by Mr. Meinzer, of the Federal Survey, in cooperation with R. H. Forbes and F. C. Kelton, of the State experiment station, was sent to the Public Printer during the fiscal year.

The special 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 resumed in May, 1913, by H. E. Gregory, who has from the beginning been in charge of the work. The results of these investigations are reported to the Commissioner of Indian Affairs, to assist the engineers of the Indian Office in developing water supplies. Prof. Gregory is also preparing for publication a water-supply paper on the region.

#### DIVISION OF WATER UTILIZATION.

The work of the division of water utilization has been continued during the year under the organization 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 performed in part by Mr. La Rue and Mr. Murphy, and in part by W. B. Heroy and W. N. White, geologist and assistant classifier, respectively, in the land-classification board, who were detailed to this work during a portion of the field season.

The personnel of this division and the allotment of funds therefor are insufficient to meet the demands made upon them. Many of the power-site withdrawals still remain unexamined; many applications for rights of way, some of which have been pending in the Survey for more than two years, have not yet been reached; applications for power permits and for segregations of land under the Carey Act, which are now generally acted on by the Survey without field examination, although such examination is often highly desirable, will doubtless in many future cases be referred to the field for report; and applications for designation under the enlarged-homestead act, which require field examination, are constantly accumulating. In addition, the examination and classification of the lands valuable for power sites and reservoirs in New Mexico and Arizona, made neces-

sary by the acts of Congress admitting these States (36 Stat., 564 and 575), has not yet been made. These acts provide that—

There is hereby reserved to the United States and exempted from the operation of any and all grants made or confirmed by this act to said proposed State all land actually or prospectively valuable for the development of water powers or power for hydroelectric use or transmission and which shall be ascertained and designated by the Secretary of the Interior within five years after the proclamation of the President declaring the admission of the State.

The proclamation admitting New Mexico was dated January 6, 1912, and that admitting Arizona was dated February 14, 1912. The field examination necessary for the classification of the lands of these two States which are valuable for power is understood to be required of this branch.

#### LAND-CLASSIFICATION BOARD.

##### ORGANIZATION AND PERSONNEL.

The organization of the land-classification board received its present form by Survey Order No. 10, issued May 1, 1912. The organization and personnel for the fiscal year 1912-13 have therefore remained practically as they were during the previous year and as outlined in the thirty-third annual report. The most important changes are those due to the appointment of G. H. Ashley as administrative geologist early in the fiscal year and of N. C. Grover as chief hydraulic engineer in charge of the water-resources branch near the close of the year. Mr. Ashley continues to act as chairman of the coal board, but C. E. Lesher has been named as vice chairman in order to relieve Mr. Ashley of a great part of the detailed work of the section. Herman Stabler has been assigned to the duties heretofore devolving upon Mr. Grover.

On July 1, 1912, the entire personnel of the board numbered 35, of whom 11 were geologists and engineers, 4 draftsmen or other technical workers, and 19 (including 5 temporary employees) of clerical or subclerical grades. This number remained fairly constant throughout the year, there being 34 members on the board's staff at its close—10 geologists and engineers, 4 technical employees, and 20 (including 3 on the temporary rolls) clerical or subclerical. At the end of the year the branch was organized as follows:

W. C. Mendenhall, chief of branch.

Elsie Patterson, secretary.

##### Division of mineral classification:

Coal section: G. H. Ashley, chairman; C. E. Lesher, vice chairman.

Oil section: M. W. Ball, chairman.

Phosphate section: A. R. Schultz, chairman.

Metalliferous section: A. R. Schultz, chairman.

##### Division of hydrographic classification:

Water-power section: Herman Stabler, chairman.

Irrigation section: W. B. Heroy, chairman.

## SPECIAL FEATURES.

A feature of the year's work that is worthy of special mention is the revision of the regulations for the classification and valuation of public coal lands. The revised regulations were approved by Secretary Fisher on February 20, 1913. The reasons which led to this revision are set forth in some detail on pages 144-146, and the regulations and the principles which underlie them are given in Bulletin 537, "The classification of the public lands," this bulletin itself representing an important part of the work of the land-classification board.

Other administrative advances to which the land-classification board has contributed are represented by the regulations governing the issue of right-of-way permits for power purposes under the act of February 15, 1901 (31 Stat., 790). The first draft of these regulations was approved by Secretary Fisher on August 24, 1912. They were later modified in minor particulars and were approved in their present form on March 1, 1913.

Similarly, regulations were devised governing procedure under the act of March 3, 1911 (36 Stat., 1253-1254), providing for rights of way for transmission lines. These regulations were finally adopted and approved by Secretary Fisher on January 6, 1913.

While these various special tasks have been accomplished from time to time, the regular work for which the board is organized, namely, classifications of the public lands on the basis of results secured by the field branches and the promulgation of these classifications, has gone steadily forward. These classifications are summarized in the chapter on each resource, but a graphic idea of the work and of the increased efficiency exhibited in its accomplishment may be presented by a summary of the letters and reports written during this year and a comparison with previous years.

Between July 1, 1912, and June 30, 1913, 16,954 letters were referred to the board for reply, an increase of 32 per cent over the previous year, and 19,399 letters and reports were written in the board, an increase of 70 per cent over the production of the previous year. For the working days of the year this was a daily average of 55 incoming and 63 outgoing letters. The greater part of these letters are technical reports upon the mineral or power value of individual tracts of public land. Most of them, of course, are brief letters, but each represents research and makes available a modicum of the Survey's accumulated information. From reports of this simple type those issued by the board vary to full discussions of complex problems 50 pages or more in length. As some of the letters received cover many cases and require a large number of replies, there has been through the year a steady accumulation of unsettled cases, amounting at its end to about

5,600, and this despite the fact that there was a large excess of outgoing reports over incoming inquiries during the year.

That the board has been able to accomplish this great gain in output without increase of force, while at the same time improving its system and rendering its handling of cases more prompt and sure, is due to the standardization of procedure, to the increasing efficiency of the personnel, and to the adoption of time-saving devices, such as multigraphed forms and safety maps.

#### COOPERATIVE CORRESPONDENCE.

The primary purpose for which the land-classification board was created is to assist in the administration and utilization of the public domain. This it does by making available to the department in the solution of public-land problems the experience and judgment of the technical and scientific men on the Survey's staff and the data regarding the character of the public lands contained in the Survey's records. This assistance is rendered, first, by the classification of public lands into types recognized by the statutes; second, by the promulgation of classifications in the form of recommendations for withdrawals or restorations where appropriate; and, third, by cooperative correspondence with other Government offices by which classifications of individual tracts are reported. The classifications themselves are the foundation of the work, but the cooperative correspondence by which these classifications are rendered directly available to the department and to other bureaus absorbs a large part of the energies of the board. By means of this correspondence the Secretary's office, the Indian Office, and the Land Office are supplied with information as to the mineral character of lands or their value for power sites or reservoirs. In the majority of cases the question is whether or not certain lands sought to be acquired from the Government are of the character contemplated by the statute under which their acquisition is attempted.

Thus under the agreement of March 5, 1912, between the Land Office and the Survey all entries and selections except homestead and desert-land entries, valid settlement claims, and metalliferous-mining claims are referred to the Survey for report as to whether or not the lands entered or selected are mineral in character or have power or reservoir possibilities. If the Survey reports the land in a given case to be without value for mineral, power, or reservoir resources, the case is clear-listed by the Land Office, unless other factors prevent, and proceeds to patent. If, on the other hand, the Survey reports the land to be mineral or to have power or reservoir value, the Land Office gives the applicant opportunity to disprove the classification, and in the event that he is unable to do so acts in accordance

with the Survey's report. In cases where the Survey's information is too meager to warrant a definite report, the information available in the Survey's records is furnished to the Land Office for use in an examination by the field service of that bureau. The board received during the year 12,852 requests of this general type and took action upon 9,503.

The benefits of this agreement are threefold. In the first place the public's interest in the appropriate disposition of the public lands is protected, and inappropriate disposition is guarded against so far as can be insured by the fullest use of the data which the Survey has accumulated in the last 30 years. In the second place, the Government is saved the expense of a large number of field examinations. The extent of this saving is shown by the fact that of 9,503 cases handled by the Survey during the fiscal year, field examination was recommended in only 2,815 cases—less than 30 per cent. The saving of time and money to the Land Office field service, which is seriously overburdened at best, is of great importance, enabling that service to devote a greater part of its energies to the many other types of cases of equal urgency which it must investigate. In the third place, inasmuch as the majority of the tracts considered are, as indicated in the table below, reported to be without mineral, power, or reservoir value, the claimant receives his patent in a shorter space of time than if his case must go to the field for examination. Even the applicant whose case requires field examination should receive final action earlier than if all these cases were assigned to the field, because the large number of cases in which field examination is obviated enables the Land Office field service to take up the remaining cases more promptly.

*Action on Land Office requests for information under cooperative agreement of March 5, 1912, during fiscal year 1912-13.*

State.	Pending July 1, 1912.				Received.				Total.	Acted upon.										Pending June 30, 1913.				
										Mineral.					Power.									
	Mineral.	Power.	Both.	Total.	Mineral.	Power.	Both.	Total.		Mineral.	Nonmineral.	Field examination recommended.	Recall.	Total.	Power.	Nonpower.	Field examination recommended.	Recall.	Total.	Total.	Mineral.	Power.	Both.	Total.
Alabama.....			1	1		1	17	18	19		7	5		12		13			13	13			6	6
Alaska.....	3	1	2	6		18	104	122	128		99	1		100	2	112	1		115	118		1	9	10
Arizona.....		5	58	63	3	112	55	170	233		71	10		81	1	179			180	181	2	17	33	52
Arkansas.....			5	5			31	33	38	2	5	2		9		7			7	9			29	29
California.....		40	34	74	16	145	3,370	3,531	3,605	157	1,109	1,873		3,139	150	3,017	101		3,268	3,273	11	51	270	332
Colorado.....		5	14	19	39	40	157	236	255	35	141	3		179	12	169			181	218	2	6	29	37
Florida.....			2	2	2	1	46	49	51	2	20			22		21			21	23			28	28
Idaho.....	2	5	169	176	4	117	435	556	732	40	259	77	25	401	15	423	14	25	477	483		40	209	249
Indiana.....							1	1	1														1	1
Kansas.....			1	1		15	15	16			9			9		9			9	9			7	7
Louisiana.....			14	14	8	1	22	31	45	2	17	1		20		18			18	20	6	1	18	25
Michigan.....						4	17	21	21							2			2	2		2	17	19
Minnesota.....		24	29	53	2	21	90	113	166		82		1	83	2	122	1	1	126	128			38	38
Mississippi.....			1	1			25	25	26		1			1		1			1	1			25	25
Missouri.....							4	4	4														4	4
Montana.....	3	28	438	469	19	86	1,608	1,713	2,182	444	965	66	116	1,591	10	1,546		116	1,672	1,685	9	20	468	497
Nebraska.....			1	1		227	227	228	228		93		2	95		93		2	95	95			133	133
Nevada.....		11	83	94	16	43	95	154	248	7	51	106		164	5	189	10		204	211	9	7	21	37
New Mexico.....		240	10	250	36	335	337	708	958	9	244	3		256		595			595	631		200	127	327
North Dakota.....		22	3	25	2	118	372	492	517		257		5	262		346	1	5	352	352	2	50	113	165
Oklahoma.....						1		1	1							1			1	1				
Oregon.....		65	26	91	9	306	511	826	917	1	216	90		307	15	549	4		568	574	3	104	236	343
South Dakota.....	1		3	4	15	9	440	464	468		82	67		149		143			143	158	1		309	310
Utah.....		102	151	253	28	272	209	509	762	16	124	108	1	249	6	484	3	12	505	531	2	92	137	231
Washington.....	2	36	57	95	25	126	348	499	594	2	137	194	2	335	19	375	1	2	397	418	6	79	91	176
Wisconsin.....		1	6	7		5	19	24	31		8			8		13			13	13		1	17	18
Wyoming.....	1	2	284	287	15	21	283	319	606	25	246	69		340	4	339	4		347	356	7	7	236	250
	12	<sup>a</sup> 587	1,392	1,991	241	<sup>a</sup> 1,782	8,838	10,861	12,852	742	4,243	2,675	152	7,812	241	8,766	140	163	9,310	<sup>a</sup> 9,503	60	<sup>a</sup> 678	2,611	3,349

<sup>a</sup> Certain of these requests are accompanied by field service reports as to mineral character and have been included in the following table, headed "Action on Land Office field-service reports," etc. (p. 141), as follows: Pending July 1, 1912, 564; received, 1,587; acted upon, 1,516; pending June 30, 1913, 635.

Cooperation between the Land Office and the Survey under the agreement of March 5, 1912, does not cease with the furnishing of the information noted above. In cases where the Survey makes a definite report as to the character of the land, it can in general be of no further assistance, but the cases where field examination is recommended are returned to the Survey for review after field examination is made. All field-service reports regarding homestead and desert entries on withdrawn or classified lands that state that the lands are not valuable for the purpose for which they are withdrawn or classified are also forwarded to the Survey for review. By this procedure a great amount of valuable data gathered by the Land Office field service is made available for incorporation into the Survey records, and at the same time the Land Office receives the benefit of the information already on file in the Survey. This information is of especial value because from the very nature of the agreement these reports relate to areas where the Survey's records are incomplete. The character of work done by the Land Office field service is indicated by the fact that of 3,812 reports reviewed by the Survey during the fiscal year only 201 have been disapproved in whole or in part.

*Action on Land Office field-service reports under cooperative agreement of March 5, 1912.*

State.	Pending July 1, 1912.				Received.				Total.	Acted upon.										Pending June 30, 1913.				
										Mineral.					Power.									
	Mineral.	Power.	Both.	Total.	Mineral.	Power.	Both.	Total.		Approved.	Part ap- proved.	Disap- proved.	Recalled.	Total.	Approved.	Part ap- proved.	Disap- proved.	Recalled.	Total.	Total.	Mineral.	Power.	Both.	Total.
Alabama.....					7			7	7	3				3						3	4			4
Alaska.....							1	1	1														1	1
Arizona.....	5			5	111	1		112	117	104				104					1	105	12			12
California.....	64			64	1,336	29	70	1,435	1,499	1,304	1	23		1,328	62	2	3		67	1,349	118	8	24	150
Colorado.....	19	8		27	493		3	496	523	430	2	75	1	508	8		1		9	515	6	1	1	8
Florida.....	1			1	1			1	2	2				2						2				
Idaho.....	7	2	3	12	205	8	5	218	230	122	1	19		142	11		4		15	150	77	2	1	80
Louisiana.....					4			4	4				1	1						1	3			3
Michigan.....					2		2	4	4											2				4
Minnesota.....	24			24	1			1	27	25				25	2				2	27				
Montana.....	32	2		34	108	3	3	114	148	90	4	16		110	3		1		4	114	30	1	3	34
Nevada.....	11			11	44			44	55	41		4		45						45	10			10
New Mexico.....	246		6	252	359		72	431	683	422		5		427	34	1			35	427	213		43	256
North Dakota.....	72			72	312		4	316	388	259		9	11	279	4				4	279	109			109
Oklahoma.....					1			1	1	1				1						1				
Oregon.....	61	3	68	132	307	2	103	412	544	370	1	2		373	86	1	22		109	375	102	3	64	169
South Dakota.....					7		10	17	17	17				17	10				10	17				
Utah.....	100	1		101	259		10	269	370	253	6	8	11	278	2	2	1		5	278	86	1	5	92
Washington.....	31	4	2	37	128	5	15	148	185	83	1	4		88	14	2	1		17	97	79		9	88
Wyoming.....	17			17	67		29	96	113	26		1		27	2				2	27	59		27	86
	690	20	79	789	3,752	50	327	4,129	4,918	3,552	16	167	23	3,758	238	8	34		280	3,812	910	16	180	1,106

In addition to the cases which fall within the agreement of March 5, 1912, there are several other types of cooperation with the Land Office by which the Survey's data and the judgment of its technical force are made useful.

Under departmental order of April 27, 1911, all proposed eliminations from national forests are referred to the Survey for report as to whether or not the lands are valuable for coal or have power possibilities. Inasmuch as withdrawals and classifications of lands containing coal are made without regard to national-forest boundaries, no report as to this mineral is necessary, and the Survey reports only as to power-site and reservoir possibilities. The number of these cases is not large, but the area covered is greater than the number of cases would indicate.

Certain other types of cooperation with the General Land Office have already been discussed. Of these, applications for the classification of land included in power-site reserves, desert-land proofs under irrigation projects, applications for rights of way, water-power permits, and Carey Act lists fall within the scope of the division of hydrographic classification, while applications for classification and for reclassification of coal lands are handled by the division of mineral classification. In a majority of these cases a report is furnished to the Land Office for the guidance of that office and of the Secretary.

The cooperative correspondence of the land-classification board is not confined to the Land Office or to the Secretary's office. On March 27, 1911, Secretary Fisher directed that a report as to mineral character and power-site or reservoir possibilities should be obtained before the issuance of patent to Indians under tribal allotments. A renewal of this order on August 23, of that year, directed that to these cases should be given precedence over other work in the Survey. As a result of these orders the Survey receives from the Office of Indian Affairs several thousand requests for information each year, in response to which the Survey either reports the lands as without mineral, power, or reservoir value, or as of value for one or more of these resources, or reports that sufficient information is not available to warrant a definite conclusion. If the Survey's report is definite it is used by the Indian Office as a guide in determining whether or not patent to the lands involved shall issue. The Indian Office has no field service such as that maintained by the Land Office, and the result is that in many cases in which the Survey reports insufficient data for classification the Indian Office requests it to make the necessary investigation to determine water-power or mineral value, that office furnishing the funds. Several of these examinations were made during this year, as noted elsewhere in this report. The number of

Indian Office cases received and acted upon during the last two years is shown in the following table:

*Action on Indian Office requests for information under departmental orders of March 27 and August 23, 1911.*

Year.	Received.	Acted upon.	Pending.
1911-12.....	4,879	3,385	1,494
1912-13.....	2,917	4,092	319
	7,796	7,477	319

Action on enlarged-homestead petitions is not, strictly speaking, cooperative correspondence, as many of these petitions are received in the Survey directly from the applicants. However, the petitions are in the nature of requests for classification, and the correspondence is similar in its nature to that carried on under cooperative orders. This correspondence is therefore included in the summary table below, which shows the number of cases of each class received during the year, the gain or loss, and the amount of work outstanding at the close of the fiscal year.

*Balance sheet of cooperative cases for year ended June 30, 1913.*

Class of cases.	Pending July 1, 1912.	Received.	Disposed of.	Pending June 30, 1913.	Gain (+) or loss (-).
<b>Mineral only:</b>					
General Land Office requests for information ...	12	241	193	60	- 48
General Land Office, special agent.....	126	2,165	2,016	275	- 149
Applications for reclassification.....	4	33	22	15	- 11
Applications for classification.....	1	10	11	0	+ 1
	143	2,449	2,242	350	- 207
<b>Water only:</b>					
General Land Office requests for information.....	23	195	175	43	- 20
General Land Office, special agent.....	20	50	54	16	+ 4
Forest Reserve cases.....	16	102	90	28	- 12
Application for reclassification.....	16	25	22	19	- 3
Carey Act lists.....	1	18	19	0	+ 1
Right-of-way applications.....	128	546	637	37	+ 91
Enlarged-homestead petitions.....	349	1,944	946	1,347	- 998
Water-power permits.....	0	37	19	18	- 18
Desert proofs, irrigation projects.....		117	102	15	- 15
	553	3,034	2,064	1,523	- 970
<b>Both:</b>					
General Land Office requests for information.....	1,392	8,838	7,619	2,611	-1,219
General Land Office, special agent.....	79	327	226	180	- 101
Special Agent mineral, requests for information, power.....	564	1,587	1,516	635	- 71
Indian Office cases.....	1,494	2,917	4,092	319	+1,175
	3,529	13,669	13,453	3,745	- 216
<b>Grand total.....</b>	<b>4,225</b>	<b>19,152</b>	<b>17,759</b>	<b>5,618</b>	<b>-1,393</b>

## DIVISION OF MINERAL CLASSIFICATION.

## GENERAL FEATURES.

The division of mineral classification in the land-classification board corresponds to the geologic branch in the Survey. It receives from this field branch the results of the field operations of its staff and prepares from these results the official classifications of mineral lands. As heretofore, the largest item in the work of the division is that of coal-land classification. During the year 9,959,880 acres of lands were classified as to their coal content, mainly on the basis of field reports rendered by the geologic branch. Classifications of lands valuable for other minerals have likewise continued as heretofore, and in general restorations have exceeded withdrawals. As the outstanding withdrawals at the beginning of the fiscal year included most of the lands believed to be valuable for the minerals for which they were withdrawn, the examinations made during the year permitted restoration of a portion of these lands which proved not to contain the minerals in question. In coal lands, for example, the total area of new withdrawals recommended during the year was 145,764 acres, while the area of restorations effected was 9,497,468 acres. These restorations, however, do not mean that the lands do not contain coal. Coal lands as well as noncoal lands are restored to entry as soon as prices based on their coal content have been placed on them.

The withdrawals of oil lands during the year amounted to 124,736 acres, and the restorations of lands previously withdrawn amounted to 302,780 acres. The phosphate withdrawals during the same period included 95,200 acres and the restorations 513,205 acres, the result being a reduction of the area included in phosphate withdrawals at the end of the fiscal year to less than 3,000,000 acres. Minor acreages of potash lands were withdrawn, special naval petroleum reserves were created, and the classifications of metalliferous mineral lands within the Indian reservations and within the limits of the Northern Pacific Railroad grants in Idaho and Montana were continued. Details of this action are reported on pages 147-156.

## COAL.

## NEW REGULATIONS GOVERNING THE CLASSIFICATION AND VALUATION OF COAL LANDS.

The coal-land regulations in operation at the beginning of the fiscal year were those approved by Secretary Ballinger April 10, 1909, as amended June 6, 1910. It had long been evident that certain changes in those regulations were desirable, chiefly because the groups into which they divided coals for the purpose of classification and valuation proved to be not adapted to this purpose and because they did not take cognizance of certain factors that have been found to have an important bearing on coal classification. For example, the

regulations of April 10, 1909, divided coal into four distinct classes, whereas as a matter of fact no such distinct classes exist in nature. On the basis of this fourfold classification different depth limits and prices were fixed. It sometimes happened that for a coal on the border line between two of these classes the decision had to be made whether the depth limit should be 500 feet or 2,000 feet, while it should be, as a more natural classification would permit, say, 1,200 feet. The depth limits of two coals which may differ but slightly must needs under that scheme be fixed in the one case at 500 and in the other at 2,000 feet. There was no provision for graduation between those points or between 2,000 and 3,000 feet. One effect of this provision was that when a coal bed that changes slightly in character is traced along the outcrop the point may be reached where it passes from one class to another and the depth limit there suddenly changes. At this point the classification of the overlying surface as coal land would at once shift 1 mile or even 2 miles without any obvious or, indeed, any logical reason. Again, under those regulations all coals of one class were given the same depth limit, regardless of differences of quality within that class or of differences in thickness.

Studies carried on for over a year by the coal-land-classification board, assisted by other coal experts, resulted in the drafting of a new set of regulations governing the classification and valuation of coal land, and these regulations were on February 20, 1913, approved by Secretary of the Interior Fisher. The changes made were intended primarily to meet the difficulties just set forth by providing for graduated changes in depth limit, in minimum thickness, in prices, and in other like features. To do this the new regulations adopt a uniform gradient of prices in accordance with the heat value of the coal as expressed in British thermal units but allow a margin of elasticity for special qualities that enhance that value or detract from it. The superseded regulations provided a minimum thickness of 14 inches for all coals from 15,000 British thermal units or more down to 10,500 British thermal units, then increased the thickness at the rapid rate of 1 inch for each decrease of 100 British thermal units. The new regulations use the same thickness for the coals above 12,000 British thermal units, then increase that thickness at a varying rate down to 8,000 British thermal units, the final result being to maintain the same minimum thickness as before for the high-grade and low-grade coals but to increase the minimum slightly on intermediate coals, so as to eliminate the abrupt change that previously existed. Furthermore, in the new regulations the depth limit is determined in accordance with the quality and thickness of the coal, on the basis that the depth at which any coal can be commercially mined is dependent on the profit that may be derived

from its extraction. A factor not taken into account by the old regulations is the rapid increase in the cost of mining thin beds with decrease in thickness. It was found by careful study of mining experience that this increase is not directly proportional to the thickness of the bed, but increases at a greatly accelerated rate as the thickness decreases below 6 feet. It is also recognized that the percentage recovery of coal is greater for thin beds than for thick beds, a fact which tends to offset the increased cost of mining thin beds. These various factors were considered in framing the provisions of the new regulations. Another change which, it is believed, will eventually work to the benefit of the buyer of coal land, particularly the man of small means, is a provision in the regulations made effective November 15, 1912, by Secretary Fisher and included in the new regulations of February 20, 1913, that, where for good reasons it is advisable, classification of coal land may be made by  $2\frac{1}{2}$ -acre or 10-acre tracts or multiples thereof, described as minor subdivisions of quarter-quarter sections or rectangular lotted tracts. The reason for this provision is apparent when it is realized that the classification as coal land of a tract only partly underlain by coal often results in valuing at the minimum of \$10 or \$20 an acre lands whose price obtained by dividing the total estimated coal value by the number of acres in the subdivision is only a few dollars an acre, but for which, under the law, the minimum price of \$10 or \$20 an acre must be charged. A second advantage to the purchaser of small means is obtained in offering for sale small tracts along the outcrop of certain coal beds, in that this procedure will permit the purchase of a sufficient area to warrant the opening of a small country bank for meeting local demands under conditions which will not warrant the investment of the amount of capital necessary to purchase the entire 40-acre tract.

The general effect of the regulations of February 20, 1913, is to increase the area classified as coal land underlain by beds of the best quality and of thicknesses over 6 feet and to decrease the area classified as coal land but underlain by the poorer coals or by beds less than 6 feet in thickness. These changes are due to modifications of the depth limit for coals of the various grades and thicknesses. Values per acre are increased slightly for land in which the coal exceeds 15 feet in thickness and are decreased materially for land containing beds from 2 to 5 feet in thickness. The latter effect in turn results in a greater acreage valued at the minimum price.

#### CLASSIFICATIONS.

The fiscal year 1912-13 has shown a notable decrease in the area of land included in outstanding withdrawals, the reduction being due to the fact that the lands examined, classified, and restored have greatly exceeded the area withdrawn during the year.

During the fiscal year 2,064,014 acres were classified as coal land and valued at \$33,477,908, and 7,895,866 acres were classified as noncoal land. A large part of the area classified as coal land was in the region of low-grade coals of North Dakota, South Dakota, and eastern Montana, although several small fields of higher grade coal in north-central Montana, Idaho, Utah, Wyoming, and New Mexico have been examined and classified. Every effort was made during the year to obtain information regarding withdrawn areas which were believed to be largely noncoal lands in order that such areas might be eliminated from the withdrawal. Field work in areas containing thick and high-grade coals has been done with greater detail than before and consequently covers smaller areas than in previous years. These examinations during the last year were made for the most part in areas previously classified as coal land on preliminary examinations made several years ago. The total area and value of coal land classified as the result of the later work, though varying somewhat from those fixed by the previous classification of the same land, does not materially increase the total area classified as coal land or the total value. No small part of the work has been the classification of lands in Indian reservations that were thrown open to settlement. The following table shows the progress of coal-land classification by States:

*Summary of coal-land classifications and valuations June 30, 1912 and 1913.*

State.	Area classified as coal land and appraised (acres).	Area classified as non-coal land (acres).	Valuation fixed.	Minimum valuation.	Average price per acre.
Arizona.....	1912.....	42,492			
	1913.....	42,492			
Arkansas.....	1912..... 60,715	70,038	\$1,473,762	\$1,214,280	\$24.30
	1913..... 60,715	70,038	1,473,762	1,214,280	24.30
California.....	1912..... 7,720	6,242	585,086	154,404	75.80
	1913..... 7,720	6,242	585,086	154,404	75.80
Colorado.....	1912..... 2,880,215	5,871,436	168,374,600	50,435,309	58.50
	1913..... 2,844,202	8,826,559	167,888,247	49,715,086	59.00
Idaho.....	1912.....	6,710,572			
	1913..... 2,113	7,883,591	51,824	42,260	24.50
Montana.....	1912..... 4,171,995	15,210,457	105,320,836	86,507,003	25.20
	1913..... 4,550,945	17,198,654	111,127,826	92,313,993	24.40
New Mexico.....	1912..... 954,052	2,864,168	21,280,162	13,520,352	22.30
	1913..... 953,772	2,874,926	21,274,562	13,514,752	22.30
Nevada.....	1912.....				
	1913..... 5,880	2,428	117,600	117,600	20.00
North Dakota.....	1912..... 230,814	1,020,999	4,584,255	4,584,255	19.90
	1913..... 1,775,497	2,281,250	30,670,925	30,670,925	17.20
Oregon.....	1912..... 1,897	1,070,103	49,909	37,919	26.30
	1913..... 1,897	1,047,063	49,909	37,919	26.30
South Dakota.....	1912..... 82,217	6,517,626	831,270	831,270	10.10
	1913..... 249,897	6,956,334	2,756,427	2,756,427	11.00
Utah.....	1912..... 670,306	2,321,891	38,323,592	8,678,513	57.20
	1913..... 670,272	2,334,624	38,320,001	8,677,373	57.20
Washington.....	1912..... 40	659,274	2,000	800	50.00
	1913..... 40	659,474	2,000	800	50.00
Wyoming.....	1912..... 7,179,474	10,516,025	382,221,890	110,432,145	53.20
	1913..... 7,180,509	10,593,514	382,207,101	110,449,245	53.20
Total areas recorded as classified.....	1912..... 16,239,445	52,881,323	723,047,362	276,396,250	44.50
	1913..... 18,303,459	60,777,189	756,525,270	309,665,064	41.30
Area classified during fiscal year 1912-13.....	2,064,014	7,895,866	33,477,908	33,268,814	16.20

## SALES OF COAL LAND.

The sale of coal land at the new figures has continued at a moderate rate during the last year, as during the years immediately preceding. In all 10,338.70 acres were sold for \$270,396.90, an average price of \$26.15 an acre. These sales indicate that the suggestion once made that coal lands would not sell at the new figures was not well founded. Indeed, owing to the increased detail with which the work in the field is being done, there is a growing tendency to accept the Survey's appraisal as a fair indication of the value of the lands classified by it. Increase in the coal production of the Rocky Mountain States during the last few years indicates that the coal industry of that region has not been injured by the Survey's work, as some feared it might be. Under the regulations now in force a large part of the public coal land will continue to be classified at the minimum price. All the land in the Dakotas is being so priced, and much of that in Montana, besides a considerable percentage of land classified in other States, and purchases will continue to be made at the minimum price.

The following table shows the prices at which coal lands have been sold, the number of entries at the different prices, the number of acres sold at these prices, and the receipts since July 1, 1907:

*Sales of coal lands at various rates since July 1, 1907.*

Price per acre.	Entries to date.	Acres.	Receipts.	Price per acre.	Entries to date.	Acres.	Receipts.
\$10.00	395	55,891.05	\$559,834.63	\$100.00	2	233.29	\$23,329.00
12.50	1	56.03	700.38	110.00	-----	198.73	21,860.60
14.50	1	40.00	580.00	115.00	-----	63.19	7,266.85
15.00	16	2,470.55	37,058.25	120.00	2	121.68	14,600.80
17.50	1	40.00	700.00	130.00	2	201.73	26,224.90
19.00	1	22.80	433.20	135.00	2	136.96	18,489.60
20.00	296	57,553.51	867,438.40	140.00	1	120.00	16,800.00
25.00	42	11,811.68	147,671.70	145.00	1	40.00	5,800.00
30.00	26	3,279.81	98,394.30	150.00	-----	22.33	3,349.50
33.00	1	40.00	1,320.00	155.00	2	120.08	18,612.40
35.00	3	279.78	9,792.30	170.00	1	39.89	6,781.30
36.00	1	40.00	1,440.00	175.00	-----	16.21	2,836.75
40.00	0	880.72	35,228.80	180.00	1	40.00	7,200.00
45.00	2	360.00	16,200.00	200.00	-----	77.06	15,412.00
49.00	1	40.00	1,960.00	270.00	1	39.79	10,743.30
50.00	70	8,338.63	415,023.00	370.00	1	41.40	15,318.00
60.00	1	160.00	9,600.00	375.00	1	41.73	15,648.75
65.00	-----	240.00	15,600.00	385.00	2	83.14	32,008.90
70.00	1	80.79	5,655.30	390.00	1	41.64	16,239.60
75.00	2	161.23	12,092.25	395.00	2	124.63	49,228.85
80.00	-----	40.00	3,200.00	400.00	2	83.15	33,260.00
85.00	1	40.00	3,400.00	405.00	3	166.51	67,436.55
90.00	2	204.96	18,446.40	410.00	2	83.39	34,189.90
92.00	1	40.00	3,680.00				
95.00	1	38.51	3,658.45		905	144,286.58	2,731,745.71

## WITHDRAWALS AND RESTORATIONS.

The area of lands withdrawn during the fiscal year 1912-13 has been small compared with that withdrawn during preceding years and is considerably less than the area classified and restored, so that at the end of the year there is a considerable net decrease in the area withdrawn over that withdrawn on June 30, 1912. The following

table shows by States the coal lands withdrawn and restored during the fiscal year 1912-13:

*Coal lands withdrawn and restored during fiscal year 1912-13.*

[In acres.]

State.	Outstanding July 1, 1912.	New withdrawals during fiscal year.	Restorations during fiscal year.	Outstanding June 30, 1913.
Arizona.....	118,718			118,718
California.....	239,903			239,903
Colorado.....	8,245,063	8,826	3,216,168	5,037,721
Idaho.....	1,566,918		1,175,132	391,786
Montana.....	17,642,291	44,077	1,634,453	16,051,915
Nevada.....	92,141		8,308	83,833
New Mexico.....	5,750,440		11,593	5,738,847
North Dakota.....	18,454,410		2,533,123	15,921,287
Oregon.....	3,521	23,040		26,561
South Dakota.....	866,809		866,809	
Utah.....	6,364,783	67,340	160	6,431,963
Washington.....	2,206,190		160	2,206,030
Wyoming.....	6,664,302	2,481	51,562	6,615,221
	68,215,489	145,764	9,497,468	58,863,785

APPLICATIONS FOR CLASSIFICATION.

The number of applications for classification is decreasing from year to year, having fallen from 46 in 1910-11 to 10 during the last fiscal year. This decrease is doubtless due in part to the classification and restoration of large areas of noncoal land previously withdrawn, but probably to a greater extent it is due to a better understanding of the operation and effect of the act of June 22, 1910, providing for agricultural entries on lands withdrawn or classified as coal land, and to the act of April 30, 1912, extending the act of June 22, 1910, to State selections and isolated tract sales. There still remain, however, a few entrymen who object to patents reserving coal to the Government and who file applications to have lands classified as noncoal land. Most of the affidavits by which such applications are supported are valueless, and therefore few such requests can be granted, as the withdrawals are made for the purpose of retaining title to the coal in the Government until information adequate for classification is obtained. There have also been received a few applications for the classification and valuation of lands which it is desired to purchase as coal land. The following table shows the action taken upon applications for classification received through the Land Office or the department:

*Applications for classification of withdrawn coal lands.*

	Received.	Approved.	Denied.	Pending.
1910-11.....	46	4	36	6
1911-12.....	18	1	22	1
1912-13.....	10	4	7	0
	74	9	65	0

## APPLICATIONS FOR RECLASSIFICATION.

In order to guard against possible errors in classification, whereby injustice might be done, provision is made for applications for reclassification. Any person desiring to enter or select, under the agricultural laws, lands classified as coal lands may submit an application for reclassification, supporting it by affidavits setting forth the evidence which seems to him to show that the existing classification is erroneous. As a rule, the affidavits thus submitted are of the most perfunctory sort and are barren of facts affecting the classification. Now and then, however, an application is accompanied by valuable information, to which most careful consideration is given, and when this information shows the previous classification to be in error a reclassification is made.

In addition to the applications filed by entrymen requesting that lands classified previously as coal land be reclassified as noncoal land, the Survey received during the year a small number of applications for the reclassification of lands previously classified as noncoal land, the entryman desiring to purchase as coal land. Some of these applications have resulted in new field examinations by the Survey and, on the basis of the data gathered, a reclassification as requested.

There were also received late in the fiscal year several applications for reclassification, alleging the values fixed by the Survey to be too high and praying that lower appraisal be made. These applications were filed as the result of departmental decisions especially authorizing their submission. The information submitted with most of the applications was not of a character to be of assistance in arriving at correct valuations, and a careful review of all the data available led to the conclusion that the values already fixed were reasonable and in accordance with departmental regulations and to a denial of the applications. The following table shows the action on applications for reclassification submitted through the Land Office or the department since they first began to be received:

*Applications for reclassification of coal lands.*

	Received.	Ap- proved.	Part ap- proved.	Denied.	Pending.
1909-10.....	126	3	3	116	4
1910-11.....	48	.....	.....	21	<sup>a</sup> 29
1911-12.....	29	.....	.....	53	<sup>b</sup> 4
1912-13.....	33	4	.....	18	15
	236	7	3	208	15

<sup>a</sup> One case canceled by relinquishment and one returned to entryman.

<sup>b</sup> One case recalled by General Land Office.

## OIL.

A very important piece of legislation enacted during the year was the act of August 24, 1912, providing for agricultural entries on oil and gas lands in the State of Utah. The bill as originally introduced in Congress applied to all the States of the Union but was changed in committee to apply only to a single State, the committee reporting that the bill was to a certain extent experimental in character and should be extended to other parts of the public domain if found satisfactory. As the table below shows, there are 1,952,326 acres included in oil reserves in Utah, and these lands are now open to homestead entries, desert-land entries, isolated tract sales, State selections, including Carey Act segregations, and Reclamation Service withdrawals, the claimant being entitled, when he has complied with the law, to a patent containing a reservation to the United States of all oil and gas deposits and the right to prospect for, mine, and remove them. In order to guard against disposition under the unsatisfactory placer law of deposits underlying lands so entered or selected, the act provides that "the reserved oil and gas deposits in such lands shall be disposed of only as shall be hereafter expressly directed by law." A second act, that of February 27, 1913, provides for selection by the State of Idaho of lands which have been withdrawn or classified as oil lands or which are valuable for oil. So far as known to the Survey there are in the State of Idaho no deposits of oil or gas of sufficient importance to warrant withdrawal or classification. The act is, however, a step in the desired direction of extending the separation principle to all public-land States.

During the year the area restored to entry has exceeded that withdrawn from entry by 178,044 acres. The two withdrawals made during the year comprise an area in the northern part of the Wind River Basin, Wyo., and an area in the vicinity of Moorcroft, Wyo. Large areas in California which investigations during the fiscal year showed to be unfavorable for oil and gas accumulation were restored.

One of the most important events of the year was the segregation of naval petroleum reserves in California aggregating 68,249 acres and estimated to contain 250,000,000 barrels of oil. As early as February 24, 1909, the attention of Secretary Garfield was called to the superiority of liquid fuel for the Navy and the desirability of retaining a supply thereof in Government ownership. During the last year the Navy Department requested of the Department of the Interior the special segregation of an area estimated to contain a sufficient supply of fuel oil for the Navy's needs for 25 years. Accordingly, two naval petroleum reserves were created—No. 1, including a part of the Elk Hills on the west side of the San Joaquin Valley, on September 2, 1912; and No. 2, comprising a portion of

the Buena Vista Hills, in the same general locality, on December 13, 1912. Both these areas were already included in oil withdrawals, and their inclusion in naval petroleum reserves does not, therefore, add to the total acreage withdrawn. The following table shows the outstanding areas, as well as the action taken during the year by States:

*Summary of oil withdrawals, fiscal year 1912-13.*

[In acres.]

State.	Outstand- ing July 1, 1912.	New with- drawals.	Restora- tions.	Outstand- ing June 30, 1913.
Arizona.....	230,400	.....	.....	230,400
California.....	1,616,011	.....	227,931	1,388,080
Colorado.....	87,474	.....	.....	87,474
Louisiana.....	414,720	.....	.....	414,720
Oregon.....	74,849	.....	74,849	.....
Utah.....	1,952,326	.....	.....	1,952,326
Wyoming.....	398,402	124,736	.....	523,138
	4,774,182	124,736	302,780	4,596,138

**PHOSPHATE.**

The examination of phosphate deposits in Idaho, Montana, and Utah was continued during the summer of the present fiscal year along the same lines as in Idaho in 1911-12. Nearly all the phosphate examinations were of a detailed type and were restricted to areas included in outstanding phosphate reserves, and consequently resulted in covering much smaller areas than during the preceding season. The results of the year's activities did not materially extend the knowledge of the distribution of the western phosphate deposits. Reports of the occurrence of phosphate deposits at different stratigraphic horizons and in areas remote from the known phosphate fields were received from various men engaged in geologic examinations in the Rocky Mountain States, but from none of these localities was sufficiently definite evidence submitted to warrant further field examination.

The results of the detailed examinations, as in previous years, have materially modified the outstanding reserves and have added new tracts to the area withdrawn. New information gathered during the year has led to the withdrawal of additional lands not previously known to contain phosphate beds and to the restoration of areas found to contain no valuable phosphate deposits. As predicted in the report on this subject for 1912, the restorations for this fiscal year exceed the withdrawals by more than a quarter of a million acres, with a corresponding reduction in the area of the outstanding reserves. Future field examinations will probably result in further eliminations and perhaps in some additions to outstanding with-

drawals. The results of the phosphate examinations for the fiscal year 1912-13 are set forth in the following summary:

*Withdrawals and restorations of phosphate lands, fiscal year 1912-13.*

[In acres.]

State.	Outstand- ing July 1, 1913.	Withdraw- als during year.	Restora- tions dur- ing year.	Outstand- ing June 30, 1913.
Florida.....	35,640	84,817	.....	120,457
Idaho.....	1,058,056	.....	141,287	916,769
Montana.....	274,861	.....	.....	274,861
Utah.....	107,745	.....	.....	107,745
Wyoming.....	1,864,259	10,383	371,918	1,502,724
	3,340,561	95,200	513,205	2,922,556

No phosphate examinations were made in Florida during the year. There were, however, 84,817 acres of vacant Government land in the phosphate region withdrawn from entry and made a part of the Florida phosphate reserve, pending an examination and classification of the lands or the enactment of legislation providing for the disposition of the phosphate deposits under laws more satisfactory than the present placer-mining law. In order to minimize as far as possible the hardships caused to agricultural interests in Florida, only vacant Government lands in the general phosphate region were included in the phosphate withdrawals.

There has been no change in the procedure as regards classification of phosphate lands during the fiscal year 1912-13. The regulations governing the withdrawal and restoration of phosphate lands have not been modified and are those adopted in 1912. Deposits containing less than 30 per cent of tricalcium phosphate are considered nonmineral lands. Phosphate beds that are 6 feet or more thick and contain 70 per cent or more of tricalcium phosphate are reserved to a depth of 5,000 feet. Thinner and low-grade phosphate beds are held to depths ranging from the maximum of 5,000 feet to a minimum of zero at the surface.

No legislation providing for the disposition of phosphate deposits in the public domain has been enacted during the year, and the mineral must still be acquired, if at all, under the lode or placer law. Legislation was enacted during the year, however, that provides for the State selection of otherwise unreserved public lands of the United States in the State of Idaho which have been withdrawn or classified as phosphate or oil lands, reserving to the United States the right to the phosphate and oil in such lands. It would be advantageous if the separation principle were extended to all forms of homestead entry. Such a law would relieve the agricultural interests in those areas where the withdrawn phosphate lands are valuable for agriculture.

## POTASH.

Field work undertaken by the Survey in the search for potash has heretofore been largely of an exploratory character, but during the last year important principles have been established which will be of material assistance in future work. During the year a number of shallow drill holes were sunk in some of the old lake basins in Nevada and California and a careful study was made of some of these lakes. Some of these experiments are yielding significant and perhaps important results. As promising areas that may prove of value as sources of potash are discovered, the public land included in such areas is withdrawn from entry until its value for potash can be demonstrated or disproved. As a result of the Survey's reconnaissance examinations in California and Nevada, 133,829 acres have been included in potash withdrawals.

*Withdrawals of potash lands, fiscal year 1912-13.*

[In acres.]

State.	With- drawals.	Outstand- ing June 30, 1913.
California.....	94,407	94,407
Nevada.....	39,422	39,422
	133,829	133,829

## METALLIFEROUS LANDS.

## WITHDRAWALS.

During the year a withdrawal of an unusual type, designated mineral-land withdrawal No. 1, Arizona No. 1, was made. The withdrawal covers an area in the Warren mining district (Bisbee, Ariz.), in which investigations by the Survey revealed geologic conditions favorable to the occurrence of deep-seated deposits of copper on which no surface discovery, as required by the lode law, can be made. As a result, discovery and hence valid location will depend on expensive deep drilling or deep shafting and will require time. There was danger that before prospecting of these types could be completed attempts would be made to obtain title to the lands by means of State selections or other nonmineral entries. Accordingly the President directed that an area including approximately 9,787 acres be withdrawn. 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. Later 1,280 acres of this reserve were restored to entry.

## CLASSIFICATION.

Under the act of February 26, 1895 (28 Stat., 683), provision was made for classifying, with regard 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 proved unsatisfactory for many areas, 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 Survey. The field examination of these lands was first undertaken by the Survey during the field season of 1910, when 176,031 acres were classified as mineral and 112,434 acres as non-mineral. The work was continued during the field season of 1911, when 20,270 acres were classified as mineral and 137,036 acres as non-mineral, and during the year 1912, when the work was completed, except as to a few small tracts in Montana.

The results of the Northern Pacific classification work for the three years, 1910, 1911, and 1912, are shown in the following table:

*Lands in Northern Pacific Railroad grant in Montana and Idaho classified by United States Geological Survey.*

[In acres.]

	Classified prior to July 1, 1912.	Classified during fiscal year 1912-13.	Classified June 30, 1912.
Mineral.....	196,309	20,800	217,109
Nonmineral.....	249,550	66,770	316,320
	445,859	87,570	533,429

Lands in the Keams Canyon or White Mesa copper district, in the Navajo Indian Reservation, Ariz., were examined by the Survey at the request of the Secretary of the Interior, and a report regarding the mineral character of these lands was furnished to the Commissioner of Indian Affairs. A report of a similar character was furnished to the Commissioner of the General Land Office regarding the Humboldt group of mining claims in the San Poil mining district, Wash. Reports on the mineral classification of the Deer Horn group of mining claims in the Nespelem Valley, Wash., and on three townships in the Myers Creek mining district, in the north half of the former Colville Indian Reservation, Wash., were sent to the Secretary of the Interior.

Lands within the Colville and Yakima Indian reservations, Wash., and the Blackfeet and Flathead Indian Reservations, Mont., were examined for the Indian Office by the Survey in order to separate the

mineral from the nonmineral lands as a basis for sales and allotments. The work in the Blackfeet and Flathead reservations was undertaken by the Survey during the field season of 1911 and continued during the field season of 1912. The examinations in the Blackfeet and Yakima Reservations were completed, but in the other two reservations the work was only partly completed and will be continued during the season of 1913. The work in these reservations during the two years 1911 and 1912 resulted in classifications as follows, these classifications being made during the fiscal year, 1912-13:

*Lands in present and former Indian reservations in Washington and Montana classified by United States Geological Survey.*

	Acres.
Mineral -----	1, 590
Nonmineral -----	1, 616, 723
	<hr/> 1, 618, 313

#### DIVISION OF HYDROGRAPHIC CLASSIFICATION.

The division of hydrographic classification considers reports of field examination and other data involving water supply and water utilization on the public lands and prepares classifications and correspondence based thereon. The scope and amount of the work of this division are briefly summarized in the following pages.

#### 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, 1912, the area included in outstanding withdrawals was 1,813,753 acres. During the year, as a result of additional information procured largely through field investigations by the topographic and water-resources branches, 152,727 acres additional were withdrawn and 68,075 acres previously included in power-site reserves were determined to be without sufficient value to warrant the continuance of the withdrawal and were restored to the public domain. On June 30, 1913, the total area withdrawn in connection with water powers was 1,898,405 acres.

The following table shows the action taken during the last year and the areas outstanding, classified by States:

*Power-site reserves.*

[In acres.]

	Outstand- ing July 1, 1912.	New with- drawals during fiscal year.	Restora- tions dur- ing fiscal year.	Outstand- ing June 30, 1913.
Arkansas.....		17, 704		17, 704
Arizona.....	192, 961		5, 730	187, 231
California.....	165, 008	61, 733	4, 350	222, 391
Colorado.....	244, 653	10, 007	40	254, 620
Idaho.....	295, 457	33, 563	37, 099	291, 921
Minnesota.....	11, 254		532	10, 722
Montana.....	151, 106	1, 259	2, 465	149, 900
Nevada.....	15, 295	372		15, 667
New Mexico.....	14, 536		959	13, 577
Oregon.....	184, 243	15, 567	4, 145	195, 665
Utah.....	375, 030	1, 485		376, 515
Washington.....	103, 141	3, 826	7, 469	99, 498
Wyoming.....	61, 069	7, 211	5, 286	62, 994
	1, 813, 753	152, 727	68, 075	1, 898, 405

## APPLICATIONS FOR RECLASSIFICATION.

Nineteen applications for the reclassification of lands included in power-site reserves have been received during the year from persons desiring to obtain title to the lands withdrawn. On nine applications favorable action has been taken, investigation having disclosed the fact that the lands desired are not primarily valuable for use in connection with water-power development. Eight applications were denied because of the water-power value of the lands. At the close of the year 18 applications were awaiting action.

## WATER-POWER PERMITS.

Departmental regulations of August 24, 1912, and March 1, 1913, under the act of Congress approved February 15, 1901 (31 Stat., 790), charge the Survey with important administrative duties in connection with applications for permits to use 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. The Survey is required to consider such matters as relative priority of applications, incompatibility of works, relative beneficial utilization of resources, as well as 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, the Survey prepares a draft of permit setting forth terms on which the use of the desired right of way is to be conditioned and makes report on the circumstances in the case.

The first cases of this nature were several pending applications forwarded from the Secretary's office on August 26, 1912. During the fiscal year 37 applications for permits have been received by the Sur-

vey. Permits have been prepared for 7 of these, with aggregate total capacity of 51,100 horsepower, and for 2 involving only transmission lines. At the close of the fiscal year 18 applications for permits were pending, 10 having been returned to the General Land Office without action or with unfavorable recommendation.

#### TRANSMISSION-LINE GRANTS.

On January 6, 1913, departmental regulations under the act of March 4, 1911 (36 Stat., 1253-1254), were approved. These regulations require applications under this act to be made and considered in the same manner as applications for permits under the act of February 15, 1901 (31 Stat., 790). Accordingly, duties such as are outlined above with reference to the earlier act now devolve upon the Survey in connection with term grants of easements for transmission lines. During the fiscal year five applications of this type have been received by the Survey. On two of these favorable action was taken; the remaining three were pending on June 30, 1913.

#### RIGHT OF WAY APPLICATIONS.

In addition to applications for permits for hydroelectric developments a large number of applications for rights of way of various 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, report being made on interference with power development, the feasibility of the project, and other features of the application; applications for rights of way across national forests for the development of power 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.*

	Railroad.	Irriga- tion.	Water power.	Miscella- neous.	Total.
Pending July 1, 1912.....	44	70	7	7	128
Received July 1, 1912, to June 30, 1913.....	114	383	9	33	539
Acted on July 1, 1912, to July 30, 1913.....	139	435	16	40	630
Pending June 30, 1913.....	19	18	.....	.....	37

## IRRIGATION.

## RESERVOIR WITHDRAWALS.

In addition to withdrawals of lands which appear to be primarily valuable in connection with water-power development, a number of reservoir sites, principally valuable for irrigation storage, have been investigated by the Geological Survey and the lands included therein withdrawn from entry under one or the other of the withdrawal acts.

The area included in such withdrawals at the close of this fiscal year is shown in the following table:

*Reservoir-site reserves.*

[In acres.]

State.	Outstand- ing July 1, 1912.	New with- drawals during fis- cal year.	Restora- tions during fiscal year.	Outstand- ing June 30, 1913.
Arizona.....	23,040	.....	.....	23,040
Montana.....	15,640	.....	.....	15,640
North Dakota.....	1,569	.....	.....	1,569
Oregon.....	16,884	.....	6,265	10,619
South Dakota.....	8,542	.....	.....	8,542
Washington.....	31,553	4,530	.....	36,083
	97,228	4,530	6,265	95,493

## CAREY ACT SEGREGATIONS.

On July 1, 1912, one proposed segregation list under the Carey Act was awaiting report by the Survey as to available water supply, general feasibility of plan of reclamation, and mineral character of the lands. Eighteen lists were received for report during the year, and 14 cases were submitted for reconsideration in connection with additional information. Three of the new lists and nine of those reconsidered received favorable report. The remainder were reported adversely in whole or in part because of insufficient water supply or inadequacy of the plan of reclamation. Suggestions for modification of plans were made in several cases.

## IRRIGATION PROJECTS.

In addition to reporting on rights of way for canals, ditches, and reservoirs for irrigation, the Geological Survey, by the instructions of the Secretary of the Interior dated March 15, 1913, furnishes the Commissioner of the General Land Office with 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. Under these instructions 117 such projects have been considered in the Geological Survey, and all have been reported on except 15, which were pending at the close of the fiscal year.

## 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 acts now being applicable to 12 States. The area designated represents a substantial increase over that classified in the previous fiscal year. The increased acreage is a result in large part of surface and underground water investigations in Idaho, Montana, Utah, and New Mexico, together with the first designations in North Dakota. The following table summarizes the work of the fiscal year:

*Status of enlarged-homestead designations.*

[In acres.]

State.	Outstanding July 1, 1912.	Designations during fiscal year.	Cancellations during fiscal year.	Outstanding July 1, 1913.
Arizona.....	26,959,779	.....	.....	26,959,779
California.....	.....	1,793	.....	1,793
Colorado.....	20,365,536	17,181	.....	20,382,717
Idaho:				
Secs. 1-5 only.....	5,424,628	139,973	22,363	5,542,238
Sec. 6.....	7,801	7,053	200	14,654
Total.....	5,432,429	147,026	22,563	5,556,892
Montana.....	32,028,776	219,353	646	32,247,483
Nevada.....	49,512,960	.....	9,451	49,503,509
New Mexico.....	16,443,652	1,464,087	.....	17,907,739
North Dakota.....	.....	130,502	.....	130,502
Oregon.....	11,357,888	160,048	.....	11,517,936
Utah:				
Secs. 1-5 only.....	6,943,671	126,870	4,552	7,065,989
Sec. 6.....	1,201,600	17,951	18,865	1,200,686
Total.....	8,145,271	144,821	23,417	8,266,675
Washington.....	3,402,896	6,001	.....	3,408,897
Wyoming.....	17,587,973	32,800	.....	17,620,773
	191,237,160	2,323,612	56,077	193,504,695

The general provisions of the act, which apply in all 12 States, permit the entry by one person of 320 acres of "nonmineral, non-irrigable, unreserved, and unappropriated surveyed public lands which do not contain merchantable timber." As a prerequisite to the allowance of such an 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. The Geological Survey is primarily engaged in determining the nonirrigable character of the lands in making recommendations of designations, but under the Secretary's instructions, which have been in force during the fiscal year, all lands which are not enterable under the act are eliminated from the lists. The work has thus not only required careful field investigations to determine the physical characteristics of the land, but after report is received

it has been necessary to obtain from the General Land Office the status of the lands which are determined to be nonirrigable, in order to eliminate nonenterable lands. The office work of preparing the orders of designation in proper form thus became very large and made correspondingly heavy demands upon the time of the available force. As a result of this situation, the recommendations of large general areas for designation, because of the time necessary to prepare the lists, has been greatly curtailed and instead it has been found necessary to request applicants to furnish definite lists of the lands which they propose to enter if designated. These applications and lists are referred to as enlarged homestead petitions. The last year shows an enormous increase in the number of requests of this character received, and while the office force assigned to this work has not been materially increased the number of petitions which have been acted upon is largely in excess of previous years. This result has been accomplished largely by the adoption, as far as practicable, of mimeographed forms in correspondence, the systematizing of office records, and the making of classification maps by which the proper action to be taken upon a petition falling within the area classified can be readily determined.

About the close of the year departmental instructions were so modified as to permit lands to be designated in a body without complete determination of status. This will simplify procedure and facilitate designations for the next fiscal year. The following table indicates the disposition made of the petitions received during the year:

*Action on enlarged-homestead petitions, fiscal year 1912-31.*

State.	Out- standing July 1, 1913	Re- ceived during year.	Designated.		Refused.	Total acted on.	Pending June 30, 1913.
			All.	Part.			
Arizona.....		12	2	3	1	6	6
California.....		9	1	1	3	5	4
Colorado.....	12	117	37	2	21	60	69
Idaho.....	220	412	158	45	124	327	305
Kansas.....		1			1	1	
Montana.....	58	218	26	23	32	81	195
Nevada.....							
New Mexico.....	5	45	2	1	4	7	43
North Dakota.....		971	306	17	44	367	604
Oregon.....	25	79	42	13	7	62	42
Utah.....	8	38	4	1	6	11	35
Washington.....	16	8	1	6	2	9	15
Wyoming.....	5	34	4	4	2	10	29
	349	1,944	583	116	247	946	1,347

PUBLIC WATER RESERVES.

During the fiscal year the withdrawal under the act of June 25, 1910, of lands primarily valuable because of springs, streams, or other watering places situated thereon was continued, recommenda-

tions being made on the information procured by field men of the Geological Survey and General Land Office. The following table indicates the progress of this work:

*Public water reserves, fiscal year 1912-13.*

[In acres.]

State.	Outstand- ing July 1, 1912.	New with- drawals.	Outstand- ing June 30, 1913.
Arizona.....	.....	1,200	1,200
California.....	.....	94	94
Utah.....	23,143	3,160	26,303
Wyoming.....	62,979	.....	62,979
	86,122	4,454	90,576

**PUBLICATION BRANCH.**

**BOOK-PUBLICATION DIVISION.**

**SECTION OF TEXTS.**

The publications of the year consisted of 1 annual report, 1 monograph, 5 professional papers, 26 bulletins, 26 separate chapters from 5 bulletins, 25 water-supply papers, 1 annual report on mineral resources (published also in 56 advance chapters, 20 delivered in 1911-12 and 36 in 1912-13), 18 advance chapters from the annual report on mineral resources for 1912, 4 geologic folios, 2 lists of publications, a pamphlet entitled "Topographic instructions of the United States Geological Survey," a pamphlet entitled "Logarithms and factors for converting latitudes and departures in feet to seconds of latitude and longitude for latitudes 0° to 72°"; charts showing mineral and clay products and the production of coal in the United States to the close of 1911, 2 circulars concerning geologic folios, 15 index map circulars, 60 press bulletins, and 12 monthly lists of new publications. The numbers of these publications in the regular series follow: Thirty-third Annual Report; Monograph LI; Professional Papers 71, 74, 77 to 79, inclusive; Bulletins 471 (published also in 10 advance chapters, 4 delivered in 1911-12 and 6 in 1912-13), 498, 501 to 503, inclusive, 508, 510, 513 to 520 (published also in 13 advance chapters, 3 delivered in 1911-12 and 10 in 1912-13), inclusive, 521 to 524, inclusive, 527, 529, 530 (published also in 18 advance chapters, 13 delivered in 1911-12 and 5 in 1912-13), 4 advance chapters from 531, 532, 534, 535, 537, and 1 advance chapter from 540; Water-Supply Papers 259, 281, 283, 284, 289 to 294, inclusive, 296 to 301, inclusive, 304, 305, 310, 311, and 313 to 317, inclusive; Mineral Resources for 1911 (published also in 56 advance chapters, 20 delivered in 1911-12 and 36 in 1912-13), and 18 advance chapters from Mineral Resources

for 1912; Geologic Folios 184 to 187, inclusive; Lists of Publications, October 1, 1912, and May 1, 1913; Circulars 9-322 (concerning geologic folios) and 9-322, reprint (concerning sale of damaged folios); Index Map Circulars 9-323a to 9-323s, inclusive (except c, d, i, and q); Press Bulletins 63 to 122, inclusive; and Monthly Lists of New Publications 56 to 67, inclusive. Titles and summaries of the publications of the regular series are given on pages 14-27.

The total number of pages in these publications was 18,917. The publications of the year 1911-12 comprised 17,846 pages.

During the year 38,191 pages of manuscript were edited and prepared for printing, and proof sheets for 22,395 final printed pages were read and corrected, this work involving the handling of 4,877 galley proofs and 38,864 page proofs. The corresponding figures for 1911-12 were 48,210 pages of manuscript, 15,677 final printed pages, 5,648 galley proofs, and 30,513 page proofs. Indexes were prepared for 55 publications, covering 14,942 pages; the figures for the previous year were 49 publications and 10,571 pages.

At the close of the fiscal year 7 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 personnel of the section of illustrations at the close of the year consists of the chief of the section and 8 other draftsmen, 1 clerk, and 1 assistant map printer. The number of illustrations prepared during the year was 2,641, a total below the average in the last few years. Of these, 928 were transmitted to accompany 1 annual report, 16 bulletins (3 in 6, 7, and 13 parts, respectively), 14 water-supply papers, 4 professional papers, 13 separate papers for Mineral Resources 1911 and 1912, 1 departmental circular, and 1 topographic instructions. These illustrations included 229 maps, 464 photographs prepared for reproduction, 370 diagrams and sections, 7 landscape drawings, 1,383 paleontologic drawings and photographs, and 188 miscellaneous pieces. Proofs to the number of 1,394 were received and compared critically. The finished work representing all the illustrations furnished by contractors was examined. This consisted of 189 plates. Eighty-four engraved cuts were reused during the year, and electrotypes of 128 were furnished to outside applicants.

#### SECTION OF DISTRIBUTION.

The section of distribution received during the year 83 new books, 10 reprinted books, 4 folios, 12 geologic maps, 81 new topographic maps, 8 revised maps, 12 photolithographs, and 277 reprints of maps, a total of 487 publications. The total of all editions received was 253,850 books, 14,146 geologic folios, and 1,219,288 maps, a grand total of 1,487,284.

Reprints of the following publications were delivered to the Survey during the fiscal year 1913: Bulletins 491, 520-A, 530-K, 530-P, and 537; Water-Supply Papers 255 and 295, and 3 chapters from Mineral Resources for 1911.

There were distributed 375,213 books, 40,387 folios, and 684,373 maps (including 533,245 maps, 36,530 folios, and 136 books sold), a total of 1,099,973.

The total amount received and turned into the Treasury as the result of sales of publications was \$29,117.66, an increase of \$3,362.44 over the amount received in the fiscal year 1912. The proceeds of sales of topographic and geologic maps was \$25,373.91, of topographic and geologic folios, \$3,099.25, and of books, \$644.50. The sales of maps and folios showed an increase of 22 per cent over the amount received in 1912.

Fifteen persons were employed in this section during the year.

#### DIVISION OF MAP EDITING.

##### SECTION OF GEOLOGIC MAPS.

This section is especially charged with the direction of the publication of the maps and illustrations of the geologic folios. In addition it reviews and criticizes all geologic maps and illustrations used in other reports of the Survey.

Four folios (Nos. 184-187, inclusive), which are listed on page 27, were completed and published during the year. The maps for the Barnesboro-Patton (Pa.), Belleville-Breese (Ill.), Columbus (Ohio), Eastport (Maine), Philipsburg (Mont.), Raritan (N. J.), and Tallula-Springfield (Ill.) folios were completed and will be published with the descriptive texts during the coming year.

The Niagara (N. Y.) and San Francisco (Cal.) folios were well advanced in publication, and the Eureka Springs-Harrison (Ark.), and Van Horn (Tex.) folios were begun. The Castle Rock (Colo.), Colorado Springs (Colo.), Detroit (Mich.), Deming (N. Mex.), Galena-Elizabeth (Ill.), Minneapolis-St. Paul (Minn.), Silver City (N. Mex.), and Tolchester (Md.) folios were recently received in the section and at the close of the year were on file awaiting editing.

The list of folios in course of publication and in preparation for publication, arranged in order of progress, is as follows:

Barnesboro-Patton, Pa. (No. 189).  
Niagara, N. Y. (No. 190).  
Raritan, N. J. (No. 191).  
Eastport, Maine (No. 192).  
Philipsburg, Mont.  
San Francisco, Cal.  
Belleville-Breese, Ill.  
Columbus, Ohio.  
Van Horn, Tex.

Eureka Springs-Harrison, Ark.  
Minneapolis-St. Paul, Minn.  
Castle Rock, Colo.  
Colorado Springs, Colo.  
Silver City, N. Mex.  
Tolchester, Md.  
Deming, N. Mex.  
Galena-Elizabeth, Ill.  
Detroit, Mich.

A great number of geologic maps and other illustrations prepared by the section of illustrations for reports other than folios were referred during the year to the chief of this section for criticism and comment.

Three persons are employed in this section.

#### SECTION OF TOPOGRAPHIC MAPS.

At the beginning of the year 167 atlas sheets and maps of special areas were on hand for publication, of which 82 have been published. The accessions during the year were 112, of which 3 have been published. The total number of separate map publications for the year is 101, of which 81 are new engraved sheets, 8 revised sheets (of which 4 were reengraved), and 12 photolithographs of State maps. The following statement shows the comparative status of map editing and publication on June 30 for three years past.

*Progress of map publication for three years ending June 30, 1913.*

	1913	1912	1911
Published during the year.....	101	114	86
In process of engraving.....	89	65	56
Unedited.....	105	102	95

The manuscripts edited during the year comprise 107 topographic atlas sheets and other maps prepared for engraving; 6 State maps on scale of 1:500,000; the 9-sheet contour map of the United States; 37 sheets of plans and profiles of rivers; corrections for 355 engraved maps about to be reprinted; and 152 maps for illustration of 30 Geological Survey reports. The proof read comprises 90 new topographic maps, corrections to 161 old maps, and 6 maps reproduced under contract. The maps for the 21 index circulars of the series 9-323 were revised during the year and all but 6 of the circulars, now in press, were reprinted.

Six men were continuously employed in this work.

#### DIVISION OF ENGRAVING AND PRINTING.

##### MAPS, FOLIOS, AND ILLUSTRATIONS.

During the fiscal year 81 new topographic maps were engraved and published, and 12 State maps on the scale of 1 to 500,000 were photolithographed and printed. Corrections were engraved on the plates of 364 sheets. In all, 377 editions of topographic maps were printed, with a total issue of 1,226,237 copies, an increase of 103 editions and 297,665 copies over the previous year.

Several Alaska maps were extensively corrected and readjusted on the plates, amounting in some instances to practical reengraving of

whole plates. The map of Kauai, Hawaii, was completed. The engraving of this map was equivalent to the engraving of about six atlas sheets of average cost. The United States nine-sheet map is in hand for correction. This work requires almost complete reengraving of the contour and drainage plates, in addition to extensive corrections of the culture base, and is about half finished.

Four geologic folios were published during the year, which is two less than the number published in the preceding year. Of the number published this year one (No. 185) is a double folio. Octavo editions of two of this number and of three folios reported last year were published during the present year. Editions and partial editions of folios and octavos amounting to 18,546 copies were printed and delivered. This is a decrease of 11,581 copies for the year.

For the Government Printing Office the following items were printed and delivered: Illustrations for the annual report of the Chief of Engineers, United States Army; annual report of the Chief Signal Officer, United States Army; annual report of the Commissioner of Indian Affairs; annual report of the Department of the Interior; annual report of the Governor of Alaska; annual report of the governor of Hawaii; annual report of the War Department, Volume 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 I; Interstate Commerce Commission reports, volume 24; Opinion 1967—Interstate Commerce Commission; Hearings, Isthmian Canal (map of the Canal Zone), Part VI; report on Panama Canal, traffic and tolls; American Ephemeris and Nautical Almanac, 1913; American Ephemeris and Nautical Almanac, 1915; 12 Senate and House documents; bulletins 45, 55, and 64, Bureau of Mines; Bulletin 91, Bureau of Entomology; Bulletins 244 and 260, Bureau of Plant Industry; illustrations for Geological Survey Bulletins 471-I, 501, 502, 503, 510, 520-A, 522, 525, 526, 527, 528, 531-B, 531-C, 534, 535, Professional Paper 74, Water-Supply Papers 294, 304, 313, 318, 319, Mineral Resources—The stone industry in 1911, Thirty-third Annual Report of the Director of the United States Geological Survey, Instructions to topographers. In addition the following separate illustrations were printed and delivered to the Government Printing Office: Diagrams of nine bird reservations and two Indian reservations; Ringlemann's scale for grading density of smoke; Photometric lamp sheet test, Form 174; Protractors, Forms 678 and 678-a; Map of the United States by counties; map of Yosemite Valley; map showing Indian reservations; map of Utah, showing homestead lands; oyster bottoms of the Mississippi east of Biloxi.

The following work was done for other Government departments and bureaus: For the Forest Service, maps of 59 national forests, 33

proclamation diagrams of national forests, map of southern Appalachian region, map of North America (1:10,000), map of national forests—district No. 1, map of United States showing production of lumber by States and kinds in 1910, map of North America—base for atlas of pines, forest trees of North America—36 maps, forest map of Oregon and Washington, map showing hydroelectric development on the watershed of Feather River, map showing hydroelectric development on the watershed of Truckee River, diagram of lookout station protractor, statistical diagram, and illustrations for surveyor's instruction book; for the General Land Office, 1,492 township plats, 775 mineral and homestead plats, 10 State maps showing enlarged homesteads, and other miscellaneous work; for the Post Office Department, 20 diagrams showing floor plans and interior fixtures of mail cars, parcel-post maps of the United States and Hawaiian Islands; for the Office of Indian Affairs, maps of three Indian reservations and other miscellaneous work. Work was also done for the Department of the Interior, Army War College, Isthmian Canal Commission, Department of Commerce and Labor, Bureau of Mines, District of Columbia, Interstate Commerce Commission, Reclamation Service, Department of Justice, Bureau of Education, Smithsonian Institution, Army Service Schools, Howard University, Bureau of Lighthouses, War Department, Alaska Railroad Commission, United States and Canada Boundary Survey, Weather Bureau, Bureau of Standards, and Bureau of Soils.

This work for various branches of the Government amounted to about \$75,000, for which the division was reimbursed by transfer of credit on the books of the United States Treasury. Work was also done for the State militia of New York, Massachusetts, Maine, and Vermont; the State geological surveys of Ohio, Illinois, Wisconsin, and Nebraska; Corps of Engineers, United States Army; Hawaiian Volcano Observatory; Yale National Geographic Peruvian Expedition; C. S. Hammond Co., Eckert Lithographic Co., A. B. Graham Co., Matthews-Northrup Works, H. W. Hilleary Co., and American Book Co.; and the money received in payment for the work, amounting to about \$675, was turned into the Treasury of the United States to be credited to miscellaneous receipts.

Of contract and miscellaneous printing of all kinds, the total number of copies delivered was 2,686,970, which required approximately 4,300,000 printings. The total number of copies printed, including topographic maps and geologic folios, was 3,931,753, requiring approximately 10,000,000 impressions. On requisition of the Government Printing Office 495 transfer impressions were made and shipped to contracting printers.

## INSTRUMENT SHOP.

The work of the instrument shop consisted of repairing surveying, drafting, engraving, stream-gaging, and other instruments and making copper plates and electrotypes. More than 2,000 repairs and overhauls were made, 130,887 square inches of new copper plates were made and 834 square inches were resurfaced, and 12,637 square inches of electrotypes were made.

## PHOTOGRAPHIC LABORATORY.

The output of the photographic laboratory included 13,424 negatives, of which 9,198 were dry, 3,298 were wet, and 928 were paper, and 29,993 prints, of which 9,966 were maps and diagrams and 20,027 were photographs for illustrations.

## ADMINISTRATIVE BRANCH.

## EXECUTIVE DIVISION.

The work in the executive division was of the same scope as in other years, except that the work of the purchasing clerk, the record of property in Washington, and the work of obtaining stationery, printing and binding, and miscellaneous supplies were transferred to the new division of accounts.

*Mails, files, and records.*—During the year 149,145 pieces of mail were opened and referred, an increase of a little more than 5 per cent over that for the fiscal year 1912. Of this number 2,545 were registered. In addition 87,424 letters were received direct by the other divisions—a total of 236,569 for the Survey.

Of the letters opened in this division 28,162 contained remittances for Survey publications, a slight decrease as compared with the number of similar letters received during the last fiscal year, but the amount of money received, \$30,060.20, shows an increase of \$4,227.18 over that for the fiscal year 1912.

The recording, referring, and filing of correspondence required practically the entire services of five clerks. The number of letters mailed through the division was 99,993, an increase of a little more than 20 per cent over the preceding year. This number does not include the outgoing registered mail, which numbered 17,151 pieces, or 187,526 pieces of letter mail sent direct from the other divisions—a total of 304,670 for the Survey.

*Personnel.*—The roll of those holding Secretary's appointments numbered at the close of the fiscal year 893, compared with 880 at the close of the fiscal year 1912. The total number of changes in the personnel for the year was 835, which included original appointments, separations, promotions, extensions, and changes of status of every

description. Of these, 229 were new appointments, 216 were separations, 304 were promotions, and 4 were reductions.

During the year 13,252 days of annual leave and 2,112 days of sick leave were granted, being about 63 per cent of the amount of annual leave and 11 per cent of the amount of sick leave which it is permissible to grant under the law; also there were granted 3,081 days of leave without pay.

*Express and freight.*—During the year 3,919 pieces of freight and express were handled, of which 963 were outgoing and 2,956 were incoming. There were 403 transportation accounts checked during the year.

*Stationery.*—During the year 6,167 requisitions were filled from stock in the stationery room.

## DIVISION OF ACCOUNTS.

A condensed statement covering the financial transactions of the fiscal year is given below, including disbursements up to September 20. 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, 1913.*

Title of appropriation.	Appropriation.	Repayments.	Available.	Disbursements.	Balance.
Salaries, office of Director .....	\$35,340.00	.....	\$35,340.00	\$34,712.55	\$627.45
Salaries, scientific assistants .....	29,900.00	.....	29,900.00	29,288.88	611.12
Skilled laborers, etc .....	20,000.00	.....	20,000.00	19,432.01	567.99
Gaging streams, etc .....	150,000.00	\$19,980.59	169,980.59	166,270.93	3,709.66
Chemical and physical researches .....	40,000.00	34.46	40,034.46	39,837.79	196.67
Preparation of illustrations .....	18,280.00	.....	18,280.00	16,681.11	1,598.89
Mineral resources of United States .....	75,000.00	5.68	75,005.68	73,807.91	1,197.77
Geologic maps of United States .....	110,000.00	76,393.22	186,393.22	162,238.35	24,154.87
Books for the library .....	2,000.00	.....	2,000.00	1,103.50	896.50
Topographic surveys .....	350,000.00	4,088.14	354,088.14	349,422.67	4,665.47
Geologic surveys .....	300,000.00	38,893.92	338,893.92	330,381.06	8,512.86
Mineral resources of Alaska .....	90,000.00	602.83	90,602.83	77,690.03	12,912.80
Surveying national forests .....	75,000.00	7.15	75,007.15	72,213.34	2,793.81
	1,295,520.00	140,005.99	1,435,525.99	1,373,080.13	62,445.86

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, 1913.

Appropriation.	Total.	Salaries and wages.	Transportation of persons.	Transportation of things.	Subsistence and support of persons.	Subsistence and care of animals, etc.	Communication service.	Printing, engraving, lithographing, etc.	Furnishing heat, light, power, etc.	Special and miscellaneous services.	Materials.	Stationery, drafting, etc., supplies.
Salaries, office of the Director...	\$34,712.55	\$34,712.55										
Salaries, scientific assistants...	29,288.88	29,288.88										
Skilled laborers, etc.	19,432.01	19,432.01										
Gaging streams, etc.	166,270.93	125,036.08	\$14,753.44	\$769.84	\$7,529.52	\$992.01	\$670.45	\$3,093.15	\$215.50	\$1,704.67	\$669.42	\$1,348.34
Chemical and physical researches.	39,837.79	29,082.03	2,413.05	1,005.26	1,049.18	148.15	65.44	81.84	330.33	920.46	246.62	740.36
Preparation of illustrations.	16,681.11	15,423.17		.70			12.75	951.36		1.50	74.78	132.09
Mineral resources of the United States.	73,807.91	66,482.36	1,846.21	98.70	1,437.30	4.45	444.77	459.04	49.75	410.84	.15	764.21
Geological maps of the United States.	162,238.35	124,770.87	52.93	37.06	37.30		53.50	1,914.31	2,628.97	1,768.40	9,838.40	16,263.20
Books for the library.	1,103.50			5.45								18.40
Topographic surveys.	349,422.67	244,899.32	24,745.78	4,799.48	37,707.18	11,131.05	374.34	6,271.72	165.00	1,856.23	874.80	1,902.52
Geologic surveys.	330,381.06	265,129.94	17,818.62	1,639.70	13,822.75	5,726.17	444.41	4,633.20	139.93	5,546.32	506.32	1,965.05
Mineral resources of Alaska.	77,690.03	56,539.52	8,624.16	1,299.98	2,707.78	535.95	109.61	1,006.48	212.50	337.70	99.66	704.96
Surveying national forests.	72,213.34	43,348.42	4,524.90	1,045.57	9,517.18	4,336.43	43.04	581.94		238.05	343.97	220.44
Total.....	1,373,080.13	1,054,145.15	74,779.09	10,701.74	73,808.19	22,874.21	2,218.31	18,993.04	3,741.98	12,784.17	12,654.12	24,059.57

Appropriation.	Fuel.	Mechanics', engineers', 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).	Rent of buildings.	Fees for licenses, permits, etc.
Salaries, office of the Director...												
Salaries, scientific assistants...												
Skilled laborers, etc.												
Gaging streams, etc.	\$68.63	\$299.34	\$20.95	\$305.56	\$85.89	\$299.54		\$14.85	\$4,953.00	\$105.00	\$3,331.00	\$4.75
Chemical and physical researches.	327.08	66.78	5.20		192.94	599.10		25.45	2,208.35		330.17	
Preparation of illustrations.		3.28							81.48			
Mineral resources of the United States.		1.90	14.58			.27		2.19	966.19		825.00	
Geologic maps of the United States.	427.62	424.49	278.00	.11		8.38		48.41	3,686.40			
Books for the library.									1,079.65			
Topographic surveys.	306.28	56.25	33.29	84.25	5,861.48	984.05	\$1.60	115.37	7,097.58			65.00
Geologic surveys.	116.14	59.08	48.71	13.60	2,212.27	4,056.20	19.80	141.34	6,304.86	74.10	16.00	12.00
Mineral resources of Alaska.	182.90	43.75	14.09	196.35	378.97	1,536.14	50.90	36.60	3,054.63	12.15	5.00	.25
Surveying national forests.	89.42	21.10	15.04	40.30	2,956.66	431.79		23.17	4,435.92			
Total.....	1,518.07	975.97	429.86	640.17	11,688.21	7,915.47	72.30	407.38	33,868.06	191.25	4,531.82	82.00

## LIBRARY.

The library receives its increase through purchase, exchange, and gifts, the exchanges being largely in excess of the purchases and gifts. Additions from all sources in 1913 numbered 15,040 and included books, pamphlets, periodicals, and maps. The accessions comprise practically all new literature on geology, paleontology, and mineralogy and such other publications as were considered necessary in the Survey's work. All purchases were made with the approval of the committee on the library.

Current accessions were catalogued as received, full titles being furnished to the Library of Congress for printing on cards. A sufficient number of the printed cards were supplied to the Survey for incorporation in the author and subject catalogues and the shelf list. During the year 4,253 books, 317 pamphlets, and 970 maps were catalogued. There were added to the catalogues 11,579 cards, and 1,005 titles were furnished to the Library of Congress for printing. In addition to the current cataloguing, the work was continued on the full cataloguing of various series in the older portion of the library, including reports and maps of geological surveys of Hungary, Slavonia-Croatia, Galicia, France, Switzerland, and Tasmania (in part), the monographs of the Palaeontological Society of London, public documents, mostly of the Western States, procured for the use of the land-classification board, and maps of the New England, Middle Atlantic, and some of the Southern States.

Printed cards for these various series, as well as for the new geologic books and for all of those catalogued in former years, are now available to librarians. As these cards, marked "Library, U. S. Geol. Survey," are filed in the many public, institutional, and university libraries of the country the information goes abroad that the books described are in the Geological Survey library. This fact accounts in part for the increased number of requests for loans made upon the library by librarians and specialists outside of this city, and also for the increased number of specialists who come here to use the library. While every reasonable effort is made to aid serious workers in availing themselves of the library privileges it is necessary to refuse many requests for outside loans. Many of the books requested are so rare that it is inadvisable to risk sending them away, or are too much used to be conveniently spared. On the other hand, this library has occasionally found it necessary to borrow from out-of-town libraries books which could not be found in Washington. The number of readers in the library during the year was 9,213, and 10,162 books and maps were loaned for use outside.

Up to the present year no scheme for the classification and notation of the maps to harmonize with that of the books had been worked

out, and only an imperfect and incomplete catalogue of the maps existed. The collection consisted of maps received either by exchange or gift and a few which had been purchased. They were rather roughly classified geographically and placed in the drawers. Henry Gannett and J. M. Nickles have thoroughly inspected, arranged, and classified the whole collection and eliminated material that was considered useless. Several thousand maps were transferred to the Library of Congress; others of no value were destroyed. The work of cataloguing the maps of States has progressed through Florida. The collection now contains about 25,000 maps aside from duplicates. The maps issued by the State geological surveys and those of most of the foreign geological surveys have also been completely catalogued.

The bibliography of North American geology for 1911, with 1,266 author entries, was completed and published as Bulletin 524. The bibliography for 1912 (Bulletin 545) is well under way.

The number of letters received was 4,279 and of letters sent 3,140. During the year 2,006 books were collated for binding. The exchange list for book publications of the Survey now includes libraries, institutions, and editorial offices to the number of 313 addresses in the United States and 564 addresses in foreign countries; for geologic folios, 398 addresses, domestic and foreign; and for topographic maps, 486 addresses.

The personnel of the library remained the same throughout the year, comprising the librarian, the assistant librarian, two cataloguers, and three clerks.

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