DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

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

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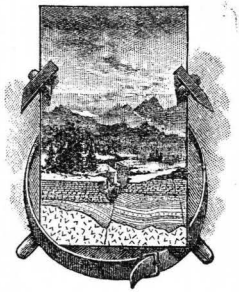

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THIRTY-THIRD ANNUAL REPORT OF THE DIRECTOR OF THE UNITED STATES GEOLOGICAL SURVEY.

GEORGE OTIS SMITH, *Director.*

The appropriations for the work of the United States Geological Survey for the fiscal year 1911–12 comprised items amounting to $1,507,920. 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.

NEED OF A SURVEY BUILDING.

GENERAL UNFITNESS OF BUILDINGS NOW OCCUPIED.

The record of the work of the Geological Survey during the fiscal year 1912 may fitly be preceded by a statement of the conditions under which that work has been done, not as an apology for either the quantity or quality of the results of the investigations made, but rather as an exhibit of the limitations forced upon this bureau—limitations on economy and efficiency which seriously hamper all efforts for better administration in the expenditure of public money.

The offices of the Geological Survey have become wholly inadequate and unadapted to its needs. Since 1884, when the Survey was first quartered in the Hooe Building, at 1330 F Street, the effort has been frequently made to provide for the growth of the organization by adding wings and extensions to the building, but every increase in floor space has been made at the expense of proper lighting of the older portions of the building, so that its fitness for the Survey's use has been steadily impaired, and the resultant conditions constitute an actual detriment to health and a menace to life and property, as well as an obstacle to efficiency. The conditions under which the Survey employees work in the Washington office are to be condemned for both humanitarian and business reasons.

EFFECTS OF CROWDED OFFICES.

Under the humanitarian clause of the indictment the present quarters of the Geological Survey can be described without exaggeration as in large part comparable in crowded and insanitary conditions to a sweatshop. Treatment of wage earners that would excite severe criticism if a corporation were the offender is tolerated in the case of these employees of the Federal Government. The crowded condition of the building occupied by the Geological Survey is so manifest to every observer that it needs to be described only for the information of those who have not had occasion to visit the offices.

In one division of the Survey statistical clerks have each on an average only 73 square feet of floor space. In another branch of the Survey the floor space allotted to each person is 67½ square feet, and in still another section, in which the workers are for the most part scientists, the average space per man is 102 square feet. The figures given do not measure the actual working space available, for not only must desks and chairs be provided, but also bookcases, large file cases, and in many rooms drafting tables.

LACK OF FRESH AIR AND LIGHT.

The congestion will become more apparent if the ventilation and lighting of these rooms are considered. If instead of floor space the cubic capacity of the rooms occupied is measured, it is found that the average volume of air per person is about 652 cubic feet, again without allowance for the considerable space occupied by furniture and therefore not available for air. Certain more or less definite standard minimum requirements for cubic contents have come into use for various classes of public buildings, these requirements being based on the customary allowances for fresh air. Thus public libraries are planned with not less than 2,400 cubic feet, hospitals with a minimum of 1,440 cubic feet, and barracks with not less than 720 cubic feet of space per occupant. The average cubic space available for each person occupying the Survey rooms is therefore below even the minimum allowed in barracks and only a fraction of that allowed in other buildings. Indeed, in five of the Survey rooms, each with two occupants, the allowance is less than one-half of the minimum required for barracks. When the ventilation of these particular rooms is taken into account the showing is even worse, for more than half the windows open into interior wells and the rest into alleys, and no system of artificial ventilation is provided, these conditions unfortunately being typical for a large proportion of the Survey rooms.

In the matter of lighting the conditions are no more favorable. In one of the divisions already cited the average window space per clerk

is two-fifths of a small window, and here again many of the windows open into interior wells, so that in most of the rooms artificial light is necessary on dark days and even for several hours on clear days in winter. The generally crowded condition has compelled the occupancy of several rooms in which artificial light must be used practically all the time. In one of the scientific sections the largest floor space assigned to one man—162 square feet—is in a room where the light is so poor that artificial illumination is needed most of the time, and the strain on the occupant's eyes is so great that rotation in assignment to this office is practiced in order that permanent injury to any one employee may be avoided if possible.

While permanent or temporary injury to the eyesight of some of the geologists and draftsmen can be definitely traced to the poor lighting of the rooms in which they have been forced to work, it is more difficult to trace the results of insufficient ventilation. That the unhygienic conditions prevailing in the building occupied by the Survey must necessarily lower the tone of the health of its employees is apparent. The customary standards for ventilation provide for a minimum of 1,000 to 3,000 cubic feet of fresh air per hour per occupant. It is doubtful whether, under the conditions prevailing in the Survey's offices during the winter, the supply of fresh air averages 600 cubic feet per hour per occupant, which is only 20 per cent of the quantity required by the higher standard now widely used to provide a proper factor of safety for the health and efficiency of employees. Without considering the effects of dust and noise, to which the employees of the Survey are subjected by reason of the location of its present quarters, it is certain that the overcrowding, resulting as it does in lack of proper lighting and ventilation, must seriously impair the health of these Government employees.

The results of this violation of practical hygiene would be more widespread and more apparent were it not for the fact that a considerable number of the members of the Survey are field men, whose work during the summer is performed in the open air where they have opportunity to recuperate each year. This open-air work may protect certain members of the force from lung disease and from defective vision, but it does not make the congested conditions seem any more tolerable to a geologist or topographer who has been assigned 1,000 square miles for five months of field service and is obliged to work the remaining seven months of the year with an allowance of 100 square feet of floor space.

ROOMS TOO HOT FOR OCCUPANCY.

The top floor in the main building of the Survey and the loft in the annex becomes so hot in the summer that at times it is impossible for the employees occupying these floors to perform their duties,

and indeed they frequently have to be assigned to work elsewhere. The larger part of the top floor, however, is for this reason occupied by field men, who usually are absent from Washington during the hot weather. In the loft of the annex, an old building in an alley, the summer temperature runs as high as 110° F., and neither the employees nor the solutions and emulsions used in the photographic laboratory there can be depended on for high-grade results under these conditions.

THE FIRE RISK.

A menace second only to the existing danger in health is the risk to public records. Estimates have been made at various times of the money value of the records necessarily stored in the Survey building. The latest inventory shows a present value of $4,840,000, and this value represents largely the amount that would necessarily be expended in duplicating the unpublished material and in replacing the large stock of map plates which could be reengraved from published maps. Moreover, there is a sense in which the loss in official records can not be estimated in dollars. The detailed stream-gaging records for 20 years could not be replaced except by another 20 years of observations, and similarly, unpublished geologic data contained in notebooks and plats and represented by the working collections of specimens could hardly be replaced, except in an equal length of time. The land-classification work of the Survey is now proving how invaluable are these unpublished data, accumulated during the last 33 years, and a destructive fire in the wing of the building occupied by the land-classification board would destroy records whose loss would long delay the issuing of land patents throughout the public-land States.

The Survey library is a collection of geologic literature that in degree of completeness can not be duplicated elsewhere in this country, if indeed in the world. This library therefore has a value which can not be easily estimated, since, if destroyed, it could not be wholly replaced, and such portion as is replaceable could be duplicated only at great expense of time and public money.

It is believed that every safeguard against fire that is possible through an efficient watch service and the careful distribution of fire extinguishers has now been provided, but the fact remains that although the building is constructed of iron and brick it is honeycombed with light wooden partitions, which present some 2 acres of surface that could be easily ignited. Even if these wooden partitions should be replaced with fireproof ones the building would still be classed with the third-rate risks because of the lack of protection of the bottom flanges of the I beams that support the floor arches. A fire once started in this large amount of inflammable material would

result in quick buckling of the unprotected iron beams, and the consequent collapse of the floors would make the fire hard to fight.

The exterior fire risks should also be considered, inasmuch as all the buildings in the block, except two, present even greater fire risks than the building occupied by the Survey. During the last nine years there have been four fires in the Survey building, and it is notable that the latest fire, which occurred on a Sunday, originated on the first floor of the building, in a store over which the Government has no jurisdiction, although the fire was discovered by a Survey watchman, and the spread of the fire in the Survey library was checked only by the efforts of the watchmen and the members of the Survey who happened to be in the building at the time.

RESULTS OF OFFICIAL INSPECTION.

On April 14, 1911, an inspection of the Survey buildings was made at the request of the Director by the District fire marshal and inspector of fire escapes, whose detailed report presents suggestions for the better protection of the occupants in case of fire or other emergency. On April 25, 1911, a further inspection was made by a special subcommittee of the House Committee on Public Buildings and Grounds, accompanied by the chief engineer of the fire department. Both inspections convinced those who made them that the buildings were unadapted for Government use and resulted in certain recommendations, which have been put into effect, except one by the fire marshal that the use of the annex loft be discontinued because it is "utterly unfit" for the purpose for which it is used.

IMPAIRMENT OF EFFICIENCY.

The third great objection to the longer continuance of the Survey in these rented quarters is a practical one. Maximum efficiency is impossible with such congestion and the attendant inadequate ventilation and lighting and with the impossibility of systematically arranging the offices and working collections; and the dirt and noise consequent upon the Survey's location at the very business center of Washington present further obstacles to economical administration. The whole situation not only results in less efficient use and hence in actual waste of Government money, but also on that account creates a feeling of dissatisfaction and discouragement among the highest class of scientists and other members of the Survey, who wish to make the largest and best contribution possible to the public service.

The present overcrowding has already been considered with respect to hygiene, but the consequent loss in efficiency is greater than that measured simply by impairment in health. Tests have shown that

light suitable for clerical or technical-clerical work fails at approximately a distance of 15 feet from the window line, yet 12½ per cent of the floor space occupied in the main building is more than 15 feet from the windows, and this computation is based on the assumption that the windows in the light wells are as effective for lighting as are those on the exterior walls. If, however, a lighting factor of 50 per cent is assumed for the well windows on the lower floors, an estimate which appears to be liberal, the space unsuited for clerical work in the building is found to be 33.8 per cent. It is evident that both the quantity and quality of work performed in the poorly lighted portions of these rooms must fall far below the standard that could be attained with better lighting.

In a similar way with the deficiency in ventilation: even where the presence of various noxious gases does not actually result in pronounced ill effects on the health, the lack of pure air results in relative inefficiency in the mental processes of employees subjected to the conditions described.

INCONVENIENCE DUE TO LACK OF PROPER SPACE.

The crowding of the Survey building precludes a systematic arrangement of offices and of working material, including specimens, notes, and maps, that should be close at hand for repeated reference. Specimens, for instance, are stored not only in the offices of the geologists but also in the halls, and where the limit of floor safety has been reached for such storage, collections are packed up and placed in the cellar, where they can not with any propriety be called accessible.

Sections and divisions in the Survey which should be close together are now far apart, and even the members of the same part of the organization are scattered in different parts of the building. The growth of the topographic branch has necessitated the renting of additional quarters in another building, into which a portion of the technical force has overflowed. Another instance of undesirable separation of related sections is seen in the fact that the offices of the editor of texts and the chief of the section of illustrations, who should be in frequent consultation, are necessarily located in widely separated parts of the building. Similarly, most of the paleontologists, whose work is closely connected with that of the other geologists and who should be, therefore, in close touch with them, have been crowded out of the Survey building and have been quartered in the National Museum, through the courtesy of the Secretary of the Smithsonian Institution. This separation of men engaged in researches which ought to be closely correlated is seriously retarding the scientific work.

DIRT AND NOISE FROM WITHOUT.

The location of the building occupied by the Survey on the busiest street in town brings its attendant evils of dirt and noise. Not only do the neighboring chimneys pour out soot and fine cinders that keep the books, files, and records covered with dirt, but on three sides the building is bordered by a street and alleys, which are a constant source of additional dirt and also a source of noise. These alleys, which afford access to a theater, two newspaper offices, a hotel, an office building, and several saloons, necessarily have an almost constant traffic of heavy wagons, and the noise of these passing up and down the cobblestones is deafening; the only variations are the rehearsals of a summer opera company and the chorus of yells by newsboys who congregate at the rear of the Survey building awaiting the various editions of an afternoon paper.

The street noises in the summer, when the windows must be opened, are so great and annoying that it is at times impossible to use the rooms on F Street for dictation to stenographers, and to use the telephones in those rooms it is often necessary to close the windows temporarily. The almost constant passage of heavy cars along F Street, in front of the building, sets up vibrations so great that at times scientists wishing to use delicate instruments have been obliged to do such work at intervals after midnight, and even then the effect of vibration was not wholly avoided.

DISTRACTING NOISES IN THE BUILDING.

In addition to the prevalent noises of exterior origin, which constitute a great drawback to intellectual work, there are interior noises, inevitable upon the crowded condition of the building—noises that are amplified or intensified by numerous wooden partitions, which constitute excellent sounding boards.

The common arrangement of placing a stenographer in a room occupied by a high-salaried man engaged in scientific investigations is not to be commended for its efficiency, yet the present congestion is so great that relatively few of the geologists are ever free from the distracting noise of the typewriter. In the computing section of another of the scientific branches six or seven hydraulic engineers are crowded into a single room, together with an adding machine or two. Inasmuch as hydraulic computations require constant attention and freedom from diverting noises, it is plain that larger quarters and some degree of isolation would facilitate the work. A careful estimate places the possible increase in efficiency at 30 per cent, which would represent an annual gain of several thousand dollars in this one section alone.

INCREASE OF EFFICIENCY POSSIBLE UNDER BETTER CONDITIONS.

Several other estimates have been made by the administrative officers of the Survey of the increased degree of efficiency that could be attained by changing the quarters for the various classes of employees from indifferent or worse to suitable accommodations. The estimated increase ranges from 15 to 30 and even to 50 per cent. A significant statement, based on recent experience, is made by one of the geologists. While quarantined at home he continued his Survey work in a large, well-lighted, clean, and quiet study and found, as a result of this practical test of doing the same kind of work under these different conditions, that he could accomplish 50 per cent more than in his Survey office, which happens to be one of the best in the building. This increase was in part attributable to freedom from interruption, but it is believed to be largely due to better light and air, lack of crowding, and freedom from noise.

PRESENT QUARTERS OF SURVEY UNWORTHY.

Another argument for a special building is hardly less practical in its ultimate bearing. The present housing of this Federal bureau is unworthy of the Nation. Both the work and the workers of the United States Geological Survey have an international reputation, and visiting foreign scientists do not conceal their astonishment at the miserable environment in which these investigations are being carried on. Our neighbors on this continent, in Canada and Mexico, have erected buildings especially adapted to the work of their geological surveys, which are properly housed, as is nearly every other geological survey in the world, and yet the geological survey of no other nation compares in size of organization or scope of work with that of the United States. In fact, the surveys of several of the larger European countries are organizations whose personnel is comparable in number only with that of single divisions of the American Survey.

The practical side of this feature is the increased inducement that suitable quarters would afford in retaining in the Government service men of the highest professional talent. At best, most of these investigators are carrying on their Government work at a financial sacrifice, and the temptation to go into professional or corporation work at largely increased salaries is strengthened by the contrast between the well-lighted and sanitary offices generally provided in the business world and the noisy, dirty, dark, and crowded quarters offered by the Survey. To retain in the Government service the best men is by far the largest administrative problem of the Director of the United States Geological Survey.

STATUS OF LEGISLATION FOR NEW BUILDING.

The present status of the legislation providing for the erection of a building for the Geological Survey may be briefly stated. After efforts extending over 27 years an item authorizing the construction of a building was included in the sundry civil appropriation bill as reported to the House of Representatives at the second session of the Sixtieth Congress, but it went out on a point of order. In the same year (1909) the House Committee on Public Buildings and Grounds unanimously reported a bill making the same provision, but this also failed of consideration. Similar favorable recommendation from this committee had been reported as early as 1889. The public buildings act approved June 25, 1910, however, directed (in sec. 32) the preparation of designs and estimates for a building for the accommodation of the Geological Survey and other bureaus of the Interior Department and made available for this purpose a balance of $96,506.20 remaining from an appropriation originally made for the purchase of the square bounded by E, F, Eighteenth, and Nineteenth Streets NW., on which, by the terms of the act, the proposed building is to be erected. On May 20, 1911, the Secretary of the Treasury transmitted to the Speaker of the House of Representatives sketches prepared for such a building, with five preliminary estimates of cost, ranging from $1,950,000 for a three-story brick building to $4,900,000 for a seven-story stone building. The larger amount is approximately the same as the replacement value of the public property that would be safeguarded by the erection of such a building and that is now exposed to the considerable fire risk in the Survey's present quarters. The act authorizing these estimates specifies a "fireproof building of modern office-building type of architecture." These plans and estimates were referred to the House Committee on Public Buildings and Grounds of the Sixty-second Congress.

PROGRESS OF SCIENTIFIC WORK.

CONTRIBUTIONS OF ECONOMIC WORK TO "PURE SCIENCE."

Notwithstanding the growth of the Survey work along practical economic lines, scientific work has not been neglected. In fact, in the Geological Survey the scientific investigations are inseparable from the economic work, though the one or the other may predominate in purpose according to the needs of the particular research in hand. In any field economic work of the highest rank is impossible without full knowledge of the scientific laws and principles pertaining to the subject of the work; but as there is no application of geology which does not involve unsolved problems, some of them of the highest importance, the best knowledge available is nevertheless rela-

tive. It thus follows that the broad and searching observations which should accompany every piece of good economic work comprehend data that are eventually combined in the construction of new scientific hypotheses, some of which, as more observations accumulate, grow into established laws or principles that are in turn of the greatest practical consequence. Thus the detailed studies of the metalliferous deposits in one region or another bring to light evidence from which to determine the genesis of the ores and the modes or conditions of their occurrence, and the economic inquiry becomes more intelligent and successful when once this new principle regarding the mode of an ore occurrence is understood.

On account of the plain duty of this Federal service to minister to the immediate needs of the various mining districts, it is not generally possible to concentrate and direct the observations to a series of regions systematically chosen as suited soonest to furnish the requisite data bearing especially on some particular scientific problem, however important and advantageous its solution may be; but nevertheless the data are gradually accumulated for the interpretation of many of these problems without sacrifice of the Survey's obligations to the public. An interesting illustration of the deduction of a principle from data so accumulated is found in the paper by W. H. Emmons on the enrichment of sulphide ores, the manuscript of which has been completed during this year. Another illustration of scientific results based on a long period of field studies, pertaining mainly to economic areas, is found in the pre-Paleozoic history of central North America, as described in the monograph by Van Hise and Leith on the geology of the Lake Superior region, which appeared during the year.

Among other long-term studies more distinctly scientific in character may be mentioned particularly the investigations, made under Mr. Vaughan's direction, of the formations of the southern Coastal Plain and Gulf embayment, which, though having an economic object, are yielding important contributions to our knowledge of the stratigraphy, physiography, and geologic history of this province; the work under the direction of Mr. Cross in the San Juan region of southwestern Colorado, which, in connection with the thorough geologic studies made during the preparation of folios, is affording new scientific results of a high order concerning especially the volcanism and physiography of the region; and the studies begun last year by Messrs. Campbell and Alden in the Glacier National Park, which promise important results concerning the origin of the structure and physiography of this part of the Rocky Mountains and of the glacial topography, which, as it is still "in the making," offers exceptional opportunities for scientific study as well as observation by the traveler interested in the natural wonders of his own

country. Important regional studies of high scientific rank which should also be mentioned are those prosecuted by Mr. Keith and his associates, on the difficult stratigraphy and intricate geologic structure of the older Paleozoic regions of western New England and the Appalachian region, the results of which are partly published in folio texts, and those carried on by Prof. Emerson in southern New England. A report by Prof. Emerson on the geology of Massachusetts and Rhode Island has been submitted during the year.

PALEONTOLOGIC WORK.

The paleontologic work of the Survey continues to be of the highest rank. Many of its publications, written by the most distinguished representatives of the various branches of paleontology in the country and embodying experience and observations gathered during years of patient research, have contributed much to the scientific reputation of the organization. The descriptive paleontologic papers are often treated as "pure science;" yet instructive, striking, or tedious as may be these delineations of the groups of animal or plant life which lived on the globe in some particular epoch, there is not one of these papers describing the fauna or flora of a formation that does not prove sooner or later to possess practical value and to be essential to geology in its constantly increasing refinement of study and results. Without paleontology the geologic classification of formations, their correlation, and the determination of their mutual relations would be impossible. In fact, real and symmetrical progress in geology is impossible without corresponding interrelated development and refinement of its handmaid paleontology. The economic geology of any region of complicated structure is blind and inconsequent unless the time relations of the strata concerned are known. The monograph now being issued from the press on the Cambrian Brachiopoda, prepared by ex-Director Walcott and representing many years of painstaking study and distinguished attainment, embraces our best and most complete presentation of the criteria for the discrimination of the Cambrian formations in America and will for many years be a manual for the use of workers in Cambrian geology and paleontology. This monograph brings deserved credit to American science and to the Geological Survey, under whose auspices most of the work was accomplished. Other paleontologic publications specially deserving mention by reason of their scientific merit are J. P. Smith's philosophic treatment of the Middle Triassic faunas, and the monograph on the Mesozoic and Cenozoic Echinodermata of the United States by W. B. Clark and M. W. Twitchell, the manuscripts for both of which are now in hand. Works like that of Kindle on the Onondaga

fauna, lately printed, and those by Berry on the Upper Cretaceous and Eocene floras of South Carolina and Georgia and by Stephenson on the Cretaceous deposits of the eastern Gulf region, both now in manuscript, are indispensable to geology. In these papers the stratigraphic value and the practical application of the results of the paleontologic investigations are given much prominence. The two papers last named are based on materials gathered in the course of the study of the Coastal Plain already mentioned, the economic motive for which was the investigation of the underground water resources. They are therefore representative of a series of scientific reports resulting from studies whose immediate object is economic.

WORK ON GEOLOGIC FOLIOS.

The folios describing and mapping in detail the geology of quadrangles in different parts of the country are regarded as mainly scientific, though always giving attention to the economic resources of the region. The areal studies now in progress in the valley region of central Alabama, a part of which has been described by Mr. Butts in the Bessemer-Vandiver and Montevallo-Columbiana folios, now in hand, promise important additions to the geologic history of the southern Appalachian region. On the other hand, the Claysville (Pennsylvania) folio, which has been issued during the year, affords a striking example of the first-hand aid in oil and gas development to be derived from the careful delineation of geologic structure and its economic explanation. Not inferior in scientific value to the papers just cited, though primarily economic, are such reports as those by Messrs. Brooks and Prindle on the Mount McKinley region, Alaska, and by Messrs. Calkins and Emmons on the geology and ore deposits of the Philipsburg quadrangle, in Montana.

WORK IN LAND CLASSIFICATION.

An important and interesting effect upon the scientific work of the Survey has resulted from the work in land classification. The constantly increasing demand for both completeness and exactness of information regarding the mineral resources of the public lands under classification have developed methods and scope of view in this economic work that have exerted a marked influence on the folio work in other areas.

Thus, the training and methods developed in the course of the classification of the coal lands have brought about higher standards of refinement in stratigraphy, as well as in economic work, in other regions of the country. Another very notable illustration of scientific results springing from the study of economic problems is found in the administration of the Weeks Act. The intensive hydrometric

experimental studies carried on in order actually to show, in accordance with the terms of the law, the degree of protection afforded by forests to soil and water in certain areas proposed for purchase as national forests have resulted in empirical determinations and demonstrations of high scientific value as well as of tangible economic importance.

WORK ON OIL AND GAS.

The principles governing the origin and mode of occurrence of petroleum and natural gas are as yet but fragmentarily grasped. Every oil field examined in detail contributes its data for use in the eventual interpretation of the problems, and each pool is studied with keen alertness for the discovery of some key which may aid in the coordination of the data, which sometimes, according to the region and conditions, seem, on acount of our lack of knowledge, even to be in conflict. The observations made by the Survey geologists in the oil and gas fields of California and Kentucky promise to further the solution of some of the problems, and by pointing out the relations of oil and gas occurrence to the geologic structure of the regions examined they have rendered important scientific as well as economic aid in oil and gas development; but the basic principles controlling the widely varied modes of occurrence and accounting for the differences in kinds of the oils in widely separated regions are possibly still far from view.

THEORETIC WORK BY SURVEY GEOLOGISTS.

On account of the more conservative and dignified character of the official publications of the Survey and the care taken to confine their substance to matters of demonstrated fact, they do not offer to the geologists the forum for free discussion of scientific theories and problems that is afforded to those periodicals and serial publications of scientific societies which are especially devoted to matters of strictly professional interest and which are more widely distributed among scientists. For this reason many of the scientific results of the Survey's operations are first published in these journals. Examples of papers of high rank contributed in this way are numerous. Without implying relative merit among these, mention as typical may be made of the paper by Mr. Campbell, "Historical review of theories advanced by American geologists to account for the origin and accumulation of oil," published in Economic Geology, vol. 6, No. 4, and that by Mr. Ulrich, entitled "Revision of the Paleozoic systems," printed in the Bulletin of the Geological Society of America, vol. 22, No. 3. Besides contributing to the programs of other scientific societies in Washington, the members of the Survey maintain for the discussion of purely geologic topics three profes-

sional societies, including the Geological Society of Washington, before which Mr. Campbell's paper, just cited, was presented as a presidential address. Meetings of some one of these societies or of their sections average two a week for the winter and by far the greater number of the papers read are offered by members of the Survey.

EDUCATIONAL WORK OF THE SURVEY.

Closely connected with the scientific work of the Survey is its educational function, which has not on the whole received the attention that so importantly useful a work deserves. The Survey has, however, in cooperation with several State surveys, participated in the preparation of a number of educational bulletins that have, in accordance with the agreements, been submitted to the respective States for publication. As distinctly educational in their scope, though far from elementary, should be named the valuable paper by Mr. Willis entitled "Index to the stratigraphy of North America," published as a professional paper in explanation of the new geologic map of the continent, and the paper by Messrs. Tarr and Martin describing the earthquake phenomena in the region of Yakutat Bay, Alaska.

A notable contribution to the study of physiography was the Survey's Professional Paper 60, "The interpretation of topographic maps," by R. D. Salisbury and W. W. Atwood, consisting chiefly of reprints of parts of the Survey's maps and of brief suggestions as to the origin and history of the features shown on them. For many years the topographic maps made by the Survey have been regularly used in the courses of instruction in geography and physiography in most of the universities and colleges and to some extent in the secondary schools. It is very gratifying to note that the maps prepared in accordance with the present high standard, and more fully adapted to such use, are coming to the attention of teachers in the graded and country schools. Teachers of schools located in the quadrangles surveyed in recent years find the corresponding topographic sheets a most practical and invaluable aid to their efficiency and success in teaching elementary geography.

LAND-CLASSIFICATION POLICY.

Formal action was taken on May 1, 1912, giving the land-classification board the rank of an independent branch within the Geological Survey. This recognition of the increasing importance of this phase of the work of the bureau is in line with other developments in the present public-land policy, which has highest utilization as its purpose. The present epoch in public-land legislation and administration may be said to date from 1888, when Congress made special provision for an irrigation survey and authorized the with-

drawal or reservation, pending further legislation, of the reservoir sites and irrigable lands designated as a result of special investigation by the Geological Survey. This legislation was simply the forerunner of the reclamation act of 1902, which is most notable as providing a practical means of insuring that the irrigable lands thus classified shall be put to their highest use, through a Federal agency, the Reclamation Service. In a somewhat similar way the act of June 4, 1897, marked the beginning of a national-forest policy of administration on a scale that later necessitated the organization of another technical corps, the Forest Service. The legislation of 1897 is interesting in this connection as providing specifically for examination and survey of forest areas by the United States Geological Survey for purposes of land classification.

During the last decade, however, "classification of the public lands," the first of the statutory functions of the Geological Survey, has come to take a large share of its activities. The field data accumulated as the result of three decades of geologic and topographic surveys, of stream measurement, and of detailed investigation of every mineral resource now contribute to putting into practice this business policy. In practice land classification means simply the determination of highest use. To encourage development and at the same time to enforce wise utilization by preventing partial or wasteful use is to protect the public interest. With the different values of the land made known by adequate examination, the highest use can be determined and, in so far as the statutes are in accord with economic law, the highest use can be assumed.

The scientific classification of the Nation's lands is now an integral part of the public-land administration. The field work of the geologist and the engineer is made to contribute to a business policy in the management of the Nation's real estate along three distinct lines. Quantitative knowledge of the land and its resources is now made a preliminary, first, to disposition of lands under the various settlement and development laws; second, to reservation of lands from present acquisition pending the enactment of adequate legislation; and third, to valuation of lands where the statute provides for disposition at prices expressing known value. For each of these phases a statement of the past year's work will best serve the purpose of illustration.

The determination of the character and the highest use of land for the purpose of disposing of it under the appropriate law includes its classification as mineral or nonmineral and as irrigable or nonirrigable. Upon the questions of fact as to mineral character depends the passage of title from the Government under the agricultural or mineral laws and the applicability of certain railroad nonmineral land grants. The total area classified for these purposes in

the fiscal year ended June 30, 1912, was one and a half million acres. The questions involving water supply on the public lands bear directly upon the administration of the statutes encouraging irrigation and dry farming, namely, the Carey Act and the desert-land and enlarged-homestead laws, as well as various right-of-way statutes. Upon the determination by field engineers of the quantity of water actually available for reclaiming the arid lands must wait the development of the remnant of agricultural lands in the public domain. Hydrographic classification of lands to serve this practical end aggregated last year more than 2,000,000 acres.

The second phase of activity in land classification is one that provides for future rather than present disposition of the public domain. The withdrawal act of June 25, 1910, looks forward to better utilization in the future and opens up the question of amendment of present laws by specific provision for reservation from immediate disposal of oil and gas and phosphate lands and of power and reservoir sites. Under the authority of the statute the Geological Survey during the fiscal year 1912 recommended the executive withdrawal of more than one and one-third million acres of oil reserves and almost one and one-fifth million acres of phosphate reserves, based on geologic data; of more than one-third million acres of water-power sites and 60,000 acres of irrigation-reservoir sites, based on hydrographic and topographic surveys; and of 86,000 acres of public water reserves essential to the control of public grazing lands. The areas of the outstanding withdrawals are approximately four and three-fourths million acres of public lands chiefly valuable for oil and gas, three and one-third million acres of phosphate lands, more than one and four-fifths million acres of lands essential to water-power development, nearly one hundred thousand acres primarily valuable for irrigation storage, and 86,000 acres of lands including springs or other watering places, unrestricted access to which, by the public, is essential in connection with the free use of the public range. The areas thus described as withdrawn, however, include tracts of privately owned land, which are in reality unaffected by the orders of withdrawal, although located in the larger legal subdivisions enumerated in those orders.

The third and most direct application of science to national stewardship is the valuation of the public coal lands. The coal-land law of 1873 is essentially a sales rather than a settlement law and provides for a minimum selling price. Since 1907 coal lands have been sold at appraised prices fixed by the Geological Survey on the basis of geologic field examination and chemical and physical analyses, valuation data of the latter kind being obtained from the Bureau of Mines, which is charged by its organic law with the analyzing and testing of coals and lignites.

WORK OF THE YEAR.

GENERAL INCREASE.

Although the appropriations made directly for the Geological Survey showed an increase of only $30,480 over those of 1911, there was a notable increase in the amount of work done by the field service. The funds available through cooperation with other Federal bureaus and with the States amounted in 1912 to 27 per cent of the direct appropriations and showed an increase over cooperative funds of the preceding year of 42 per cent. This increase in the field work involved a large increase in the work of the Washington office, to which was added the greatly increased service rendered the Secretary's Office, the General Land Office, and the Office of Indian Affairs in connection with public-land administration.

PUBLICATIONS.

The work done by the Survey finds public expression chiefly through its printed reports and maps, which are published in editions adapted to meet the demand. During the fiscal year ended June 30, 1912, the number of reports printed (437,501) corresponded very closely to the number distributed (437,637). The reports are sent out only on application.

The publications of the year are listed below.

THIRTY-SECOND ANNUAL REPORT of the Director of the United States Geological Survey to the Secretary of the Interior, for the fiscal year ended June 30, 1911. 1911. 151 pages, 2 plates.

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

MONOGRAPH LII. The geology of the Lake Superior region, by C. R. Van Hise and C. K. Leith. 1911. 641 pages, 49 plates, 76 text figures. Price $2.50.

An exhaustive treatise, representing the first attempt to give a connected account of the geology of this region as a whole, with special reference to the iron and copper bearing formations for which it is famous. Attention is directed primarily to general features of correlation of the formations, to the geologic history of the region, and to the origin of the iron and copper ores. The volume contains accurate maps of all the producing districts, a general geologic map of the region, diagrams, and halftone reproductions of photographs of minerals.

PROFESSIONAL PAPER 69. The earthquakes at Yakutat Bay, Alaska, in September, 1899, by R. S. Tarr and Lawrence Martin, with a preface by G. K. Gilbert. 1912. 135 pages, 33 plates, 5 text figures.

A detailed discussion of the earthquakes occurring at Yakutat Bay in 1899 and the phenomena accompanying them. As this is the first seismic disturbance that has been proved to be the direct cause of a great advance and complete breaking up of glaciers, the report will be of interest and value to scientists investigating variations in the movement of glaciers. Evidence is also

presented that the earthquakes caused notable local movements, upward or downward, of the surface of the earth. The Yakutat shock of September 10, 1899, is classed among the "world-shaking" shocks—that is, those which affect seismographs all around the earth. The book is profusely illustrated with halftone plates and diagrams of the region after the earthquakes and with seismograms of the shocks taken in different parts of the world.

PROFESSIONAL PAPER 70. The Mount McKinley region, Alaska, by A. H. Brooks, with descriptions of the igneous rocks and of the Bonnifield and Kantishna districts, by L. M. Prindle. 1911. 234 pages, 18 plates, 30 text figures.

A detailed account of an exploratory journey from the Pacific seaboard through the Alaska Range along the northwest base of Mount McKinley to Tanana and Yukon rivers, with full descriptions of the stratigraphy, structure, and geologic history of the whole Mount McKinley province and a concise statement of the present knowledge of the mineral wealth of the region. Summarizes all available information concerning climate, vegetation, agricultural lands, and game. Illustrated by topographic and geologic maps, geologic sections, and halftone views.

PROFESSIONAL PAPER 73. The Tertiary gravels of the Sierra Nevada of California, by Waldemar Lindgren. 1911. 226 pages, 28 plates, 16 text figures.

This report traces a part of the history of the Sierra Nevada, the great range which, for 300 miles, divides the central valleys of California from the deserts of the Great Basin. It presents an account of the Tertiary formations of the range and deals especially with the origin and distribution of the gold-bearing gravels which made these mountains one of the treasure houses of the world. Contains detailed descriptions of the area by quadrangles. The illustrations include geologic maps and sections and halftone plates showin features of hydraulic mining.

PROFESSIONAL PAPER 75. Geology and ore deposits of the Breckenridge district, Colorado, by F. L. Ransome. 1911. 187 pages, 33 plates, 29 text figures.

This report gives the results of an investigation of one of the most important mining districts of Colorado, including descriptive and economic geology, topographic and geologic maps, and numerous halftone plates and text figures showing geologic features. The minerals of the district are listed and their characteristics noted. The important mines are described in detail, and general conclusions are drawn as to the economic future of the mining industry in this region.

BULLETIN 448. Geology and mineral resources of the Nizina district, Alaska, by F. H. Moffit and S. R. Capps. 1911. 111 pages, 12 plates, 11 text figures.

A detailed account of investigations in this part of the Chitina copper belt, including descriptive, historical, and economic geology, topographic and geologic maps, and halftone plates and text figures showing geologic features. The most important result of these investigations is the fact that the copper-ore bodies appear to occur chiefly along a system of cross fractures which are at approximately right angles to the greenstone-limestone contact. These fractures occur along well-defined faults, at least one of which has been traced for a long distance. This may apply to the entire Chitina district and is worthy of consideration by the prospector.

BULLETIN 450. Mineral resources of the Llano-Burnet region, Texas, with an account of the pre-Cambrian geology, by Sidney Paige. 1911. 103 pages, 5 plates, 22 text figures.

Deals chiefly with the geologic relations of the pre-Cambrian rocks in this region and with the associated iron ores. Contains three geologic maps.

BULLETIN 451. Reconnaissance of the ore deposits in northern Yuma County, Arizona, by Howland Bancroft. 1911. 130 pages, 8 plates, 21 text figures.

A description of the deposits and a brief geologic sketch of their formation, with views of the mining properties.

BULLETIN 454. Coal, oil, and gas of the Foxburg quadrangle, Pennsylvania, by E. W. Shaw and M. J. Munn. 1911. 85 pages, 10 plates, 15 text figures.

A discussion of the stratigraphy, structure, and mineral resources of the quadrangle, which is in the central part of Pennsylvania, about 75 miles north of Pittsburgh. Contains general and detailed descriptions of the coals, coal analyses, and descriptions by townships of the oil and gas pools. Illustrated by well and coal sections and geologic maps.

BULLETIN 455. Copper deposits of the Appalachian States, by W. H. Weed. 1911. 166 pages, 6 plates, 32 text figures.

A report on the occurrence of copper in the Appalachian region and in the Atlantic coast States, including a discussion of the types of copper deposits. All important mines are described in detail, by States. The report is illustrated by text figures showing the workings of many of the mines, by plates showing specimens of ores, and by diagrams indicating geologic structure.

BULLETIN 456. Oil and gas fields of the Carnegie quadrangle, Pennsylvania, by M. J. Munn. 1911. 99 pages, 5 plates, 2 text figures.

A report on the stratigraphy and structure of the region, with special reference to the origin of the oil and gas and the general position of the pools in each producing sand. The oil and gas fields are described in detail by townships. Sketch maps and sections of wells in the region illustrate the report.

BULLETIN 458. Results of spirit leveling in Arkansas, Louisiana, and Mississippi, 1896 to 1909, inclusive—R. B. Marshall, chief geographer. 1911. 79 pages, 1 plate.

BULLETIN 464. Results of spirit leveling in New Mexico, 1902 to 1909, inclusive—R. B. Marshall, chief geographer. 1911. 53 pages, 1 plate.

Reports on precise and primary leveling in the States indicated in the titles, showing the altitude above sea level of a great number of places. In Louisiana and Mississippi the work during part of the time was done in cooperation with the respective States. Each of these bulletins contains a halftone illustration, showing designs for bench marks used by the United States Geological Survey.

BULLETIN 466. Retracement of the boundary line between Idaho and Washington from the junction of Snake and Clearwater rivers northward to the international boundary—R. B. Marshall, chief geographer. 1911. 39 pages, 7 plates, 1 text figure.

A report on the resurvey of part of the Idaho-Washington boundary line, including an account of the original survey and descriptions of operations and mileposts. Contains a lithographed map of the boundary line.

BULLETIN 467. Geology and mineral resources of parts of the Alaska Peninsula, by W. W. Atwood. 1911. 137 pages, 14 plates, 18 text figures.

Results of an investigation of the Chignik, Herendeen Bay, and Unga coal fields, including some information, collected incidentally, in regard to the general geology and mineral resources of the entire peninsula. Accompanied by accurate detailed maps of the surveyed fields and halftone plates showing geographic and geologic features of the region.

BULLETIN 468. Results of spirit leveling in Texas, 1896 to 1910, inclusive—R. B. Marshall, chief geographer. 1911. 133 pages, 1 plate.

BULLETIN 469. Results of spirit leveling in North Dakota, 1897 to 1910, inclusive—R. B. Marshall, chief geographer. 1911. 23 pages, 1 plate.

Reports on precise and primary leveling in the States indicated in the titles, showing the altitude above sea level of a great number of places. Each of these bulletins contains a halftone illustration showing designs for bench marks used by the United States Geological Survey.

BULLETIN 470. Contributions to economic geology (short papers and preliminary reports), 1910, Part I, Metals and nonmetals except fuels—C. W. Hayes and Waldemar Lindgren, geologists in charge. 1911. 558 pages, 17 plates, 64 text figures.

Composed of 28 brief reports on investigations of mineral deposits, except fuels, made in the United States in 1910. These papers are only such as have a direct economic bearing, all topics of purely scientific interest being excluded. They have been grouped according to the subjects 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 report follows:

The auriferous gravels of the Trinity River basin, Cal., by J. S. Diller.

The economic geology of Carson camp, Hinsdale County, Colo., by E. S. Larsen.

Geology and mineralization of the upper St. Joe River basin, Idaho, by J. T. Pardee.

Gold-bearing ground moraine in northwestern Montana, by F. C. Schrader.

Geologic relation of ore deposits in the Elkhorn Mountains, Mont., by R. W. Stone.

Notes on the economic geology of the Ramsey, Talapoosa, and White Horse mining districts, in Lyon and Washoe counties, Nev., by J. M. Hill.

The ore deposits near Pinos Altos, N. Mex., by Sidney Paige.

Survey publications on gold and silver.

Metalliferous ore deposits near the Burro Mountains, Grant County, N. Mex., by Sidney Paige.

Preliminary report on the mineral deposits of Ducktown, Tenn., by W. H. Emmons and F. B. Laney.

Survey publications on copper.

Notes on lead and copper deposits in the Bear River Range, Idaho and Utah, by R. W. Richards.

Lead and zinc deposits in the Metaline mining district, northwestern Washington, by Howland Bancroft.

Survey publications on lead and zinc.

The arsenic deposits at Brinton, Va., by F. L. Hess.

Survey publications on antimony, chromium, monazite, nickel, platinum, quicksilver, tin, tungsten, uranium, vanadium, etc.

Iron ores in the Montevallo-Columbiana region, Alabama, by Charles Butts.

Survey publications on iron and manganese ores.
Survey publications on aluminum ores—bauxite, cryolite, etc.
Survey publications on asphalt.
Variegated marble southeast of Calera, Shelby County, Ala., by Charles Butts.
Supplementary notes on the commercial granites of Massachusetts, by T. N. Dale.
Survey publications on building stone and road metal.
Survey publications on cement and concrete materials.
Clay near Calhan, El Paso County, Colo., by G. B. Richardson.
Clay resources of the Murphysboro quadrangle, Illinois, by E. W. Shaw.
Notes on some clays from Texas, by Alexander Deussen.
Survey publications on clays, fuller's earth, etc.
Gypsum deposits in Eagle County, Colo., by E. F. Burchard.
Survey publications on gypsum and plasters.
Survey publications on lime and magnesite.
Survey publications on glass sand and glass-making materials.
Survey publications on abrasive materials.
Preliminary report on a portion of the Idaho phosphate reserve, by R. W. Richards and G. R. Mansfield.
Rock phosphate near Melrose, Mont., by H. S. Gale.
A reconnaissance of the phosphate deposits in western Wyoming, by Eliot Blackwelder.
Survey publications on phosphates and other mineral fertilizers.
Paint shales of Pennsylvania, by B. L. Miller.
Survey publications on mineral paints.
Survey publications on salines, including salt, borax, and soda.
Sulphur deposits near Soda Springs, Idaho, by R. W. Richards and J. H. Bridges.
Survey publications on sulphur and pyrite.
The types, modes of occurrence, and important deposits of asbestos in the United States, by J. S. Diller.
Dolomite for flux in the vicinity of Montevallo, Shelby County, Ala., by Charles Butts.
Graphite near Dillon, Mont., by A. N. Winchell.
Fluorspar near Deming, N. Mex., by N. H. Darton and E. F. Burchard.
Survey publications on miscellaneous nonmetallic products—asbestos, barite, feldspar, fluorspar, graphite, mica, quartz, etc.

BULLETIN 471. Contributions to economic geology (short papers and preliminary reports), 1910, Part II, Mineral fuels; advance chapters as follows:

Bulletin 471–A. Petroleum and natural gas. 1911. 132 pages, 10 plates, 2 text figures. Contains the following papers:
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.
Notes on the geology and possible oil resources of the south end of the San Joaquin Valley, Cal., by Robert Anderson.

Bulletin 471–B. Coal on Dan River, N. C., by R. W. Stone. 1912. 35 pages, 1 plate, 4 text figures.

Report on an examination of all coal exposures in the Dan River district, leading to the conclusion that no commercially valuable coal beds exist there.

Bulletin 471–C. Lignite in the Fort Berthold Indian Reservation, N. Dak., north of Missouri River, by M. A. Pishel. 1912. 19 pages, 2 plates.

A brief report on the lignite beds of this district, estimated to contain 1,819,953,682 tons of available fuel.

Bulletin 471–E. Coal fields in Montana. 1912. 66 pages, 3 plates. Contains the following papers:

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 Sweet grass counties, Mont., by W. R. Calvert.

The Electric coal field, Park County, Mont., by W. R. Calvert.

BULLETIN 472. Results of spirit leveling in South Dakota, 1896 to 1910, inclusive—R. B. Marshall, chief geographer. 1911. 54 pages, 1 plate.

BULLETIN 473. Results of spirit leveling in Kansas and Nebraska, 1896 to 1909, inclusive—R. B. Marshall, chief geographer. 1911. 42 pages, 1 plate.

Reports on precise and primary leveling in the States indicated in the titles, showing the altitude above sea level of a great number of places. Each of these bulletins contains a halftone illustration showing designs for bench marks used by the United States Geological Survey.

BULLETIN 474. Coals of the State of Washington, by E. E. Smith. 1911. 206 pages, 8 plates.

A discussion of the character and quality of the coals of the State, giving analyses, methods of sampling, and detailed descriptions, by counties, of the mines and coals. A map of a portion of western Washington, showing the distribution of coal mines and prospects, and halftone plates illustrate the bulletin.

BULLETIN 475. The diffusion of crude petroleum through fuller's earth, with notes on its geologic significance, by J. E. Gilpin and O. E. Bransky. 1911. 50 pages, 7 text figures.

An account of experiments in which crude Illinois petroleum was allowed to diffuse upward through fuller's earth. These experiments were similar to those discussed in Bulletin 365 and confirmed the results of the earlier work. One object was to obtain further light as to the variations among the oils of this country.

BULLETIN 476. Results of spirit leveling in Ohio, 1909 and 1910—R. B. Marshall, chief geographer. 1911. 79 pages, 1 plate.

A report on precise and primary leveling in Ohio, showing the altitude above sea level of a great number of places. The work was done in cooperation with the State. The bulletin contains a halftone illustration showing designs for bench marks used by the United States Geological Survey.

BULLETIN 477. Results of spirit leveling in West Virginia, 1909 and 1910—R. B. Marshall, chief geographer. 1911. 54 pages, 1 plate.

A supplement to Bulletin 399, showing the altitude above mean sea level of more than 900 places determined by precise leveling of the Geological Survey and the Coast and Geodetic Survey and by primary leveling of the Geological Survey. The work was done in cooperation with the State. The bulletin contains a halftone illustration showing Geological Survey bench marks.

BULLETIN 478. Geology and ore deposits near Lake City, Colo., by J. D. Irving and Howland Bancroft. 1911. 128 pages, 8 plates, 33 text figures.

Discusses the geology of the San Juan Mountains and the Lake City district and gives a brief history of their mineral industry and detailed descriptions of their ore deposits and mines. The illustrations include topographic and geologic maps and diagrams of the veins and workings.

BULLETIN 479. The geochemical interpretation of water analyses, by Chase Palmer. 1911. 31 pages, 1 text figure.

An exposition of the principle that natural water may be definitely characterized if the salts dissolved in it are recognized not as a load, but as a chemical system of balanced values. The relation of silica to primary alkalinity and the persistence of silica in river waters are among the topics considered.

BULLETIN 480. Mineral resources of Alaska—report on progress of investigations in 1910, by A. H. Brooks and others. 1911. 333 pages, 13 plates, 19 text figures.

This bulletin includes the following papers:

Administrative report, by A. H. Brooks.

Report on progress of surveys of public lands in Alaska during 1910, by A. H. Brooks.

The mining industry in 1910, by A. H. Brooks.

Geologic features of Alaskan metalliferous lodes, by A. H. Brooks.

Mining in southeastern Alaska, by Adolph Knopf.

The Eagle River region, by Adolph Knopf.

The upper Susitna and Chistochina districts, by F. H. Moffit.

Preliminary report on a detailed survey of part of the Matanuska coal fields, by G. C. Martin.

A reconnaissance of the Willow Creek gold region, by F. J. Katz.

Placer mining in the Yukon-Tanana region, by C. E. Ellsworth and G. L. Parker.

Mineral resources of the Bonnifield region, by S. R. Capps.

Gold placer mining developments in the Innoko-Iditarod region, by A. G. Maddren.

The Shungnak region, Kobuk Valley, by P. S. Smith and H. M. Eakin.

The Squirrel River placers, by P. S. Smith.

BULLETIN 481. Results of spirit leveling in California, 1907 to 1910, inclusive—R. B. Marshall, chief geographer. 1911. 115 pages, 1 plate.

BULLETIN 482. Results of spirit leveling in Montana, 1896 to 1910, inclusive—R. B. Marshall, chief geographer. 1911. 154 pages, 1 plate.

Reports on precise and primary leveling in California and Montana, respectively, showing the altitude above sea level of a great number of places in each State. The work in Sacramento, Salinas, and San Joaquin valleys, Cal., was done in cooperation with the State. Each bulletin contains a halftone illustration showing designs for bench marks used by the United States Geological Survey.

BULLETIN 483. Economic geology of Richmond, Va., and vicinity, by N. H. Darton. 1911. 47 pages, 10 plates, 1 text figure.

Describes the rocks of Richmond and vicinity, with special reference to the high-grade granite and brick clays. Accompanied by a map showing the economic geology of the district and halftone plates illustrating the working of the quarries and clay deposits.

BULLETIN 484. The granites of Connecticut, by T. N. Dale and H. E. Gregory. 1911. 137 pages, 7 plates, 12 text figures.

Treats of Connecticut granites both scientifically and economically, classifying them, giving statistics of production, and describing the quarries and their product in detail. The illustrations consist of halftone plates showing some of the uses made of the granites and maps and sections of the quarries.

BULLETIN 485. A geologic reconnaissance of the Iliamna region, Alaska, by G. C. Martin and F. J. Katz. 1912. 136 pages, 9 plates, 20 text figures.

A sketch of the stratigraphic and structural geology of a recently surveyed district situated in southwestern Alaska, west of the southern half of Cook Inlet and north of the Alaska Peninsula. Special mention is made of the mode of occurrence of the copper lodes and auriferous quartz veins, and the few claims and prospects now in existence are briefly discussed. The report contains tables showing the sequence and character of rocks in different parts of the region and the correlation of formations in western and southwestern Alaska, topographic and geologic maps, and structure sections.

BULLETIN 486. Results of spirit leveling in Colorado, 1896 to 1909, inclusive—R. B. Marshall, chief geographer. 1911. 107 pages, 1 plate.

BULLETIN 487. Results of spirit leveling in Idaho, 1896 to 1909, inclusive—R. B. Marshall, chief geographer. 1911. 46 pages, 1 plate.

BULLETIN 488. Results of spirit leveling in Nevada, 1897 to 1909, inclusive—R. B. Marshall, chief geographer. 1911. 28 pages, 1 plate.

BULLETIN 489. Results of spirit leveling in Utah, 1897 to 1910, inclusive—R. B. Marshall, chief geographer. 1911. 38 pages, 1 plate.

Reports on precise and primary leveling in the States indicated in the titles, showing the altitude above sea level of a great number of places. Each of these bulletins contains a halftone illustration showing designs for bench marks used by the United States Geological Survey.

BULLETIN 490. Mineralogical notes—series 1, by W. T. Schaller. 1911. 109 pages, 14 text figures.

Results of researches in mineralogy in the chemical laboratory of the United States Geological Survey from 1905 to 1909. Describes many new minerals and contains text figures showing their crystal forms.

BULLETIN 491. The data of geochemistry (second edition), by F. W. Clarke. 1911. 782 pages.

A manual of geologic chemistry, including chapters on the nature, distribution, and relative abundance of the chemical elements, the composition of the atmosphere and of volcanic gases and sublimates, the mineral content of surface and underground waters, the nature of saline residues, the molten magma of the earth's interior, the rock-forming minerals, the composition of igneous, sedimentary, and metamorphic rocks, rock metamorphism and decomposition, metallic ores, natural hydrocarbons, coal, lignite, and peat.

BULLETIN 492. The gabbros and associated rocks at Preston, Conn., by G. F. Loughlin. 1912. 158 pages, 14 plates, 18 text figures.

A detailed description of the areal and structural geology in the vicinity of Preston, with especial reference to the petrography of the gabbros and other igneous rocks. The illustrations consist of photomicrographs of the rocks and maps showing the location of outcrops and the geology of the district.

BULLETIN 493. Results of spirit leveling in Illinois, 1909 and 1910—R. B. Marshall, chief geographer. 1911. 115 pages, 1 plate.

A report on precise and primary leveling, showing the altitude above sea level of more than 1,300 places. Contains a halftone illustration showing designs for bench marks used by the United States Geological Survey.

BULLETIN 494. The New Madrid earthquake, by M. L. Fuller. 1912. 119 pages, 10 plates, 18 text figures.

A systematic discussion of the phenomena accompanying the shocks of the earthquake at New Madrid, Mo., in 1811–12, which may be regarded as a type, exhibiting in unusual detail the geologic effects of great disturbances upon unconsolidated deopsits. The illustrations include maps, diagrams, and halftone plates.

BULLETIN 495. Bibliography of North American geology for 1910, with subject index, by J. M. Nickles. 1911. 179 pages.

A list of papers published in 1910 on North American geology, 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 496. Results of triangulation and primary traverse for the years 1909 and 1910—R. B. Marshall, chief geographer. 1912. 392 pages, 2 plates.

Gives the results of triangulation and primary traverse in the United States for the years 1909 and 1910, listing 428 triangulation stations and 6,903 primary traverse stations, nearly all on United States standard datum. Includes a map showing the condition of astronomic location and primary control to January 1, 1911, and a halftone plate showing Geological Survey station marks.

BULLETIN 497. A reconnaissance of the Jarbidge, Contact, and Elk Mountain mining districts, Elko County, Nevada, by F. C. Schrader. 1912. 162 pages, 26 plates, 3 text figures.

A sketch of the geology of this promising mining region, surveyed for the first time in the summer of 1910, with descriptions of mines and prospects and a discussion of the mineral deposits. The illustrations include geologic reconnaissance maps, maps showing surveyed claims, and halftone plates of mineral specimens.

BULLETIN 499. Coal near the Black Hills, Wyoming-South Dakota, by R. W. Stone. 1912. 66 pages, 7 plates, 8 text figures.

Gives the results of two field examinations of all known coal exposures near the Black Hills and includes all information previously published by the United States Geological Survey on this subject. The geology of the district is briefly discussed and the coal localities are treated separately and in detail. The illustrations include sketch maps of mines and prospects and sections of coal beds.

BULLETIN 500. Geology and coal fields of the lower Matanuska Valley, Alaska, by G. C. Martin and F. J. Katz. 1912. 98 pages, 19 plates, 12 text figures.

Describes the geology of an important coal-bearing region of Alaska, surveyed in detail in the summer of 1910, discusses the character and accessibility of its coal beds, and gives sections of many of these beds. Topographic and geologic maps and halftone plates showing geologic features make up the illustrations.

BULLETIN 504. The Sitka mining district, Alaska, by Adolph Knopf. 1911. 32 pages, 1 plate, 4 text figures.

A sketch of the geology of the Sitka mining district, comprising Chichagof, Baranof, Kruzof, and a few smaller islands, with especial reference to the mineral resources of the west coast. After 10 years' stagnation in the mining industry of this district, interest has been revived by the discovery and prosperous development of high-grade gold ore at Klag Bay, 50 miles north of Sitka. A geologic reconnaissance map of the Sitka and Juneau mining districts accompanies the report.

BULLETIN 505. Mining laws of Australia and New Zealand, by A. C. Veatch, with a preface by Walter L. Fisher, Secretary of the Interior. 1911. 180 pages.

A summary of the underlying principles, development, and practical workings of the mining laws of Australia, Tasmania, and New Zealand, investigated by Mr. Veatch in 1907–8 by order of the President. Reprinted from report of the joint committee of Congress to investigate the Department of the Interior and the Bureau of Forestry.

BULLETIN 506. Geology and mineral resources of the Peoria quadrangle, Illinois, by J. A. Udden. 1912. 103 pages, 9 plates, 16 text figures.

A study of the geology of the Peoria quadrangle with especial reference to its coal deposits. In this quadrangle are situated the manufacturing cities of Peoria and Pekin, whose growth has been enhanced by their proximity to workable coal beds. The bulletin includes a chapter on the water resources of the district and is illustrated by geologic maps, halftone views of coal mines, and sections and diagrams of coal exposures.

BULLETIN 507. The mining districts of the western United States, by J. M. Hill, with a geologic introduction by Waldemar Lindgren. 1912. 309 pages, 16 plates, 1 text figure.

A catalogue, by States and counties, of the mining districts of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Texas (western part), Utah, Washington, and Wyoming, with a section on the local geology of their ore deposits. The book contains a map of each State showing the location of its mining districts and an alphabetic index of all the districts.

BULLETIN 509. Mineralogical notes—series 2, by W. T. Schaller. 1912. 115 pages, 1 plate, 5 text figures.

A continuation of Bulletin 490, giving results of researches in mineralogy in the chemical laboratory of the United States Geological Survey from January, 1910, to June, 1911. Many new and rare minerals are discussed.

BULLETIN 511. Alunite, a newly discovered deposit near Marysvale, Utah, by B. S. Butler and H. S. Gale. 1912. 64 pages, 3 plates.

An account of the discovery of alunite near Marysvale, Utah, and the development of the deposit as an important source of potash. The known occurrences of alunite both in the United States and elsewhere are mentioned and its commercial availability is discussed.

BULLETIN 512. Potash-bearing rocks of the Leucite Hills, Sweetwater County, Wyoming, by A. R. Schultz and Whitman Cross. 1912. 1 plate, 9 text figures.

Describes briefly the rocks in the Leucite Hills, Wyoming, and estimates the amount of leucite-bearing rock available and the approximate amount of

potash that these rocks may yield as soon as a process is discovered by which the potash can be dissociated from the rock cheaply enough for commercial use.

BULLETIN 520. Mineral resources of Alaska, 1911; advance chapters as follows:

Bulletin 520–B. Tin resources of Alaska, by F. L. Hess. 1912. 6 pages.

Bulletin 520–K. Geologic investigations along the Canada-Alaska boundary, by A. G. Maddren. 1912. 20 pages.

Bulletin 520–M. Notes on mining in Seward Peninsula, Alaska, by P. S. Smith. 1912. 8 pages.

BULLETIN 530. Contributions to economic geology (short papers and preliminary reports), 1911, Part I, Metals and nonmetals except fuels; advance chapters as follows:

Bulletin 530–A. The search for potash in the United States: A report of progress, by H. S. Gale. 1911. 27 pages, 1 plate, 1 text figure.

Bulletin 530–B. The occurrence of potash salts in the bitterns of the eastern United States, by W. C. Phalen. 1911. 18 pages.

These papers deal with experiments now in progress in the search for potash in the United States, with the purpose of developing a home industry and reducing the importation from Germany. Chapter A tells of experiments in well drilling in Nevada, and chapter B gives results of a systematic study of the brines, bitterns, and rock-salt deposits east of the Rocky Mountains. As yet potash in commercial quantities has not been discovered, but the information collected seems to warrant further investigation.

Bulletin 530–C. The Turquoise copper-mining district, Arizona, by F. L. Ransome. 1912. 12 pages, 2 text figures.

Bulletin 530–D. Notes on the gold lodes of the Carrville district, Trinity County, Cal., by D. F. MacDonald. 1912. 37 pages, 1 plate, 9 text figures.

Bulletin 530–F. Alunite in the San Cristobal quadrangle, Colo., by E. S. Larsen. 1912. 7 pages.

Bulletin 530–G. Gold and silver in Idaho. 1912. 23 pages, 1 plate, 1 text figure. Contains:

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.

Bulletin 530–I. Notes on the clays of Delaware, by G. C. Matson; Clay in the Portland region, Maine, by F. J. Katz. 1912. 24 pages, 1 text figure.

Bulletin 530–J. Notes on the Antelope district, Nevada, by F. C. Schrader. 1912. 14 pages, 1 plate, 1 text figure.

Bulletin 530–L. Graphite near Raton, N. Mex., by W. T. Lee; Mica in Idaho, New Mexico, and Colorado, by D. B. Sterrett. 1912. 22 pages, 3 text figures.

Bulletin 530–M. Notes on the northern La Sal Mountains, Grand County, Utah, by J. M. Hill. 1912. 22 pages, 1 text figure.

Bulletin 530–N. Gypsum in Utah and Virginia. 1912. 37 pages, 1 plate, 5 text figures. Contains:

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.

Bulletin 530–O. Sulphur in Utah, Wyoming, and Colorado. 1912. 25 pages, 1 plate, 1 text figure. Contains:

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

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

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

Bulletin 530–P. Zirconiferous sandstone near Ashland, Va., by T. L. Watson and F. L. Hess. 1912. 9 pages.

WATER-SUPPLY PAPERS 261, 266, 267, 268, 269, 271, 272. Parts of "Surface water supply of the United States, 1909," prepared under the direction of M. O. Leighton:

Part I. Water-Supply Paper 261. North Atlantic coast, by H. K. Barrows, C. C. Covert, and R. H. Bolster. 1911. 309 pages, 5 plates, 1 text figure.

Part VI. Water-Supply Paper 266. Missouri River basin, by W. A. Lamb, W. B. Freeman, and F. F. Henshaw. 1911. 291 pages, 5 plates, 1 text figure.

Part VII. Water-Supply Paper 267. Lower Mississippi basin, by W. B. Freeman and R. H. Bolster. 1911. 99 pages, 2 plates, 1 text figure.

Part VIII. Water-Supply Paper 268. Western Gulf of Mexico, by W. B. Freeman and R. H. Bolster. 1911. 107 pages, 6 plates.

Part IX. Water-Supply Paper 269. Colorado River basin, by W. B. Freeman and R. H. Bolster. 1911. 247 pages, 9 plates, 1 text figure.

Part XI. Water-Supply Paper 271. California, by W. B. Clapp and F. F. Henshaw. 1911. 256 pages, 6 plates, 1 text figure.

Part XII. Water-Supply Paper 272. North Pacific coast, by J. C. Stevens, E. C. La Rue, and F. F. Henshaw. 1911. 521 pages, 8 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 273. Quality of the water supplies of Kansas, by H. N. Parker, with a preliminary report on stream pollution by mine waters in southeastern Kansas, by E. H. S. Bailey. 1911. 375 pages, 1 plate, 1 text figure.

Presents the results of an investigation, conducted in cooperation with the Kansas State Board of Health, to determine the quality of the water supplies of the State. Describes briefly the salient geologic features in order that their relation to the water supply may be understood and contains 190 tables giving analyses and assays of the different waters. The underground sources are discussed separately by counties and the surface streams by river basins.

WATER-SUPPLY PAPER 274. Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses, by Herman Stabler. 1911. 188 pages.

A report setting forth the results of a systematic study of the waters likely to be utilized on the Reclamation Service projects. This study was made in order to determine the influence of the salinity of the waters on the growth of vegetation and the effect of suspended matter in silting canals and reservoirs. Contains tables giving analyses, gage heights, rates of discharge, and relative amounts of substances in solution in the waters of different rivers.

WATER-SUPPLY PAPER 275. Geology and water resources of Estancia Valley, N. Mex., with notes on ground-water conditions in adjacent parts of central New Mexico, by O. E. Meinzer. 1911. 89 pages, 14 plates, 7 text figures.

Describes the physiography, geology, soils, and climate of this valley, which, although for a long time sparsely settled, has only recently become accessible by railroads. Gives special attention to the water of the valley, discussing its source and disposal, head, recovery, and quality, and the proper mode of irrigation. Illustrations showing geologic and hydrographic features accompany the report.

WATER-SUPPLY PAPER 276. Geology and underground waters of northeastern Texas, by C. H. Gordon. 1911. 78 pages, 2 plates, 6 text figures.

An account of the geology of the region, both descriptive and historical, with special reference to its effect on the character and distribution of underground waters. The geography, geology, and water resources are treated by counties. Sections of several deep wells are given.

WATER-SUPPLY PAPER 277. Ground waters in Juab, Millard, and Iron counties, Utah, by O. E. Meinzer. 1911. 158 pages, 5 plates, 13 text figures.

A report on the water resources of an important section of central Utah, including a discussion of rainfall, soil, vegetation, streams, and industrial development. The occurrence of ground water is described and its quality considered. Its availability for irrigation, culinary supplies, and boiler supplies are given special attention. Watering places on routes of travel in the vicinity of the Sevier Desert are listed, and the report concludes with detailed descriptions of the water resources of the region.

WATER-SUPPLY PAPER 278. Water resources of the Antelope Valley, California, by H. R. Johnson. 1911. 92 pages, 7 plates, 11 text figures.

Sketches the drainage, climate, and geologic features of the valley, with especial reference to the water-bearing rocks. Describes the water resources and their economic development in detail and gives tables of data concerning individual wells.

WATER-SUPPLY PAPER 279. Water resources of the Penobscot River basin, Maine, by H. K. Barrows and C. C. Babb. 1912. 285 pages, 19 plates, 5 text figures.

Compiled chiefly from the records, reports, and maps of the United States Geological Survey and from the results of surveys made in cooperation with the Maine State Survey Commission. The report includes all data on precipitation, stream flow, water storage, and water power that were available at the end of the calendar year 1909 and is accompanied by plans and profiles of the principal rivers, lakes, and ponds in the basin. It contains also a gazetteer of the water features in the Penobscot basin, by G. E. Schulz.

WATER-SUPPLY PAPER 280. Gaging stations maintained by the United States Geological Survey, 1888–1910, and Survey publications relating to water resources, compiled by B. D. Wood. 1912. 102 pages.

Includes a complete list of the Survey gaging stations on streams in the United States and a list of all reports on water resources published by the United States Geological Survey, arranged in the order of their publication.

WATER-SUPPLY PAPERS 282, 285, 286, 287, 288. Parts of "Surface water supply of the United States, 1910," prepared under the direction of M. O. Leighton:

Part II. Water-Supply Paper 282. South Atlantic coast and eastern Gulf of Mexico, by M. R. Hall and J. G. Mathers. 1912. 109 pages, 3 plates.

Part V. Water-Supply Paper 285. Hudson Bay and upper Mississippi River, by Robert Follansbee, A. H. Horton, and G. C. Stevens. 1912. 318 pages, 3 plates.

Part VI. Water-Supply Paper 286. Missouri River basin, by W. A. Lamb, W. B. Freeman, Raymond Richards, and R. C. Rice. 1911. 308 pages, 4 plates, 1 text figure.

Part VII. Water-Supply Paper 287. Lower Mississippi basin, by W. B. Freeman and J. G. Mathers. 1911. 91 pages, 2 plates.

Part VIII. Water-Supply Paper 288. Western Gulf of Mexico, by W. B. Freeman and J. G. Mathers. 1911. 149 pages, 3 plates, 1 text figure.

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 295. Gazetteer of surface waters of California, Part I, Sacramento River basin, prepared under the direction of J. C. Hoyt by B. D. Wood. 1912. 97 pages.

The first of a series of reports on the surface waters of California, prepared by the United States Geological Survey under cooperative agreement with the State of California as represented by the State Conservation Commission and the State Board of Control (Water Powers). Every stream and gaging station in the Sacramento River basin is listed in this paper.

MINERAL RESOURCES OF THE UNITED STATES, calendar year 1909. Part I. Metals: 617 pages, 1 plate, 4 text figures. Part II. Nonmetals; 942 pages, 6 text figures.

MINERAL RESOURCES OF THE UNITED STATES, calendar year 1910. Part I. Metals; 796 pages, 1 plate, 9 text figures. Part II. Nonmetals, 1,005 pages, 17 plates, 10 text figures. 1911.

Statistics of production of mineral substances in the United States, including accounts of the chief features of mining progress and comparisons of past and present production and conditions. The report for 1909 is a consolidation of 53 advance chapters, that for 1910 of 51, each of which covers a single mining industry or group of allied industries.

MINERAL RESOURCES OF THE UNITED STATES, calendar year 1911; advance chapters as follows:

Iron-ore reserves of Michigan, by C. K. Leith. 1912. 18 pages, 1 text figure.

The production of talc and soapstone, by J. S. Diller. 1912. 9 pages.

The production of bauxite and aluminum, by W. C. Phalen. 1912. 19 pages, 1 text figure.

The production of asbestos, by J. S. Diller. 1912. 9 pages.

Potash salts, summary for 1911, by W. C. Phalen. 1912. 31 pages.

The production of graphite, by E. S. Bastin. 1912. 38 pages, 3 text figures.

The production of slate, by A. T. Coons. 1912. 19 pages.

The production of sand-lime brick. 1912. 5 pages.
The production of mica, by D. B. Sterrett. 1912. 9 pages.
The production of monazite and zircon, by D. B. Sterrett. 6 pages.
Sulphur, pyrite, and sulphuric acid, by W. C. Phalen, with notes on the manufacture of sulphuric acid from smelter fumes at Ducktown, Tenn., by F. B. Laney. 1912. 30 pages.
The production of phosphate rock, by F. B. Van Horn. 1912. 14 pages.
The production of fuller's earth, by Jefferson Middleton. 1912. 7 pages.
Statistics of the pottery industry in the United States, by Jefferson Middleton. 1912. 11 pages.
Quicksilver—production and resources, by H. D. McCaskey. 1912. 35 pages.
The production of asphalt, related bitumens, and bituminous rock, by D. T. Day. 1912. 21 pages.
The production of abrasive materials, by W. C. Phalen. 1912. 22 pages.
Gold, silver, copper, lead, and zinc in the Eastern States (mine production), by H. D. McCaskey. 1912. 18 pages.
The gypsum industry, by E. F. Burchard. 1912. 8 pages.
The production of chromic iron ore, by W. C. Phalen. 1912. 10 pages.

GEOLOGIC FOLIO 178. Description and maps of the Foxburg and Clarion quadrangles, comprising 450 square miles in western Pennsylvania, northeast of Pittsburgh, by E. W. Shaw, E. F. Lines, and M. J. Munn. 1911. 17 folio pages of text, 8 maps, 1 columnar-section sheet, 1 well-section sheet, 12 text figures. Published also in octavo form, 127 pages; maps in pocket.

GEOLOGIC FOLIO 179. Description and maps of the Pawpaw and Hancock quadrangles, comprising 460 square miles in eastern West Virginia, western Maryland, and southern Pennsylvania, by G. W. Stose and C. K. Swartz. 1912. 24 folio pages of text, 4 maps, 2 structure-section sheets, 1 columnar-section sheet, 20 halftone plates, 11 text figures, and a table of formation names and equivalents. Published also in octavo form, 176 pages; maps in pocket.

GEOLOGIC FOLIO 180. Description and maps of the Claysville quadrangle, comprising 228 square miles in Greene and Washington counties, Pennsylvania, by M. J. Munn. 1912. 14 folio pages of text, 4 maps, 1 columnar-section sheet, 1 well-section sheet, 10 text figures. Published also in octavo form, 98 pages; maps in pocket.

GEOLOGIC FOLIO 181. Description and maps of the Bismarck quadrangle, comprising 820 square miles in central North Dakota, by A. G. Leonard. 1912. 8 folio pages of text, 2 maps, 1 text figure. To be published also in octavo form.

GEOLOGIC FOLIO 182. Description and maps of the Choptank quadrangle, comprising 931.51 square miles in Anne Arundel, Kent, Queen Annes, Talbot, Caroline, and Dorchester counties, Maryland, by B. L. Miller. 1912. 8 folio pages of text, 2 maps, 3 text figures. To be published also in octavo form.

GEOLOGIC FOLIO 183. Description and maps of the Llano and Burnet quadrangles, comprising 2,050 square miles in Llano, Burnet, Mason, San Saba, Travis, and Williamson counties, Texas, by Sidney Paige. 1912. 16 folio pages of text, 4 maps, 2 structure-section sheets, 11 plates, 6 text figures. To be published also in octavo form.

TOPOGRAPHIC MAPS as follows:

Beverly, Wash.
Biggs, Cal.
Blackfoot, Mont.
Bridgeport, Cal.-Nev.
Brighton, Cal.
Browns Valley, Cal.
Butte City, Cal.
Caldwell, Ohio.
Cambridge, Ohio.
Canal Dover, Ohio.
Canton, N. Y.
Canyon, Wyo.[1]
Cataldo, Idaho-Mont.
Clear Creek, Cal.
Colorado River surveys, Cal.-Nev. (4 sheets).[2]
Copper Mountain and vicinity, Alaska.
Creede and vicinity, Colo.
Cumberland, Ohio.
Cut Bank, Mont.
De Beque oil field, Mont.
Delhi, N.Y.
Delphos, Ohio.
Dry Creek, Cal.
Elizabeth, Ill.
Franklin, Pa.
Gallatin, Wyo.[1]
Gilbert, W. Va.-Va.-Ky.
Gilsizer Slough, Cal.
Glacier National Park, Mont.
Gridley, Cal.
Grimes, Cal.
Hamburg, Pa.
Hammond, N. Y.
Hartwick, N. Y.
Honcut, Cal.
Illinois (State).
Ivanpah, Cal.-Nev.
Jefferson County, Ky.
Kasaan Peninsula, Alaska.
Keefers, Cal.[3]
Kezar Falls, Maine-N. H.
Knoxville, Iowa.
Kosmosdale, Ky.-Ind.
Lake, Wyo.[1]
Lake Providence, La.
Landlow, Cal.
Laurelville, Ohio.
Leavenworth and vicinity, Kans.-Mo.
Lincolnton, N. C.
Livermore, Me.
Loramie, Ohio.
McKeever, N. Y.
McKittrick, Cal.
Madison, W. Va.
Mason, Mich.
Meridian, Cal.
Miami copper belt, Arizona.
Milledgeville, Ga.
Mills, Cal.
Minnesota (State).
Mississippi (State).
Montpelier, Idaho-Wyo.-Utah.
Montrose, Colo.
Mount Goddard, Cal.
Mount Guyot, Tenn.-N. C.[4]
Mount Jackson, Colo.
Mullens, W. Va.
Muskingum County, Ohio.
Naugutuck, W. Va.[3]
Nelson, Cal.
New Athens, Ill.
New Berlin, N. Y.
Newhard, Cal.
North America, 28 by 38 inches.
Ontario Beach, N. Y.[1]
Oroville, Cal.[3]
Ostrom, Cal.
Oxford, Ohio.
Pineville, W. Va.
Pocahontas special, Va.-W. Va.
Pounding Mill, W. Va.[3]
Prospect, Ky.-Md.[3]
Quarryville, Pa.
Randsburg, Cal.[1]
Ray, N. Dak.
Ray and vicinity, Ariz.
Rochester, N. Y.[1]
Rochester special, N. Y.[1]
Rolla, Mo.
Sacramento Valley, Cal.
Salinas Valley, Cal., sheet No. 1.[2]
Sallisaw, Okla.[4]
Sanborn Slough, Cal.
Sansbois, Okla.[4]
Shoshone, Wyo.[1]
Singer Creek, Cal.
Spencerville, Ohio.
Summerfield, Ohio.
Sutter, Cal.
Taylorsville-La Grange, Ky.[3]
Thibedeau Lake, Mont.
Tisdale Weir, Cal.
Uhrichsville, Ohio.
United States base map, 18 by 28 inches.[1]
United States contour map, 18 by 28 inches.[1]
United States relief map, 18 by 28 inches.[1]
Vermont (State).
Welch, W. Va.
Willamette Valley, Oreg., sheet No. 4.[2]
Yellowstone National Park, Wyo.-Mont.-Idaho.[5]
Yuba City, Cal.

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 George W. Stose. Scale 1:5,000,000, or 80 miles to the inch. Printed in four parts, which together make a wall map 60 by 77 inches. Shows 42 geologic divisions.

CONVENTIONAL SIGNS: A sheet (20 by 30 inches) showing conventional signs adopted by the United States Geographic Board and recommended for use on Government maps.

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[1] New edition.
[2] Preliminary photolithograph.
[3] Preliminary edition showing part of quadrangle.
[4] Reengraved.
[5] Revised and enlarged.

FIELD WORK BY THE DIRECTOR.

During the season of 1911 the Director had field conferences with or visited parties in New Hampshire, Utah, Nevada, and Washington. In Utah the principal field conference was held with the chief geologist and G. F. Loughlin in connection with the revision of the survey of the Tintic mining district made in 1897. In Nevada an examination of a potash locality was made in company with H. S. Gale and A. H. Brooks. A large portion of the Director's attention was given, both in the field and in the office, to the administration of the examination by the Geological Survey of proposed national forest reservations. Three inspection visits were made to the field parties working in New Hampshire, one August 2–3, 1911, one November 12–16, 1911, and one May 24–26, 1912. Another trip was made November 10–11, 1911, for inspection of areas in Tennessee. A trip was also made to Virginia April 27–29, 1912, in company with the members of the National Forest Reservation Commission. The Director also attended meetings of the American Institute of Mining Engineers, the Geological Society of America, and the American Mining Congress, presenting at the mining congress a paper on "What the West needs in coal-land legislation."

CHANGES IN ORGANIZATION.

The only important formal change in the organization during the year was that of making the land-classification board equal in rank with the field branches. As contrasted with the three field branches of the Geological Survey, the land-classification board may be designated as the office of field records and intradepartmental correspondence on all matters relating to the classification of the public lands and the administration of the public domain. The board thus receives records and makes available all data valuable for purposes of land classification that have been or may be collected by the field service of the Geological Survey.

On October 15, 1911, Dr. C. W. Hayes, who had been a member of the Survey for 23 years and served as chief geologist since 1902, resigned in order to become vice president and manager of the Compañía Mexicana de Petróleo "El Águila." The vacancy thus created was filled by the appointment of Waldemar Lindgren, who had been a geologist of the Survey for 27 years.

GEOLOGIC BRANCH.

ADMINISTRATION.

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

The chief geologist has general supervision of the work of the geologic branch. C. W. Hayes resigned as chief geologist on October 15, 1911, and on November 3 Waldemar Lindgren was appointed to fill this position. The divisions composing the branch cooperate effectively in their several lines of work. Members of one division are employed in the work of another whenever it seems desirable. The statistical reports of the division of mineral resources are for the most part prepared by geologists, who are detailed from the division of geology for a portion of the year.

The land-classification board was also included in the geologic branch until May 1, 1912, when it was made a separate branch.

The administrative duties of the chief geologist prevent him from carrying on systematic field work. His work outside of the office consists chiefly of the planning of future examinations and of field conferences for determining questions of dispute.

PUBLICATIONS.

The publications of the year prepared in the geologic branch included 6 geologic folios, 2 professional papers, 24 bulletins, and the annual volumes on mineral resources. Besides these publications 101 papers were, with the permission of the Director, published in scientific journals and in the transactions of scientific societies. Such publications are ordinarily restatements of results in a more technical form and are usually prepared by members of the Survey without compensation.

The areal extent of geologic maps published by the Survey to date is shown on Plate I.

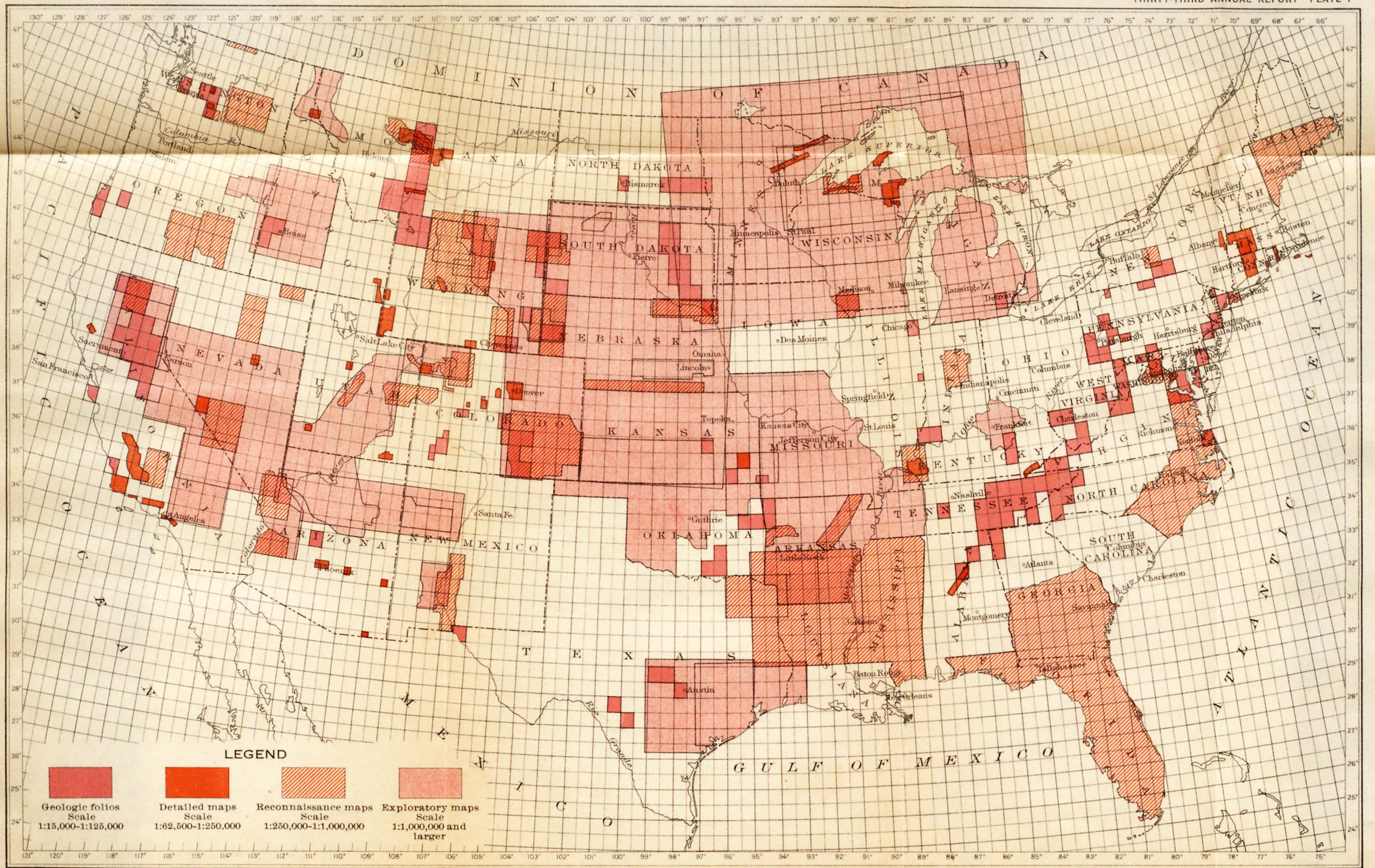
DIVISION OF GEOLOGY.

ORGANIZATION.

The scientific force at the beginning of the year consisted of 62 geologists, 57 assistant geologists, and 38 junior geologists. During the year there were 8 resignations and 1 appointment, the total being 150 at the end of the year. Of the total number, 75 were continuously employed, 34 carried on the per diem roll gave only a part of their time to Survey work, and 41 were not employed during the year. In addition to the regular force, 16 field assistants were employed for a part of the year.

The work of the division was organized under a number of sections, as follows:

Areal and structural geology, Arthur Keith in charge.
Paleontology and stratigraphic geology, T. W. Stanton in charge.
Economic geology, metalliferous ores, Waldemar Lindgren in charge.
Economic geology, nonmetalliferous minerals, F. B. Van Horn in charge.
Economic geology, fuels, M. R. Campbell in charge.



LEGEND

Geologic folios	Detailed maps	Reconnaissance maps	Exploratory maps
Scale 1:15,000-1:125,000	Scale 1:62,500-1:250,000	Scale 1:250,000-1:1,000,000	Scale 1:1,000,000 and larger

GEOLOGIC MAPS PUBLISHED PRIOR TO JULY 1, 1912

Scale $\frac{1}{14000000}$

100 0 100 200 300 400 500 Miles

ENGRAVED AND PRINTED BY THE U.S.GEOLOGICAL SURVEY

The section chiefs have direct supervision, both in the field and in the office, of the work in their sections and are directly responsible for maintaining efficiency and a high scientific standard.

The following changes were ordered in the arrangement of sections in the division of geology and paleontology, effective July 1, 1912:

1. Section of eastern areal and structural geology (east of the one hundredth meridian), Arthur Keith in charge. Subsection: Investigation of the geology of the Coastal Plain, T. W. Vaughan in charge.
2. Section of western areal and structural geology (west of the one hundredth meridian), F. L. Ransome in charge. Subsection: Investigations and work relating to petrography, E. S. Larsen in charge.
3. Section of glacial geology, W. C. Alden in charge.
4. Section of paleontology and stratigraphic geology, T. W. Stanton in charge.
5. Section of economic geology, metalliferous deposits, Waldemar Lindgren in charge.
6. Section of economic geology, nonmetalliferous deposits, H. S. Gale in charge.
7. Section of economic geology, eastern mineral fuels (east of the one hundredth meridian), David White in charge.
8. Section of economic geology, western mineral fuels (west of the one hundredth meridian), M. R. Campbell in charge.

ALLOTMENTS.

The total appropriations for geologic surveys for the fiscal year 1911–12 were:

Geologic surveys	$300,000
Statutory salaries	15,700
Search for potash deposits (part of appropriation for chemistry and physics)	20,000
	335,700

The allotments of the appropriations were as follows:

Section of areal and structural geology	$62,980
Subsection of geology of Coastal Plain	12,200
Section of paleontology	23,570
Section of economic geology of metalliferous ores	39,500
Section of economic geology of nonmetalliferous minerals, including potash	34,300
Section of economic geology of western fuels	51,946
Section of economy geology of eastern fuels	15,600
Work of land-classification board	25,000
Supervision, administration, salaries of clerical, technical, and skilled-labor force	70,604
	335,700

The above table shows that $240,096 was expended directly for geologic work, including the search for potash. Of this amount $141,746, or 59 per cent, was expended west of the one hundredth meridian and $98,350 east of that line.

The cooperative funds expended during the fiscal year 1911–12 were as follows:

General Land Office, for coal-land classification	$35,000
General Land Office, classification of Northern Pacific land grant	13,238
Indian Office, classification of land in Indian reservations, Montana, Washington, and Oklahoma	8,709
Department of Justice	1,763
Cooperation with States and official organizations	4,850
	63,560

The money allotted by the General Land Office, amounting to $48,238, was expended west of the one hundredth meridian. The first item of $35,000 was expended by the section of western fuels, for classification of coal land.

In the cooperative agreements for geologic work with the States of Alabama, Illinois, and Missouri it is provided that the funds contributed by the States should be handled by the local organization. In the cooperative agreements with Oklahoma, Maine, and Tennessee the cooperative funds contributed by the States have been expended by the United States Geological Survey.

During the fiscal year geologic work was done in 40 States, listed below:

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

SECTION OF AREAL AND STRUCTURAL GEOLOGY.

WORK OF CHIEF OF SECTION.

The work of Arthur Keith has been for the most part of an administrative character, consisting mainly of conferences with other geologists and supervision and inspection of results in areal and structural geology, both in the field and in the office. Much of this work has been done in connection with the geologic folios. The attainment of harmony and unity in the folios requires frequent conferences on all matters treated in them.

A great deal of Mr. Keith's time has been devoted to service on committees, including those on geologic names, illustrations, plans, and maps. The largest single portion of this committee service has consisted of work done on geologic names under his chairmanship until March 15, when he resigned on account of press of other work.

Maps of the following quadrangles already submitted for folio publication were inspected in the field: Boston and Marlboro, Mass.; Brandon and Castleton, Vt.; East Columbus and West Columbus, Ohio; and Colorado Springs, Colo.

Field conferences were held and inspection trips made by Mr. Keith with the geologists who were mapping the areal geology in the following quadrangles: Portland, Maine; Worcester and Marlboro, Mass.; Ducktown, Tenn.; Gaffney, S. C.; Cohutta, Ga.; Columbus, Ohio; Vinita, Nowata, and Claremore, Okla.; Deadwood and Rapid, S. Dak.; Minneapolis and St. Paul, Minn.; Castle Rock and Colorado Springs, Colo.

Mr. Keith, with the assistance of D. B. Sterrett, completed the review of the areal geology of the Cowee quadrangle, N. C., which will soon be offered for publication in a folio. He completed, also with Mr. Sterrett, the joint study of the areal geology of the Gaffney quadrangle.

Special investigations were continued by Mr. Keith into the faulted structure of the north end of the Taconic Mountains in the Brandon and Castleton quadrangles, Vt. A paper on this faulted area was presented at the meeting of the Geological Society of America. He also continued his study of the structure and stratigraphic succession of the rocks of the Vermont Valley and Green Mountains in the vicinity of Brandon, Vt.

Further studies were made in the peculiar metamorphic rocks around Ducktown, Tenn., and Murphy, N. C. A brief special study was made, in company with E. M. Kindle, of the Devonian section and of the boundary between the Ordovician and Silurian strata along Cumberland Mountain in northeastern Tennessee and Virginia.

A reconnaissance was made by Mr. Keith in the Talbotton quadrangle, Ga., and Walhalla quadrangle, S. C.

The greater portion of Mr. Keith's office time was occupied with investigations and discussions in connection with geologic folios. The descriptive texts of nine folios in course of preparation were critically read by Mr. Keith and the structural geology and areal mapping of these folios and many others were especially considered. In the editorial work he was assisted during the year by Laurence La Forge.

Numerous papers presented for publication by the Survey or in various periodicals were critically read, and the geologic maps for Survey reports were examined.

WORK IN NEW ENGLAND STATES.

The description of the geology of the Eastport quadrangle, Maine, has been completed by E. S. Bastin for folio publication in cooperation with the State of Maine.

F. J. Katz began the areal and economic survey of the Portland and Casco Bay quadrangles, Maine, for publication in a folio in cooperation with the State Water Storage Commission. This work was somewhat more than half done at the end of the field season. A preliminary map has been prepared by Mr. Katz and the field material has been worked up to date. From May 23 to the end of the fiscal year Mr. Katz was occupied in an examination of areas in North Carolina which are proposed for forest reserves under the Weeks Act and in the preparation of reports thereon. This work lies mainly in the Cranberry, Morganton, and Mount Mitchell quadrangles.

C. H. Clapp has offered for publication as a bulletin a report on the igneous rocks of Essex County, Mass. The material for this report was obtained by Mr. Clapp at his own expense.

Progress has been made in the description of the Boston and Boston Bay quadrangles, Mass., for the Boston folio by Laurence La Forge.

Prof. B. K. Emerson continued his field work in the Monadnock and Peterboro quadrangles, N. H., in extension of his work in central Massachusetts. He also revised portions of the areal geology of the Marlboro and Worcester quadrangles, Mass. The descriptive texts for the Worcester-Marlboro folio and the Webster-Blackstone folio have been prepared jointly with W. C. Alden and the folios submitted for publication.

Prof. Emerson has nearly completed the descriptive text and maps for the Sheffield-Sandisfield folio, covering two quadrangles in western Massachusetts, for publication under joint authorship with Prof. Joseph Barrell and Prof. T. Nelson Dale.

Prof. Barrell has completed the maps and description of the eastern half of the Sheffield quadrangle.

Prof. Emerson has also made progress on work on the maps and text for the folio on the Pittsfield and Becket quadrangles in western Massachusetts, of which he and Prof. T. Nelson Dale are joint authors.

A preliminary report has been submitted by Prof. Emerson for publication as a bulletin on the geology of Massachusetts and Rhode Island. He has also submitted for publication as a bulletin a mineral lexicon of Worcester County, Mass.

W. C. Alden revised his descriptions of the Pleistocene geology of central Massachusetts for the folios covering the Worcester, Marl-

boro, Webster, Blackstone, Brookfield, Barre, Belchertown, and Palmer quadrangles.

Prof. T. Nelson Dale visited the marble districts of southeastern Vermont during July and August. The description of these has been prepared by him for publication in a bulletin. He also completed the revision of his manuscript for a bulletin on the commercial marbles of western Vermont (Bulletin 521). Prof. Dale made microscopic examinations of the roofing slates from Colorado, Georgia, California, and Lancaster County, Pa., for a report for the division of mineral resources. During June he visited the slate regions of Georgia, Tennessee, Virginia, Pennsylvania, and New Jersey to obtain material for a revised edition of Bulletin 275, "Slate deposits and slate industry of the United States," which is now out of print.

WORK IN NORTHERN APPALACHIAN REGION.

The manuscript for the folio on the Niagara region, N. Y., has been submitted by E. M. Kindle and F. B. Taylor. The Paleozoic formations have been described by Mr. Kindle and the Pleistocene by Mr. Taylor.

Prof. W. S. Bayley held a field conference in the Highlands of New Jersey during September with Dr. H. B. Kümmel, State geologist of New Jersey. During the winter Prof. Bayley completed the maps and descriptions of the pre-Cambrian rocks in the Easton and Delaware Water Gap quadrangles in New Jersey and Pennsylvania, thus completing for folio publication a discussion of the pre-Cambrian geology of the New Jersey Highlands. The preparation of the descriptions of the Paleozoic and Pleistocene formations in these quadrangles has been begun by Dr. Kümmel.

The maps and descriptions of the Bellefonte quadrangle, Pa., for folio publication have been submitted by Prof. E. S. Moore.

The geologic maps of the Coatesville and West Chester quadrangles, Pa., were revised by Prof. Florence Bascom and the mapping and study of the gneisses in the Boyerton quadrangle, Pa., was begun. Prof. Bascom has completed the description of the volcanic rocks of South Mountain for the Fairfield-Gettysburg folio.

Dr. C. K. Swartz is making a detailed study of the Carboniferous rocks in the Frostburg and Flintstone quadrangles, Md., for the Maryland Geological Survey and will revise the descriptions of those rocks for the Frostburg-Flintstone folio.

The areal mapping and study of the Coastal Plain in the Elkton and Wilmington quadrangles, Del., have been continued by Prof. B. L. Miller, assisted by M. I. Goldman. This work is being done in cooperation with the Maryland Geological Survey. Progress has been made in the preparation of the folio manuscript for these quadrangles.

Dr. W. B. Clark, State geologist of Maryland, has carried on work on the Upper Cretaceous of Maryland with E. W. Berry and M. I. Goldman, on the Tertiary of Virginia and North Carolina with Dr. Julia A. Gardner, and on the Lower Cretaceous with E. W. Berry and Arthur Bibbins. Office work has been carried on and substantial progress made for all these projects.

WORK IN SOUTHERN APPALACHIAN REGION.

Work in the Abingdon quadrangle, Va., was continued by G. W. Stose and the northern half was nearly completed. A report on the salt and gypsum deposits in the area has been submitted for publication by Mr. Stose (in Bulletin 530).

Work in the Kings Mountain region of North and South Carolina was continued by D. B. Sterrett, who did a small amount of revision in the Kings Mountain quadrangle, practically completed the areal survey of the Gaffney quadrangle, S. C., and mapped about one-fourth of the Lincolnton quadrangle, N. C.

A small amount of revision of the areal geology of the Cowee quadrangle, N. C., was completed in June by Mr. Keith and Mr. Sterrett. The last three weeks in June were devoted by Mr. Sterrett to an examination of areas for proposed forest reserves under the Weeks Act in the Pisgah and Cowee quadrangles, N. C., and to the preparation of a report thereon.

WORK IN CENTRAL STATES EAST OF THE NINETY-SEVENTH MERIDIAN.

The field work on the Pleistocene deposits of the East and West Cincinnati quadrangles, Ohio, was completed by Prof. N. M. Fenneman for folio publication. This included some work in areas adjoining on the north. The areal geologic map of the Paleozoic formations for these quadrangles has been completed by E. O. Ulrich and the preparation of the descriptive text has been begun. The folio covering the area will be published under the joint authorship of Mr. Ulrich and Prof. Fenneman.

The manuscript maps and descriptions for the Columbus folio, covering the East and West Columbus, Dublin, and Westerville quadrangles, Ohio, have been transmitted for publication by Dr. J. A. Bownocker, State geologist. The descriptions were prepared by Dr. Bownocker, Prof. C. R. Stauffer, and Prof. G. D. Hubbard. This folio is to be a cooperative publication by the Federal and State geological surveys and the material has been obtained mainly at the expense of the Ohio Survey. Prof. Stauffer has described the Paleozoic formations, Prof. Hubbard the Pleistocene formations and the geography, and Dr. Bownocker the economic geology.

The manuscript maps and descriptions for the Cleveland folio, covering the Cleveland, Euclid, and Berea quadrangles, Ohio, have

been transmitted by Dr. H. B. Cushing for publication. Dr. Cushing has prepared the descriptions of the Paleozoic geology, Dr. Frank Carney those of the Pleistocene formations, and Dr. F. R. Van Horn those of the economic geology.

Prof. W. H. Sherzer has completed the field work for the folio on the Detroit quadrangle, Mich. He has finished the areal geologic maps and has made considerable progress with the descriptions of the area. This work has been done in cooperation with the State Geological Survey.

The monograph on the Pleistocene of Indiana and Michigan has been revised and transmitted for publication by Frank B. Taylor and Frank Leverett.

The examination and mapping of the Pleistocene formations of northern and northeastern Minnesota have been continued by Frank Leverett, assisted by E. R. Preston.

Field conferences were held by Mr. Leverett on questions of Pleistocene geology with Prof. F. W. Sardeson in the Minneapolis-St. Paul area; with Prof. Samuel Weidman in northeastern Wisconsin; and with Prof. W. H. Sherzer in the Detroit area, Mich.

A bulletin by Mr. Leverett on the Pleistocene deposits and soils of the Northern Peninsula of Michigan was published by the State Geological Survey in cooperation with the United States Geological Survey. Mr. Leverett has also completed for publication by the State Survey a map of the Pleistocene deposits and soils of the Southern Peninsula of Michigan.

The collection of statistics and the gathering of information on the Lake Superior iron districts was continued under the direction of Pres. Charles R. Van Hise.

The examination and mapping of the Minneapolis, St. Paul, Anoka, and White Bear quadrangles, Minn., was completed by Prof. F. W. Sardeson, who has submitted for folio publication the maps and descriptions of those areas.

The areal mapping of the De Queen quadrangle, Ark., was continued by Prof. A. H. Purdue, State geologist, assisted by H. D. Miser, as far as the topographic base was done. A small area near Hot Springs, Ark., was reexamined by Prof. Purdue, the work on this quadrangle for folio publication being thus completed.

A reconnaissance section was run northwest from the Caddo Gap quadrangle to Arkansas River by Prof. Purdue and Mr. Miser. Mr. Miser, jointly with E. O. Ulrich, made a special review of certain Paleozoic formations in the Harrison and Eureka quadrangles, Ark. This work was extended into the Yellville quadrangle, Ark., so that the field work in those quadrangles is now completed. Progress has been made by Prof. Purdue in writing the descriptive text for the Caddo Gap folio, but he has been delayed because of his appointment as State geologist of Tennessee.

WORK IN THE PUBLIC-LAND STATES.

Central States west of the ninety-seventh meridian.—The areal and economic survey of the Vinita quadrangle, Okla., was completed by Dr. D. W. Ohern. This work was done in cooperation with the State Survey of Oklahoma for folio publication. The office work on the maps and oil-well records is nearly completed, and progress has been made on the descriptions for the folio. Office work has been continued on the folio for the Nowata quadrangle, Okla., by Dr. Ohern and the manuscript will soon be submitted for publication. Office work is being done on a bulletin on the oil and gas resources of northeastern Oklahoma under the joint authorship of Dr. Ohern and Carl D. Smith.

The areal and economic survey of the Claremore quadrangle, Okla., was completed by Carl D. Smith, assisted by Robert H. Wood. The manuscript maps and descriptions for this quadrangle are now almost ready to be submitted for folio publication. This work has been done in cooperation with the State Survey of Oklahoma.

J. A. Taff has continued his preparation of the McAlester folio as fast as his professional duties permitted since his resignation from the Survey. It is expected that the manuscript will soon be submitted for publication.

C. E. Siebenthal continued his investigations of the zinc and lead deposits of northeastern Oklahoma and southwestern Missouri. The results of these studies will be incorporated in the Wyandotte folio, on which progress is being made.

N. H. Darton has completed for folio publication the description of the Cambrian and later formations in the Rapid and Deadwood quadrangles, S. Dak. A revision of the areal geology of the Spearfish quadrangle, S. Dak., was begun by Sidney Paige, and most of the area of the quadrangle was covered. The results of this work will be published as a special map in the Rapid-Deadwood folio.

Rocky Mountain region.—Work was carried on by M. R. Campbell, assisted by J. R. Hoats, on the survey of the Chief Mountain, Browning, and Midvale quadrangles, Mont., for folio publication. This area includes the larger part of the Glacier National Park. In association with Mr. Campbell, W. C. Alden, assisted by J. E. Thomas, conducted the work on the Pleistocene and the glacial features of the region. T. W. Stanton, paleontologist, was also for some time associated with Mr. Campbell in this work. Brief outlines of the results of this work have been presented by Mr. Campbell and Mr. Alden before the geological societies.

The survey of the Castle Rock quadrangle, Colo., was undertaken for a geologic folio by G. B. Richardson. The maps and descriptions for this folio have been completed and submitted for publication. Mr. Richardson also completed for outside publication a

report on the Monument Creek group in Colorado and a report on the structure of the foothills of the Front Range in Colorado.

In the Colorado Springs quadrangle, Colo., a small amount of revision was done by Prof. G. I. Finlay during and after a field conference with Mr. Keith in September.

The descriptive text for the folio on the Apishapa quadrangle, Colo., was completed by G. W. Stose and is now in press.

The survey of the San Juan Mountains in Colorado has been continued by Whitman Cross, assisted by E. S. Larsen, jr., and also during the field season by J. F. Hunter. The survey of the San Cristobal quadrangle, Colo., was completed for folio publication. The eastern half of the Uncompahgre quadrangle, Colo., was examined in a reconnaissance manner preliminary to preparation of a folio.

Office work has been carried on by Messrs. Cross and Larsen in preparation of the maps and descriptions for the San Cristobal folio, which will probably be submitted at an early date. Mr. Cross, with Mr. Larsen, has prepared for publication a paper on the unconformity at the base of the La Plata sandstone in Colorado. A bulletin on the potash-bearing rocks of the Leucite Hills, Wyo., has been prepared by Mr. Cross and A. R. Schultz and published as Bulletin 512.

The petrographic descriptions of the igneous rocks of the Apishapa quadrangle, Colo., have been completed by Mr. Cross for the Apishapa folio. Work upon a monographic discussion of the Hawaiian lavas has also been continued but is not yet completed. Mr. Cross served also as chairman of the committee to prepare definitions of sedimentary rock names.

A survey of the areal geology of Creede, Colo., and vicinity was made by E. S. Larsen, jr., in conjunction with W. H. Emmons, to complete the report on that mining district for publication as a professional paper.

Work was continued by Prof. W. W. Atwood, assisted by Kirtley F. Mather, on the Quaternary geology of the San Juan region, Colo. This work was carried on in association with that of Mr. Cross and the two parties were immediately associated in the field. The eastern half of the San Cristobal quadrangle was studied in detail, together with considerable adjoining territory to the south and east. In addition to the Quaternary mapping, Prof. Atwood is carrying out a systematic study of the physiographic development of the San Juan Mountains, aiming to connect the history of the mountains with that of the adjoining plateaus. He also did a small amount of work in the northern and eastern parts of the Montrose quadrangle, worked up the field data in the office, and put them into form for folio publication.

In connection with the investigation of underground water for the Indian Office, Prof. H. E. Gregory made a geologic reconnaissance of the Moki Buttes, Choiskai and Lukachukai mountains, and the Seven Lakes oil field, all on the Navajo and Moki reservations in Arizona and New Mexico. A geologic map and descriptions to accompany it are in preparation for the Navajo Reservation.

The descriptions for the geologic folio on the Silver City quadrangle, N. Mex., have been completed by Sidney Paige and submitted for publication. Mr. Paige also completed a small amount of revision of the folio text for the Llano and Burnet quadrangles, Tex., and the folio has been published.

A small amount of revision was done by N. H. Darton in the Deming quadrangle, N. Mex., and he has completed and submitted the maps and descriptions for the Deming folio.

Work has been continued by Prof. C. F. Tolman, jr., on the areal and economic survey of the Tucson quadrangle, Ariz., for folio publication. The field work for this folio is completed and the maps and descriptions will soon be submitted for publication.

Work on the Pacific coast.—The survey of the Klamath Mountains in northern California and Oregon has been continued by J. S. Diller. Mr. Diller made a detailed geologic reconnaissance of the Galice-Kerby region, lying west of the Riddles and Grants Pass quadrangles, Oreg., and has prepared a map of the area.

A report on the mineral resources of southwestern Oregon was prepared by Mr. Diller.

Mr. Diller also revised and prepared new illustrations for his description of Crater Lake, Oreg., and this has just been republished by the Interior Department. The Geological Survey is occasionally called upon for exhibits of its work and results and in the preparation of these exhibits Mr. Diller has had much to do.

The preparation of the folio on the Ventura quadrangle, Cal., has been continued by Dr. Ralph Arnold. Only a small amount of his time since his resignation could be devoted to this work, but the folio is now practically completed.

SUBSECTION OF GEOLOGY OF ATLANTIC AND GULF COASTAL PLAIN.

Work of chief of subsection.—T. Wayland Vaughan continued the supervision of Coastal Plain investigations. His field work consisted of an inspection tour in Louisiana, Texas, and Mississippi, where field parties were located. In order to obtain more information on the geology of the Canal Zone, for the purpose of correlating the geologic formations of the Gulf Coastal Plain with those of that region and procuring a basis for the intercorrelation of the geologic formations on the Atlantic and Pacific coasts of the United States, Mr. Vaughan spent one month, in October and November, in the

Canal Zone. The chairman of the Canal Commission, Col. George W. Goethals, and the Commission geologist, Mr. D. F. MacDonald, furnished Mr. Vaughan every possible facility for the prosecution of his investigation of the area. Arrangements have been made with specialists for the study of the collections procured. Mr. Vaughan also spent one month, in April and May, 1912, in the Bahamas, under the auspices of the Carnegie Institution of Washington. The object of this expedition was the extension of the studies of the geology and geologic processes of southern Florida to the Bahamas. Especial attention was given to the geology and the marine bottom deposits of the islands, and to the corals and coral reefs of Andros Island. Additional field work, mostly in June, was devoted to a continuation of his studies of the geology and geologic processes of southern Florida. Mr. Vaughan has almost completed his examination of the Florida keys, having visited nearly every one of the main line of keys. He has made substantial progress in his examination of the Florida coral reefs and his investigation of the corals of the region. The field expenses of these investigations in southern Florida are borne by the Carnegie Institution of Washington.

In the office Mr. Vaughan supervised the administrative work connected with the Coastal Plain investigations, read manuscripts and proofs of reports, studied collections of fossils (especially corals), and prepared summary statements of some of his investigations. He made progress in his researches on the correlation of the geologic formations of the Coastal Plain and resumed work on his monograph on the later Tertiary corals of the United States and the fossils of the West Indies and Central America.

The field work connected with the geologic survey of the Coastal Plain area is now completed as planned, except that for Cape Cod, the islands south of Massachusetts and Rhode Island, the delta of Mississippi River, a part of Mississippi, and the Rio Grande region of Texas.

During the fiscal year the following reports have been published or transmitted for publication:

The physiography and geology of the Coastal Plain province of Virginia, by William Bullock Clark and Benjamin LeRoy Miller, with chapters on the Lower Cretaceous, by Edward W. Berry, and the economic geology, by Thomas Leonard Watson. Cooperative report, published as Bulletin 4 of the Virginia Geological Survey.

Preliminary report on the geology of the Coastal Plain of Georgia, by Otto Veatch and Lloyd William Stephenson. Cooperative report, published as Bulletin 26 of the Georgia Geological Survey.

The New Madrid earthquake, by M. L. Fuller: Bull. U. S. Geol. Survey No. 494.

Notes on some clays from Texas, by Alexander Deussen: Bull. U. S. Geol. Survey No. 470–G.

Notes on the clays of Delaware, by George C. Matson: Bull. U. S. Geol. Survey No. 530–I.

A paper by E. W. Berry on the Upper Cretaceous and Eocene floras of South Carolina and Georgia was transmitted for publication as a professional paper.

A manuscript on the underground water resources of the Coastal Plain of Virginia, by Samuel Sanford, was transmitted to the State geologist for publication by the Virginia Geological Survey.

A report on the geology and underground waters of the Coastal Plain of North Carolina, by William Bullock Clark, B. L. Miller, L. W. Stephenson, B. L. Johnson, and H. N. Parker, is in press as a publication of the North Carolina Geological and Economic Survey.

The manuscripts prepared during the fiscal year are noted in the accounts of the work of individuals engaged in the Coastal Plain investigations.

Mr. Vaughan has been assisted in his paleontologic studies by Dr. C. Wythe Cooke, who gave particular attention to Tertiary fossils, and by Dr. Joseph A. Cushman, who studied the collections of Foraminifera from several of the formations of the Coastal Plain and from the Canal Zone.

Field work in the Coastal Plain investigation.—L. W. Stephenson continued the study of the geology and underground waters of parts of the Atlantic and Gulf Coastal Plain. He studied the stratigraphy and paleontology of the Cretaceous formations which outcrop in the region between Arkadelphia, Ark., and Uvalde County, Tex. T. W. Stanton accompanied Mr. Stephenson in southwestern Arkansas and northeastern Texas. Between Austin and Uvalde County the work was of a detailed reconnaissance nature and included the differentiation of formational units, the determination of stratigraphic and age relationship, and the collection of fossils. This work was done in part in collaboration with Alexander Deussen. The remainder of the year was spent by Mr. Stephenson in office work, which included proof reading, the preparation of reports, the preparation and study of fossil material relating in part to his own work and in part to the work of others, and the answering of referred letters. Work was done on the preparation of reports as follows:

A paper entitled " A deep well at Charleston, S. C.," originally intended for outside publication, is nearly completed and will be submitted for publication as a bulletin.

A cooperative report on the underground waters of the Coastal Plain of Georgia has been nearly completed; the part of this report relating to the underground waters of the Cretaceous deposits was prepared by Mr. Stephenson, and the part relating to the Tertiary and Quaternary deposits was prepared by Otto Veatch, assistant State geologist of Georgia.

A report on the underground waters of northeastern Arkansas, originally prepared by A. F. Crider, is now being revised and brought up to date by Mr. Stephenson.

In continuation of the work begun in 1909, Edward W. Berry spent two months in making field studies and collections from the plant-bearing beds of the Eocene, Oligocene, Miocene, and Pliocene in Alabama, Mississippi, Tennessee, Kentucky, Arkansas, Louisiana, and Texas. The data thus obtained furnish important criteria for determining the climatic and other physical conditions in southeastern North America during the Tertiary period. Office work done by Mr. Berry during the year includes the completion of a monograph on the Upper Cretaceous flora of the Gulf Coastal Plain, a flora largely ancestral to the Tertiary flora, as well as systematic studies of the Tertiary floras.

Investigations of the geology and hydrology of the Coastal Plain of Texas have been continued by Alexander Deussen. The months of July, August, and September, 1911, were devoted to field work, the party being in charge of Mr. Deussen, with David Donoghue as assistant. Reconnaissance surveys of the following counties of the Coastal Plain were completed: Bexar, Wilson, Karnes, Bee, Refugio, Arkansas, San Patricio, Live Oak, and a part of Medina. Mr. Deussen has in preparation a report on the geology and underground waters of the central Coastal Plain region of Texas. This report is about 65 per cent completed. A considerable portion of the time devoted to it has been taken up with the collection of analyses and tabulation of the analytical data. Mr. Deussen has also revised a report on the geology and underground waters of Texas east of Brazos River and south of Marion County. Some three months of office work have been devoted to this revision, and the report has been largely rewritten.

At the beginning of the year G. C. Matson was engaged in preparing a report on the phosphate deposits of Florida. This report was laid aside August 10 and field work on the upper Tertiary of the Gulf Coastal Plain was resumed where it had been abandoned in December, 1910. During the field season an area extending from south-central Mississippi to Alexandria, La., was examined in sufficient detail to permit a thorough revision of the former classification of the upper Tertiary formations. The field operations were suspended in November and were not resumed until May 1, 1912. During May the investigations of the previous season were extended to Sabine River and an excursion was made into eastern Texas for the purpose of correlating the work in Louisiana with that in Texas.

The months of January, February, and March were devoted to office work, and during this time Mr. Matson revised his report on

the geology and underground waters of Florida and completed his report on the phosphate deposits of Florida. In addition, he prepared a brief report on the clay deposits of Delaware and submitted it for publication as a part of Bulletin 530.

During April data were collected for a more detailed correlation of the upper Tertiary of Florida.

June 1 to 15 was devoted to a study of the oil field near Easton, La., and a detailed map was prepared showing the location of the wells and the topography of the salt dome with which the oil sands are associated. The collection of records of wells recently drilled has enabled Mr. Matson to outline the area where the structure seems favorable to the occurrence of oil.

A study of the process of sedimentation at the mouth of the Mississippi was undertaken during the last half of June.

SECTION OF PALEONTOLOGY AND STRATIGRAPHIC GEOLOGY.

T. W. Stanton continued to supervise the section of paleontology and stratigraphic geology.

At the beginning of the year Mr. Stanton was in the field with the party under M. R. Campbell, engaged in the study of the geology of the Glacier National Park and adjacent portions of the Blackfeet Indian Reservation. He studied the Mesozoic rocks exposed near the southern and eastern boundaries of the park and, with Eugene Stebinger, made an examination of the Cretaceous section along Cutbank Creek from the mountains to its junction with Two Medicine Creek. After leaving Mr. Campbell's party on August 18, Mr. Stanton examined some sections of Kootenai and associated rocks in the neighborhood of Great Falls and Belt, Mont., and then proceeded to Ashdown, Ark., to join L. W. Stephenson, with whom, from September 2 to September 13, he made a reconnaissance study of the Cretaceous formations at several localities between Ashdown and Sherman, Tex.

A large part of Mr. Stanton's time in the office was employed in making preliminary studies of current collections of Mesozoic invertebrate fossils and in preparing reports on them for the use of other geologists. The rest of his time was occupied by the reading of manuscripts, committee work, and administrative duties connected with the supervision of the section. A large increase in his committee work was caused by his appointment on March 23 to the chairmanship of the committee on geologic names.

Field studies on the early Paleozoic formations of Tennessee, Virginia, Missouri, and Arkansas were carried on during the summer of 1911 by E. O. Ulrich, assisted by Edwin Kirk and R. D. Mesler. These studies in Missouri and Arkansas were resumed in May and continued to the end of the year. In the office Mr. Ulrich continued

his general investigations of Paleozoic paleontology and stratigraphy and made the usual reports on collections for other geologists. He prepared for publication papers on the Clinton formation in the Appalachian region and on the Chattanooga shale and related formations. An illustrated work on the "Ozarkian" fauna was also brought nearly to completion and some progress was made on the text of the Cincinnati folio. Mr. Kirk acted as paleontologic assistant and Mr. Mesler attended to the routine work of preparing and caring for the collections.

H. S. Williams has continued work on a monograph of the Silurian and Devonian faunas of the Eastport quadrangle, Maine.

After completing work on the Niagara quadrangle, elsewhere referred to, E. M. Kindle continued his field studies on the correlation of Devonian formations. The problem of the correlation of the Chattanooga and Ohio shales was taken up in detail. In the field work Mr. Kindle was assisted for six weeks by P. V. Roundy. He prepared two papers on the results of the study of the Devonian shales south of Lake Erie and nearly completed a third manuscript on the Hamilton fauna of the Allegheny region. A considerable amount of Mr. Kindle's time has been spent in preparing special reports on collections of Devonian fossils made by other geologists who desired lists of species and determinations of horizons represented.

In the office R. D. Mesler and P. V. Roundy have both assisted Mr. Kindle for short periods in preparing the Devonian collections for study and reference.

G. H. Girty was employed in field work during July, August, and September, and spent the remainder of the year in the office. In the field he was engaged on problems connected with the stratigraphy and correlation of Carboniferous rocks in Kentucky, Tennessee, Arkansas, Missouri, Iowa, Kansas, Utah, Nevada, and Idaho. He was associated with Mr. Butts in Tennessee, Mr. Hinds in Kansas, and Messrs Umpleby and Richards in Idaho. In the office his time was devoted to elaborating data collected and to preparing reports on collections of fossils referred to him by other geologists. He completed for publication two papers on Carboniferous faunas from Arkansas. During most of the year he was assisted in routine preparatory work on collections by P. V. Roundy, who also spent one month collecting fossils and measuring sections in Georgia and Alabama.

The investigation of the marine Triassic formations of the Western States was continued, both in the field and in the laboratory, by J. P. Smith, who almost completed his monograph on the Upper Triassic fauna and made considerable progress on the monograph on the Lower Triassic.

All the work of preparing, recording, and caring for the collections of Mesozoic invertebrates and of fossil plants was done by T. E. Williard, who also during the year rearranged the reserve collections of fossil plants so that they are now easily referred to.

In connection with his stratigraphic work on the Cretaceous formations of the Gulf Coastal Plain L. W. Stephenson has made preliminary studies of the associated faunas.

A monograph on the Mesozoic and Cenozoic Echinodermata of the United States, by W. B. Clark and M. W. Twitchell, has been completed and transmitted for publication.

In addition to supervising geologic work in the Atlantic and Gulf Coastal Plain, T. W. Vaughan (see p. 50) continued his studies of recent and fossil corals, and, under his direction, late in the year, C. W. Cooke began work on the accumulated collections of Eocene mollusks. J. A. Cushman has begun to prepare a monograph on the Tertiary and Cretaceous Foraminifera of the Coastal Plain. A report on the Tertiary paleontology of Virginia and North Carolina, by Julia A. Gardner and a number of collaborators, is in preparation. The work of cleaning, assorting, and recording Tertiary invertebrates for Mr. Vaughan was done by I. B. Millner.

The work of W. H. Dall on tertiary invertebrate paleontology has this year consisted chiefly in the preparation and preliminary study of the large collection of fossils from the Canal Zone and adjacent areas in Central America, which was received from the Isthmian Canal Commission in October. The elaboration of this paleontologic material from the Isthmus of Panama should aid greatly in solving many important problems concerning the distribution of animals and plants and the geologic history of both North and South America. Mr. Dall also made considerable progress in his description of the fauna of the Oligocene "silex beds" of Tampa, Fla., which he is preparing for publication as a bulletin. The current work of recording, preparing, classifying, and reporting on collections and indexing the literature of Tertiary paleontology was kept up with the assistance of W. C. Mansfield.

David White has made the usual preliminary studies and reports for geologists on collections of Paleozoic fossil plants and has continued monographic investigations of the Paleozoic floras so far as his administrative duties would permit.

F. H. Knowlton continued the study of Mesozoic and Cenozoic fossil plants. For about four months and a half he was making preliminary examinations of the large current collections, mostly from the Rock Mountain area, and in preparing reports on them for the use of geologists. The remainder of the year he devoted to monographic work on the fossil plants of Raton Mesa, in northern New Mexico and southern Colorado, which will result in a large descrip-

tive volume, now nearly completed. Several short papers on paleobotanic subjects were prepared for outside publication during the year.

Under the joint supervision of Messrs. Knowlton and White, the work on the bibliography and compendium of paleobotany has been continued by Miss C. H. Schmidt, assisted by Miss I. P. Evans. This work is now practically completed to the close of 1910, all that remains being in the nature of a revision of American geologic horizons, editorial revision, and preparation for the printer.

E. W. Berry has nearly completed a report on the Eocene flora of the Southern States.

Through the courtesy of the United States National Museum all the collections of vertebrate fossils sent in by Survey field parties have been examined and reported on by J. W. Gidley and C. W. Gilmore.

SECTION OF ECONOMIC GEOLOGY OF METALLIFEROUS ORES.

Work of chief of section.—The chief of the section of economic geology of metalliferous ores, Waldemar Lindgren, devoted some time in the summer to field work in Utah, Nevada, and California, which is mentioned in detail below. The winter he spent in Washington, giving his time mainly to the administrative work of this section and to the work of the division of mineral resources relating to metallic production. In October, 1911, he visited Deadwood, S. Dak., and Idaho Springs, Colo., for conference and inspection. From November 20 to December 19 he was absent on leave without pay, giving a course of lectures at the Massachusetts Institute of Technology. The administrative duties of this section and those of the office of chief geologist occupied his time during the remainder of the year.

Eastern and Central States.—Little work was done in the Eastern and Central States. W. H. Emmons and F. B. Laney continued office work on a report on the Ducktown copper district, Tennessee, during such time as they could spare from their other work.

C. E. Siebenthal, who gave the larger part of his time to the preparation of chapters on lead, zinc, and cadmium for the division of mineral resources, also spent five months in completing a report on the genesis of the lead and zinc ores of the Joplin district, which will be published as a bulletin of the Survey. The discussion of the genesis of these ores grew out of the study of the ores of the Wyandotte quadrangle and is contributory and necessary to the completion of the folio and the economic report on that quadrangle.

Western States.—In Colorado field examinations were carried on at Creede and in the Gilpin County districts. E. S. Bastin spent four months and a half, assisted by J. M. Hill and for part of the

time by C. W. Henderson, in completing the field study of the economic geology of the Central City region, mainly a district of gold and silver bearing veins. The office work will be completed during the summer of 1912.

W. H. Emmons spent August and the first part of September in an examination of the metalliferous veins of the Creede mining district, Colo. In this work he was associated with E. S. Larsen, jr., who examined the areal geology of the district. Owing to the appointment of Mr. Emmons as professor of geology at the University of Minnesota, the field work was not completed, but it will be taken up in the summer of 1912. Mr. Emmons spent such time as he could spare from his regular work at the university in preparing a preliminary report on the Creede district (Bulletin 530–E).

The preparation of a final report on the ore deposits of Leadville, which had been interrupted by the death of S. F. Emmons in March, 1911, was intrusted to Prof. J. D. Irving, of Yale University, who for a number of years had assisted Mr. Emmons in the field and office work relating to this district. Prof. Irving continued this work during the winter and was aided by a draftsman engaged by the Survey to complete the geologic sections and maps of this district.

F. L. Hess undertook a reconnaissance of the vanadium (roscoelite) deposits in the vicinity of Placerville, Colo., in connection with a general reconnaissance of such deposits in several other States. A preliminary report was published in Bulletin 530-K. A bulletin on the crystallography and mineralogy of ferberite, mainly that of Boulder County, Colo., was prepared and submitted by Mr. Hess and W. T. Schaller. A considerable part of Mr. Hess's time was occupied in preparing reports on the production of the rare metals for the division of mineral resources.

In Wyoming D. F. Hewett, a member of the section of western fuels, examined the copper prospects of the Sunlight Basin and prepared some notes on them for publication in Bulletin 530–O.

In New Mexico F. L. Hess visited the vanadium districts in the Caballos district, a description of which was incorporated in Bulletin 530–K.

In Arizona a detailed study of the geology and ore deposits in the Tombstone district was made by F. L. Ransome. He also finished the field work for reports on the disseminated copper deposits of Ray and Miami and has nearly ready for publication the text and maps of the Ray folio. In connection with the work at Tombstone Mr. Ransome made a reconnaissance examination of the Turquoise district, the results of which were published as Bulletin 530–C. In preparation for a general report on the geology and ore deposits of Arizona, he also made a brief examination of the Bisbee district and visited the Superior and Jerome districts. During the winter Mr.

Ransome was occupied in preparing reports on the districts mentioned.

F. C. Schrader devoted the last months of the fiscal year to the preparation of a report on the mineral deposits of the Santa Rita and Patagonia Mountains, the field work of which had been completed during the previous year.

In Utah field work was continued during the summer of 1911 and also during May and June, 1912, by B. S. Butler. He examined the Marysvale, Silver Reef, Clifton, Spring Creek, Fish Springs, Dugway, Granite, Lucin, and other districts. During the winter Mr. Butler completed a professional paper on the ore deposits of the San Francisco and adjacent ranges. Together with H. S. Gale, Mr. Butler prepared a bulletin on the occurrence of alunite in the Marysvale district (Bulletin 511).

Waldemar Lindgren, assisted by G. F. Loughlin, completed during the fall a reexamination of the Tintic district, undertaken for the purpose of recording the important developments that had taken place since the district was examined by George Otis Smith and G. W. Tower. A report on the district is in preparation.

F. L. Hess examined the vanadium deposits in the San Rafael Swell near Green River and prepared a short report on them for publication in Bulletin 530–K.

A short paper on the economic geology of the La Sal Mountains, based on field work of the previous year, was prepared by J. M. Hill and published as Bulletin 530–M.

In Idaho J. B. Umpleby spent two weeks in 1911 in revisiting the Texas mining district in Lemhi County. He also spent four weeks in a geologic reconnaissance of the Bayhorse, Yankee Fork, and Loon Creek mining districts, in northwestern Custer County. The reports on both these areas have been submitted. Late in June he returned to Idaho and started a geologic reconnaissance in the vicinity of Mackay. A preliminary account of the ore deposits of the Loon Creek district was published in Bulletin 530–G.

In connection with the geologic mapping of the Taft quadrangle, Idaho and Montana, F. C. Calkins and E. L. Jones, jr., prepared a short paper on the geology and mineralization of the St. Joe-Clearwater region, which was published in Bulletin 530–G.

In Montana economic field work was carried on near Helena and in the Dillon region. During the field season of 1911 Adolph Knopf, assisted by H. G. Ferguson, mapped the geology and studied the ore deposits of an area of 1,300 square miles in central-western Montana on a scale of 1:250,000. This area includes a large number of mining camps extending from Marysvale on the northwest to Elkhorn on the southeast. A report embodying the results of the field observations was prepared during the winter and submitted for publication.

During July and August A. N. Winchell completed field work in the mining districts in southwestern Montana continued from last year. During the winter Prof. Winchell devoted such time as he could spare from his regular duties to preparing a report on the field work of the two seasons. The report will be completed during the summer of 1912. On June 11 Prof. Winchell resigned as assistant geologist in the Survey.

In Washington no field work was undertaken, but a report on the ore deposits of the northeastern part of the State, for which the field work had been completed during the previous year, was finished by Howland Bancroft. Mr. Bancroft resigned May 31 as assistant geologist in the Survey.

In Oregon the only field work relating to the examination of ore deposits was done by J. S. Diller, who during the summer of 1911 surveyed a number of smaller mining camps in the Kerby and Galice mining districts, in the southwestern part of the State. Mr. Diller spent a part of the winter in preparing a report on this region.

In California practically no field work relating to metalliferous deposits was undertaken. Mr. Lindgren spent some days in investigating the gold-dredging deposits of the central part of the State, at Marysvale and Folsom. D. F. MacDonald prepared a paper on the gold lodes of the Carrville district, Trinity County, which was published as Bulletin 530–D, the field work having been completed in a previous year.

Progress was made by F. L. Hess in the preparation of the report on the Randsburg gold-mining district.

L. C. Graton, under contract to complete a report on the copper mines of Shasta County based on the field work of previous years, states that the report will be completed in the summer of 1912.

In Nevada F. C. Schrader began a reconnaissance of the Wonder, Fairview, and Rawhide mining districts. During part of the time he was assisted by H. S. Gale. The work was unexpectedly interrupted by Mr. Schrader's assignment to the examination of mining properties in Nevada for the Department of Justice. On returning to the Washington office in the spring he continued the preparation of his report on a geologic reconnaissance in Arizona. Mr. Schrader also prepared a paper on the Antelope district, which was published as Bulletin 530–J. In August Mr. Lindgren completed the survey of the National mining district, in the northern part of Nevada. A report on this district is in preparation.

Miscellaneous general work.—During the year W. H. Emmons completed a report on the enrichment of sulphide ores, consisting of a general discussion and a compilation of the data contained in the literature on American mining districts published since 1900. It will be published as Bulletin 529.

J. M. Hill devoted some time to the completion of Bulletin 507, containing a descriptive list and maps of the mining districts of the Western States. Waldemar Lindgren prepared a geologic introduction for this bulletin.

In April, May, and June R. W. Stone, assisted by E. L. Jones and H. G. Ferguson, was detailed to complete and revise a report on the occurrence of industrial minerals in the United States, which will be issued as a part of the annual volume "Mineral resources of the United States."

B. S. Butler made short visits to the Lake Superior copper district, in Michigan, and the Butte district, in Montana, and prepared a report on the production of copper in the United States for the division of mineral resources.

Examinations for other departments.—At the request of the Department of Justice F. C. Schrader was detailed in September to make an examination of mining properties in the Bovard, Goldfield, and Diamond Field mining districts, Nev., and his services were subsequently continued in connection with this work for the department in the Federal district court at New York until March.

In December J. M. Hill, on a request from the Department of Justice, was detailed to make an examination of the properties of a mining company in Shasta County, Cal. The completion of the report on this property occupied his time until the middle of February.

At the request of the Post Office Department E. F. Burchard and D. F. Hewett were detailed to make a brief preliminary investigation of alleged deposits of manganese and iron ore, ocher, marble, and limestone in western Maryland near Harpers Ferry, W. Va., and gave testimony on the subject before the Federal grand jury at Baltimore, Md.

In March, 1912, the newspapers announced the discovery of a billion tons of iron ore in Pennsylvania. G. H. Ashley was detailed at once to investigate the matter, and his findings, failing to substantiate the discovery, were published widespread the following week through the medium of a special press bulletin.

Classification of Northern Pacific Railroad lands.—An item in the sundry civil act of June 25, 1910, being an amendment to the act of February 26, 1895 (Stat. L., vol. 28, p. 683), entitled "An act to provide for the examination and classification of certain mineral lands in the States of Montana and Idaho," made an appropriation to the General Land Office for completing the classification, as to their mineral or nonmineral character, of certain specified lands within the grant of the Northern Pacific Railroad in Montana and Idaho. Under the authority of the Secretary of the Interior the field examination and the classification of these lands were assigned to the

Geological Survey. An additional appropriation was made for this purpose in the sundry civil act of 1911 and the work was completed during the present fiscal year. F. C. Calkins, assisted by E. L. Jones, jr., completed examinations in the St. Joe and Clearwater basins, Idaho.

J. T. Pardee was occupied during almost the entire year in classifying lands in western Montana. In the winter he was mainly occupied in preparing data for the land-classification board. From January 18 to February 12 he attended the hearing at the land office at Cœur d'Alene, Idaho, giving testimony, together with H. S. Gale, in cases contested by the Northern Pacific Railway.

R. W. Stone was engaged during the greater part of the year in classifying many small and widely scattered tracts in central Montana. He was assisted in the field by Prof. Bert Kennedy, of Illinois.

Classification of lands in Indian reservations.—A sum having been set aside by the Indian Office for separating the mineral from the nonmineral lands in the Colville Indian Reservation, Wash., J. T. Pardee was detailed to this duty on June 1 and spent the month of June in organizing and beginning the work.

SECTION OF ECONOMIC GEOLOGY OF NONMETALLIFEROUS MINERALS.

Work of chief of section.—During the first part of the year F. B. Van Horn was engaged largely in administrative duties in Washington. From September 3 to October 8 he spent some time visiting field parties in Idaho and Oregon, but on account of the resignation of C. W. Hayes, chief geologist, he returned to Washington, serving as acting chief geologist between the date of the resignation of Mr. Hayes and that of the appointment of Mr. Lindgren. From May 14 to May 31 Mr. Van Horn spent some time in Kentucky and Tennessee visiting reported phosphate deposits. The rest of the year he spent in administrative work for the geologic branch and as acting chief geologist. He also prepared a report on the production of phosphate rock in 1911 for publication in the volume "Mineral resources of the United States."

Eastern and Central States.—A detailed investigation of the Clinton and other red iron ore deposits of the Appalachian region in eastern Tennessee, northeastern Alabama, and northwestern Georgia was carried on by E. F. Burchard. The field work of this investigation occupied most of his time from the middle of July to the end of November. The work in Tennessee was done in cooperation with the State Geological Survey, and that in parts of Tennessee, Alabama, and Georgia near Chattanooga in cooperation with the Chattanooga Chamber of Commerce. For the purpose of obtaining exact measurements and fresh samples of ore Mr. Burchard, with the assistance of J. R. Ryan, a practical mining superintendent,

systematically prospected the ore beds at intervals ranging from half a mile to 5 miles along more than 250 miles of outcrop—a method which is new to Survey practice in the investigation of metalliferous ores but which yielded definite and valuable information on many hitherto uncertain points. The preparation of two bulletins based on this field work is under way—a description of the red iron ores of eastern Tennessee, to be published by the Tennessee Geological Survey, and a description of the red iron ores of eastern Tennessee, northeastern Alabama, and northwestern Georgia, to be published by the United States Geological Survey.

Mr. Burchard prepared considerable material for a bulletin by E. C. Eckel on the Portland cement materials and industry of the United States, the manuscript and illustrations of which were submitted for publication as Bulletin 522. He also prepared reports on the production of iron and manganese ores, fluorspar, cement, building stones, lime, gypsum, glass sands, and concrete materials, for publication in the volume "Mineral resources of the United States."

W. C. Phalen made a study of the salt industry in the United States, with special reference to the occurrence of potash salts in brines and bitterns or associated with rock salt. The analytical work connected with the investigation is now being done by the Bureau of Soils, Department of Agriculture, but is not yet finished, and the detailed report must await these analytical results. During the course of the work Mr. Phalen visited New York, Michigan, Ohio, West Virginia, Pennsylvania, Kansas, and Louisiana. A short report embodying part of the results obtained on this trip was prepared and published as Bulletin 530–B.

The work in connection with the search for potash salts was placed in charge of Hoyt S. Gale. The early part of the field season was devoted to a review of the saline deposits in the Laramie Basin, southern Wyoming. This was followed by the selection of a drilling equipment and a site for preliminary drilling and the subsequent installation of the drilling equipment near Fallon, Nev., with J. H. Hance in charge of the outfit.

Investigations as to the finding of commercial supplies of potash salts have been concentrated along the following lines:

1. The exploration, by deep boring, for deposits of buried salines in Nevada and in other localities in the western public-land States, by a party in charge of J. H. Hance, under the direction of Hoyt S. Gale.

2. The investigation of the occurrence of certain rich potash-bearing rocks and minerals, described in short reports.

3. The investigation of the salt deposits and the brines and bitterns in the United States east of the Rocky Mountains, carried on by W. C. Phalen, under the supervision of David T. Day.

4. A limited amount of general field work in the Western States by Hoyt S. Gale.

Naturally work on such a subject as this has not been concluded within a single year, but preliminary reports have been prepared on the progress of the Government boring near Fallon, Nev., by Hoyt S. Gale (Bulletin 530–A); on the investigation of the salines east of the Rocky Mountains, by W. C. Phalen (Bulletin 530–B); on the discovery of a new deposit of alunite near Marysvale, Utah, as a possible source of potash, by B. S. Butler and Hoyt S. Gale (Bulletin 511); on the extent and distribution of leucite rock in southern Wyoming as a possible source of potash, by Whitman Cross and A. R. Schultz (Bulletin 512); and on the occurrence of nitrates in the United States, by Hoyt S. Gale (Bulletin 523). A general review of the subject is contained in a chapter from "Mineral resources" entitled "Potash salts, summary for 1911," by W. C. Phalen.

During the summer of 1911 Eliot Blackwelder made a survey of the Gros Ventre Mountains, in western Wyoming, and the west end of the Wind River Range, part of the district reconnoitered by him in 1910. During the winter special reports and plats, to serve as a basis for classifying the phosphate lands in the area surveyed, were prepared for 33 townships.

R. W. Richards, assisted by G. R. Mansfield, made a detailed examination of eight townships in the Wayan quadrangle, southeastern Idaho. These townships included large areas of phosphate lands. A preliminary report has been prepared and submitted for publication.

Messrs. Richards and Mansfield also continued the examination of the Montpelier quadrangle, Idaho.

In company with A. R. Schultz, Mr. Richards made a rapid reconnaissance of that portion of Idaho lying south of Snake River and north of the areas mapped and studied in detail by Messrs. Richards and Mansfield in 1910 and 1911. The data collected warranted the elimination from the phosphate reserve of large areas which had been originally included on the basis of the mapping by the Hayden Survey in 1877. A report of this reconnaissance examination was prepared and submitted for publication in Bulletin 530–H.

SECTION OF ECONOMIC GEOLOGY OF FUELS.

WORK OF CHIEF OF SECTION.

During the fiscal year M. R. Campbell remained in general charge of the fuel section. From the beginning of July to the middle of October he was engaged in areal mapping in the Glacier National Park and vicinity, Mont. During the remainder of the year Mr. Campbell was engaged in general administrative duties connected

with the fuel section and in preparing reports for publication. The most important of these was Bulletin 471, "Contributions to economic geology, 1910, Part II." Owing to the delay in preparation this is an unusually large volume and required a large amount of work in revision and editing before it was ready to submit for publication. In addition to the report, a paper by Alfred R. Schultz on the geology of central Uinta County, Wyo., was revised and submitted for publication as a bulletin of the Survey, a report on the Standing Rock and Cheyenne River Indian Reservations was almost completed, and considerable progress was made in assembling and revising papers for Bulletin 531, "Contributions to economic geology, 1911, Part II." Mr. Campbell has also made a new estimate of the coal resources of the United States for consideration at the meeting of the International Geological Congress in Ottawa, Canada, in 1913.

CLASSIFICATION OF SUPPOSED COAL AND OIL LANDS.

The examination of coal and oil fields in the public-land States for classification was continued during the summer of the present fiscal year. Mr. Campbell was assisted by E. G. Woodruff and W. R. Calvert, the former exercising close personal supervision in both field and office and the latter for a few months only in the field. The following list includes projects examined and those in which the work was in progress at the end of the fiscal year. It also contains brief notice of reports that are in progress or have been completed, and the names of the geologists who have carried on the work.

Big Muddy lignite field, Perkins County, S. Dak. Geologic party in charge of D. E. Winchester examined in detail 1,680 square miles of supposed lignite land. Land classified and geologic report prepared.

Little Missouri River lignite field, Harding County, S. Dak. Geologic party in charge of E. M. Parks examined in detail 1,595 square miles of supposed lignite land. Land classified and geologic report prepared.

Marmarth lignite field, Billings County, N. Dak. Geologic party in charge of C. J. Harnes examined in detail 1,070 square miles of supposed lignite land. Land classified and geologic report in preparation.

Williston lignite field, Williams County, N. Dak. Geologic party in charge of F. A. Herald examined in detail 620 square miles of supposed lignite land. Work interrupted September 16 by detail of Mr. Herald to make an examination of a part of the Fort Berthold Indian Reservation. Land classified and geologic report prepared.

Fort Berthold Indian Reservation (south of Missouri River), N. Dak. Geologic party in charge of F. A. Herald examined in detail 270 square miles of supposed lignite land. Work extended from September 20 to November 10. Land classified and geologic report prepared.

Fort Berthold Indian Reservation (north of Missouri River), N. Dak. Geologic report of work done by M. A. Pishel in 1910 submitted (in Bulletin 471).

Little Sheep Mountain lignite field, Rosebud, Custer, and Dawson counties, Mont. Geologic party in charge of G. S. Rogers examined in detail 1,440

square miles of supposed lignite land. Land classified and geologic report prepared.

Fort Peck Indian Reservation, Valley County, Mont. Geologic party in charge of C. M. Bauer examined 2,016 square miles, part in reconnaissance and part in detail. Land classified.

Baker lignite field, Custer County, Mont. Geologic report of work done by C. F. Bowen in 1910 submitted (in Bulletin 471).

Terry lignite field, Custer County, Mont. Geologic report of work done by F. A. Herald in 1910 submitted (in Bulletin 471).

Glendive lignite field, Dawson County, Mont. Geologic report of work done by J. H. Hance in 1910 submitted (in Bulletin 471).

Sidney lignite field, Dawson County, Mont. Geologic report of work done by Eugene Stebinger in 1910 submitted (in Bulletin 471).

Several lignite fields in eastern Montana. Report on geology by W. R. Calvert submitted (in Bulletin 471).

Culbertson lignite field, Valley County, Mont. Geologic report of work done by A. L. Beekly in 1910 submitted (in Bulletin 471).

Big Snowy Mountains coal field, Fergus County, Mont. Geologic party in charge of W. R. Calvert made reconnaissance survey of 972 square miles of possible coal land. Examination completed July 9, 1911. Land classified and report prepared.

Part of Milk River coal field, Chouteau County, Mont. Report begun by L. J. Pepperberg submitted (in Bulletin 471) by G. B. Richardson.

Tertiary coal fields of western Montana. Examination made by J. T. Pardee in connection with his examination of Northern Pacific Railway land grant in that part of the State. Lands classified and report prepared.

Blackfeet Indian Reservation, Teton County, Mont. Eugene Stebinger examined 1,512 square miles, partly in detail and partly in reconnaissance. Land classified and some progress made on geologic report.

Geologic party in charge of M. R. Campbell examined about 500 square miles in connection with the survey of the Glacier National Park. Land classified.

Bull Mountain coal field, Musselshell County, Mont. Field work done in previous years by R. W. Richards and C. T. Lupton. Geologic report completed by E. R. Lloyd.

Livingston and Trail Creek coal fields, Sweetgrass, Park, and Gallatin counties, Mont. Geologic report of work done by W. R. Calvert in 1908 submitted (in Bulletin 471).

Upper Stillwater Basin, Sweetgrass and Carbon counties, Mont. Geologic report of work done by W. R. Calvert in previous years submitted for publication.

Hound Creek district of Great Falls coal field, Cascade County, Mont. Geologic report of work done in 1909 by V. H. Barnett submitted for publication.

Electric coal field, Park County, Mont. Geologic report of work done by W. R. Calvert in 1908 submitted (in Bulletin 471).

Chehalis coal field, Cowlitz and Lewis counties, Wash. Examination made by A. J. Collier during July and August, 1911.

Belle Fourche Valley coal field, Weston and Converse counties, Wyo. Geologic party in charge of V. H. Barnett examined in detail 1,430 square miles of coal land. Land classified and geologic report partly prepared.

Little Powder River coal field, Crook County, Wyo. Geologic report of work done by John A. Davis in 1910 submitted (in Bulletin 471).

Buffalo-Sheridan coal field, Johnson and Sheridan counties, Wyo. Geologic party in charge of C. H. Wegemann examined in detail 90 square miles of coal land in connection with stratigraphic work along the east front of the Bighorn Mountains. Land classified.

Sussex coal field, Johnson County, Wyo. Geologic report of work done by C. H. Wegemann in 1910 submitted (in Bulletin 471).

Barber coal field, Johnson County, Wyo. Geologic report of work done by C. H. Wegemann in 1909 completed.

Powder River oil field, Johnson County, Wyo. Geologic report of work done by C. H. Wegemann in 1910 submitted (in Bulletin 471).

Lost Springs coal field, Converse County, Wyo. Geologic report of work done by D. E. Winchester in 1910 submitted (in Bulletin 471).

Oregon Basin and Meeteetse quandrangles, Park County, Wyo. D. F. Hewett, working in conjunction with a topographic party, examined in great detail 410 square miles of possible coal and oil land. Land classified.

Wind River coal region, Fremont and Natrona counties, Wyo. Geologic report of work done in 1908, 1909, and 1910 by E. G. Woodruff and D. E. Winchester submitted (in Bulletin 471).

Portion of central Uinta County, Wyo. Geologic report, based on field work by party in charge of A. R. Schultz in 1906, submitted for publication as separate bulletin.

Snake River valley, Idaho. C. F. Bowen, with one assistant, examined in a rapid reconnaissance 10,224 square miles of possible coal land. Land classified and two short geologic reports submitted.

Northwestern Oregon. Geologic report of work done by C. W. Washburne in 1910 on oil prospects submitted for publication.

North Park coal field, Jackson County, Colo. Geologic party in charge of A. L. Beekly examined in detail 1,777 square miles and covered by reconnaissance examination about 250 square miles additional. Land classified and geologic report prepared.

Meeker quadrangle, Rio Blanco County, Colo. E. T. Hancock, in conjunction with a topographic party, examined in great detail 216 square miles. Land classified and geologic report in course of preparation.

Glenwood Springs coal field, Garfield and Pitkin counties, Colo. Report on 216 square miles of coal field examined in great detail by A. L. Beekly in 1909 completed by G. S. Rogers.

De Beque oil field, Mesa and Garfield counties, Colo. Geologic report of work done by E. G. Woodruff in 1910 submitted (for Bulletin 531).

Coal resources of Gunnison Valley, Mesa and Delta counties, Colo. Geologic report of work done by E. G. Woodruff in 1910 submitted (in Bulletin 471).

Mancos coal field, Montezuma County, Colo. Geologic party in charge of Max A. Pishel examined in detail 829 square miles of supposed coal land. Land classified and geologic report in preparation.

Castle Valley coal field, Emery County, Utah. Geologic party in charge of C. T. Lupton examined in detail 500 square miles of supposed coal land. Land classified.

Blacktail (Tabby) Mountain coal field, Wasatch County, Utah. The examination of this field in 1910 was completed in the early part of the present fiscal year by the survey of 200 square miles of supposed coal land in the western part of the field. Land classified and geologic report submitted (in Bulletin 471).

Deep Creek district of Vernal coal field, Wasatch and Uinta counties, Utah. Geologic report of work done by C. T. Lupton in 1910 submitted (in Bulletin 471).

Sunnyside quadrangle, Carbon County, Utah. Frank R. Clark, in conjunction with a topographic party, examined in great detail 230 square miles. Geologic report in preparation.

Coalville coal field, Summit County, Utah. C. H. Wegemann examined in detail 70 square miles of coal land. Land classified.

Raton Mesa coal region, Colfax County, N. Mex., and Las Animas County, Colo. A comprehensive report on the stratigraphy of this region, by W. T. Lee, with descriptions of fossil plants, by F. H. Knowlton, is nearing completion. This report is the result of work done during this and previous seasons in the Raton Mesa region and also in several small coal fields of New Mexico.

Tijeras coal field, Bernalillo County, N. Mex. Geologic report submitted (in Bulletin 471) by W. T. Lee.

Silver Peak coal field, Esmeralda County, Nev., examined by J. H. Hance. Land classified and geologic report prepared.

Kern River oil field, Kern County, Cal., examined by geologic party in charge of R. W. Pack, under the direct supervision of Robert Anderson. The work embraced the examination not only of the Kern River field but also of adjacent territory on the east side of the San Joaquin Valley. Land classified.

South end of San Joaquin Valley, Cal. Preliminary report on the geology and possible oil resources (in Bulletin 471) prepared by Robert Anderson, as a result of field work of previous years.

Diablo Range, Cal. Geologic report on possible oil resources nearly completed by Robert Anderson, based on field work of previous seasons.

Pawnee, Otoe, Ponca, Kaw, and Tonkawa Indian reservations oil field, Okla. Reconnaissance examination made by R. H. Wood in spring of 1912. Report submitted (for Bulletin 531).

SUBSECTION OF FUELS EAST OF THE NINETY-SEVENTH MERIDIAN.

Work of chief of subsection.—David White held conferences and made examinations in the field with the cooperative parties, both Federal and State, engaged in the survey of the Waterloo, Milan, Carlyle, Okawville, and New Athens quadrangles, in Illinois; with the State geologist and field parties mapping the Missouri coal field and the Leavenworth quadrangle, the latter partly in Kansas; with those in the Vinita, Nowata, Claremore, and Shawnee quadrangles, in Oklahoma; those in the Pikeville, Crossville, and Rockwood quadrangles, in Tennessee; and those in the Wayne County oil fields of Kentucky. In these areas Mr. White aided the field geologists in correlation and in paleobotanic determinations of age.

Field paleontologic studies for correlating and grouping geologic formations were also made by Mr. White in Pawnee, Oklahoma, Logan, Atoka, and Pushmataha counties, Okla., and in Clay and Wichita counties, Tex.

At the close of the field season Mr. White made a brief examination of the phyllite near Worcester, Mass., to determine its geologic age; also, for the purpose of correlation, a hasty reconnaissance of the conglomerate at Dighton, Mass., to which Mansfield has given the name Dighton conglomerate, and of the series of beds near Dodgeville, Mass, which were included in the Tenmile River beds of Shaler, Woodworth, and Foerste. In addition to performing the administrative and committee work of the section, Mr. White has continued his studies of the regional variations of the Appalachian coals, concerning which he is preparing a paper. A small amount of

time has been available for examination and report on collections of Paleozoic plants submitted by several geologists.

Northern Appalachian region.—During the year no field examinations have been made of quadrangles in the coal, oil, or gas regions of Pennsylvania, the State Topographic and Geologic Survey Commission having insufficient funds for prosecuting cooperative field investigations.

The Foxburg-Clarion and Claysville folios (Nos. 178 and 180) and a report (Bulletin 454) on the coal, oil, and gas resources of the Foxburg quadrangle have been issued. Bulletins on the oil and gas resources of the Clarion and Sewickley quadrangles, prepared by M. J. Munn and transmitted several years ago by the Federal Survey for publication by the State Commission, have also been issued by the State.

The preparation of reports and folios covering the quadrangles already studied in the coal fields of Pennsylvania has progressed more rapidly since the return to the Federal Survey in March of George H. Ashley, who for nearly two years was State geologist of Tennessee. A bulletin on the economic geology of the Punxsutawney quadrangle has been prepared by him and a folio text for the same quadrangle has been nearly completed. The texts of folios covering the Curwensville and Houtzdale quadrangles are also well advanced. A folio for the Newcastle quadrangle, near the Ohio line in Pennsylvania, is also nearly ready for submission by F. W. De Wolf, whose time has been largely consumed by his duties as director of the State Geological Survey of Illinois. The folios mentioned, which will probably be submitted during the present calendar year, will complete the geologic descriptions and maps of the quadrangles in Pennsylvania that have been geologically surveyed in cooperation with the State.

Southern Appalachian region.—In Tennessee the valley rocks of the Pikeville 15-minute quadrangle have been thoroughly remapped by Charles Butts, in accordance with the most recent and complete differentiation and classification attained in other areas lately subjected by E. O. Ulrich and G. H. Girty to special paleontologic investigation. With the assistance of W. A. Nelson, of the Tennessee Geological Survey, with which the work was done in cooperation, Mr. Butts also mapped the geology of the Crossville quadrangle, besides making some reconnaissance examinations for the purpose of establishing more conclusively the identity between some of the sandstones of the Crossville quadrangle and those in the Standingstone and Briceville quadrangles described by Messrs. Campbell and Keith. In December, at the request of the State geologist, the services of E. Russell Lloyd were lent by this Survey to the State to make a detailed study of the geology of a tract known as the Herbert

domain, belonging to the State and located partly in the Pikeville 15-minute and Crossville quadrangles. The entire expense of the work was borne by the State of Tennessee.

The oil and gas developments over a large portion of Tennessee were examined by Mr. Munn, who under a cooperative agreement with the State Survey prepared short reports on the pools near Memphis and along Spring Creek in Overton County. These reports have been transmitted to the State geologist and published by the State.

In continuance of the oil and gas investigations earlier begun in cooperation with the Kentucky Geological Survey, Mr. Munn extended his examinations of the oil and gas pools of Wayne and Menifee counties and of the Ragland oil pool, in Bath and Rowan counties. A report by him on the oil and gas resources of Wayne County has been submitted for publication by the State. Preliminary reports on the Menifee, Bath, and Rowan County fields have been submitted for publication in Bulletin 531. Mr. Munn has in preparation also a general summary report describing the oil and gas developments of the southern Appalachian region.

The geology of the Cambrian and Ordovician formations in the Bessemer, Vandiver, and Columbiana quadrangles in Alabama was in June critically revised by Charles Butts, mainly to introduce a more exact and complete classification of the rocks. Two folio texts, covering the Bessemer and Vandiver quadrangles and the Montevallo and Columbiana quadrangles, have been prepared by Mr. Butts.

Central States.—In the Illinois coal field, where geologic surveying has for several years been in progress under cooperative agreements, E. W. Shaw has mapped the New Athens, Okawville, and Carlyle quadrangles and has revised the mapping of the Pleistocene formations of several other quadrangles surveyed by the State. He has submitted a folio text covering the New Athens and Okawville quadrangles and has written an economic report on the oil pools of the Carlyle quadrangle, which has been submitted for publication by the State.

In addition to performing the work above mentioned Mr. Shaw has arranged for folio publication a geologic report on the Belleville and Breese quadrangles. Jointly with A. C. Trowbridge, representing the State Survey, he has also prepared texts and maps for the Galena-Elizabeth folio and a State educational bulletin on the Galena-Elizabeth district.

In Iowa that portion of the Galena quadrangle lying west of Mississippi River has been geologically mapped at Federal expense by Mr. Shaw in order to acquire the data requisite for the completion of the Galena-Elizabeth folio.

The reconnaissance examination of the coal field of Missouri, begun in May, 1910, has been completed. In this work, which has been

carried on in cooperation with the State Bureau of Geology and Mines, Henry Hinds, the representative of the Federal Survey, has had for varying periods the assistance, in behalf of the State, of F. C. Greene, M. Albertson, and M. E. Wilson. Since the close of the field season in 1911 Mr. Hinds and Mr. Greene have been engaged in preparing a comprehensive economic report treating the entire coal field of Missouri by counties. This large and important report is now practically ready for transmission to be published by the State. In addition to the work more particularly of an economic nature, the Federal Survey has assisted in a reconnaissance examination of the upper Pennsylvanian rocks in the northwestern part of Missouri. The results of the work above described will be incorporated in a new geologic map to be issued by the State.

The detailed cooperative survey of a portion of the State of Missouri by quadrangles was begun in the summer of 1911 with the geologic mapping of the Leavenworth quadrangle, a portion of which lies in Kansas. In accordance with the plan for continuing the cooperation, the State began in June the detailed geologic investigation and mapping of the Queen City quadrangle.

In the region of the red beds of southwestern Oklahoma a very brief reconnaissance inspection was made in April by D. F. Hewett to determine whether the exposure of the beds and other conditions in that region are such as to encourage undertaking special structural studies of a kind particularly adapted to aiding the development of oil and gas resources.

WORK OF COMMITTEE ON GEOLOGIC NAMES.

The committee on geologic names was composed of Arthur Keith (chairman), M. R. Campbell (vice chairman), W. C. Alden, W. C. Mendenhall, F. L. Ransome, T. W. Stanton, G. W. Stose, and David White, until March 15. On that date Mr. Keith resigned from the chairmanship on account of pressure of other work and was succeeded by Mr. Stanton. On May 22 Mr. Mendenhall was succeeded by G. H. Ashley. The clerical work of the committee is performed by one clerk, Miss M. G. Wilmarth, who is designated as the 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; 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.

The amount of labor and research which devolves upon the committee can be understood from the statement that during the last fiscal year it considered 143 manuscripts, comprising a total of 21,614 pages and about 5,000 geologic names. These manuscripts discussed the geology of all parts of the United States.

DIVISION OF ALASKAN MINERAL RESOURCES.

CLASSES OF WORK.

The work of the division of Alaskan mineral resources was carried on under an appropriation of $100,000 for "continuation of the investigation of the mineral resources of Alaska." 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; investigation 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, 1911, there were employed in the division 1 geologist in

charge, 10 geologists, 4 topographers, 2 engineers, 3 clerks, and 1 draftsman on annual salaries, 2 geologic field assistants, and 25 camp hands and recorders. On June 30, 1912, the personnel of the division included 1 geologist in charge, 11 geologists, 4 topographers, 2 engineers, 1 draftsman, and 3 clerks on annual salaries, 1 geologist and 1 clerk on per diem salary, and 2 geologic field assistants. One geologist, employed for six months during the year, is not included in the above enumeration.

FIELD OPERATIONS IN SEASON OF 1911.

Allotments and areas covered.—Thirteen parties were engaged in surveys and investigations in Alaska during the season of 1911 for varying periods between April 20 and October 26. In addition to these the geologist in charge spent a part of the summer in Alaska carrying on geologic investigations and visiting field parties.

During the year 14,460 square miles were covered by reconnaissance topographic surveys (on a scale of 1:250,000) and 246 miles by detailed topographic surveys (on a scale of 1:62,500). Detailed geologic surveys were made of 496 square miles and geologic reconnaissance surveys of 10,550 square miles. In addition to this 8,000 square miles were covered by exploratory geologic surveys. Most of the geologists also spent considerable time in studying special problems connected with the mineral deposits. The investigation of the water supply in placer districts covered an area of approximately 8,000 square miles and included the maintenance of 68 gaging stations and 309 measurements of stream volume. Twelve of the thirty mining districts of Alaska which are being developed were visited by members of the staff. The following table shows the allotment of the appropriation to the different districts of Alaska. These figures include the cost of both field and office work, as well as inspection.

Allotment to Alaskan surveys and investigations in 1911.

Copper River region	$18,500
Prince William Sound	4,800
Kenai Peninsula	24,500
Susitna basin	5,100
Yukon basin	23,700
Noatak region	11,700
Northeastern Alaska	5,500
General investigations	6,200
	100,000

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 men may have carried on two different kinds of work, but this state-

ment will help to elucidate a later table which will summarize the complete areal surveys:

Approximate allotments to different kinds of surveys and investigations in 1911.

Geologic exploration	$5,200
Geologic reconnaissance surveys	37,600
Special geologic investigations	7,500
Topographic reconnaissance surveys	25,500
Detailed topographic surveys	4,700
Investigation of water resources	6,500
Collection of statistics of mineral production	1,100
Miscellaneous, including clerical salaries, administration, inspection, instruments, office supplies, and equipment	11,900
	100,000

Allotment for salaries and field expenses, 1911.

Scientific and technical salaries	$34,860
Field expenses	55,440
Clerical and other office salaries	9,700
	100,000

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 an unclassified amount—varying from year to year—is expended each year on special investigations that yield results which can not be expressed areally.

Progress of surveys in Alaska, 1898–1911.[a]

Year.	Appropriation.	Area covered by geologic surveys.			Area covered by topographic surveys.[b]					Water-resources investigations.	
		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.	Bench marks set.	Gaging stations maintained part of year.	Measurements of stream volume.
		Sq. m.	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Miles.*			
1898	$46,189.60	9,500	.....	.....	12,840	2,070	.....	.....	.....	.....	.....
1899	25,000.00	6,000	.....	.....	8,690	.....	.....	.....	.....	.....	.....
1900	60,000.00	3,300	6,700	.....	630	11,150	.....	.....	.....	.....	.....
1901	60,000.00	6,200	5,800	.....	10,200	5,450	.....	.....	.....	.....	.....
1902	60,000.00	5,950	10,050	.....	8,330	11,970	96	.....	.....	.....	.....
1903	60,000.00	5,000	8,000	96	.....	15,000	.....	.....	.....	.....	.....
1904	60,000.00	4,050	3,500	.....	800	6,480	480	86	19	.....	.....
1905	80,000.00	4,000	4,100	536	.....	4,880	787	202	28	.....	.....
1906	80,000.00	5,000	4,000	421	.....	13,500	40	.....	.....	14	286
1907	80,000.00	2,600	1,400	442	.....	6,120	501	95	16	48	457
1908	80,000.00	2,000	2,850	604	.....	3,980	427	76	9	53	556
1909	90,000.00	6,100	5,500	450	6,190	5,170	444	.....	.....	81	703
1910	90,000.00	.....	8,635	321	.....	13,815	36	.....	.....	69	429
1911	100,000.00	8,000	10,550	496	.....	14,460	246	.....	.....	68	309
	971,000.00	68,700	71,085	3,366	47,680	114,045	3,057	459	72	.....	.....
Percentage of total area of Alaska		11.72	12.12	0.57	8.16	19.45	0.52	.....	.....	.....	.....

[a] The areas presented in this table differ somewhat from those previously published. This is due in part to the reclassification of the work and in part to the fact that the areas have been more carefully scaled from the maps than formerly.

[b] In addition to the above, the International Boundary Survey and the Coast and Geodetic Survey have made surveys of parts of Alaska.

General investigations.—The geologist in charge was employed in office work until August, when he proceeded to Seattle and joined the party of the Secretary of the Interior. Details in regard to the itinerary of the Secretary's party have been published elsewhere, and it will therefore be sufficient to state here that parts of the Bering River coal field and of the Katalla oil field were visited and that the itinerary included journeys over the Copper River, Alaska Northern, and White Pass railways, down Lewis River to Lake Labarge, and over about 15 miles of the Valdez-Fairbanks military road. The geologist in charge left the party at Skagway on September 4 and proceeded to Juneau, where he spent two days in visiting some of the mines. Thence he returned to Valdez and devoted 10 days to a rapid reconnaissance of a part of the Port Valdez mining district. He reached Seward on September 24 and spent 10 days in studying the geology and mineral resources of a part of Kenai Peninsula, in company with Mr. Johnson and Mr. Martin. Conferences were also held in regard to topographic surveys with Mr. Sargent and Mr. Bagley. Returning, Mr. Brooks reached Seattle on October 15, proceeded to San Francisco to meet the Director, and, after attending the meeting of the American Mining Congress at Chicago, returned to Washington, arriving on October 28.

R. H. Sargent continued the general supervision of the topographic surveys and map compilation, in addition to carrying on his own field work. J. W. Bagley spent considerable time in devising methods and instruments for phototopographic surveys. These were successfully applied by him in his field work.

E. M. Aten continued to act as office assistant to the geologist in charge and supervised the office work while the geologist in charge was in the field. He also continued to assist in collecting the statistics of production of precious metals in Alaska.

Arthur Hollick, who was employed for six months, continued his study of the fossil flora of the coal measures of Alaska. W. W. Atwood also continued some office studies bearing on the coal resources of Alaska.

Southeastern Alaska.—Systematic surveys and investigations were begun in southeastern Alaska in 1901 and continued each season until 1910. The demands for surveys in other parts of the Territory prevented any further work in this province in 1911. This was unfortunate, for while the preliminary examination of much of this area has been completed and detailed surveys of the most important mining districts have been made, there is still great need for reconnaissance surveys which shall outline more definitely the geologic formations and thus furnish further evidence on the distribution of mineral resources.

Some office work was done during the year on a report treating of the region about Glacier and Lituya bays, by F. E. Wright.

C. W. Wright still has in hand the report on the copper deposits of the Kasaan Peninsula and Copper Mountain regions. His professional duties in Sardinia have prevented the completion of this report as early as he had hoped.[1]

Copper River region.—D. C. Witherspoon was assigned to the work of extending the reconnaissance survey southward from Hanagita Valley to the Bremner River region and revising the map of the lower Copper River valley. The party under his charge revised the mapping of an area of 900 square miles and surveyed a new area of 1,000 square miles, for publication on a scale of 1:250,000. Mr. Witherspoon also occupied some 20 triangulation stations which form part of a scheme for a system of triangulation from Copper Center to Chitina and from Chitina to the head of Bremner River.

F. H. Moffit, assisted by Theodore Chapin, made a geologic reconnaissance survey of about 1,500 square miles in the Hanagita Valley and Bremner River region. His party also examined the copper lodes and gold-placer prospects of the region.

Prince William Sound.—J. W. Bagley, assisted by C. E. Giffin, made a detailed topographic survey of the most important part of the Port Valdez mining district. Work in this district was begun on April 25 and continued until July 21, when the party was transferred to Kenai Peninsula. This survey was made by phototopographic methods. It covered an area of 160 square miles, for publication on a scale of 1:62,500, with 50-foot contours. A geologic reconnaissance of this area has already been made by A. H. Brooks. (See p. 75.)

Kenai Peninsula.—R. H. Sargent carried a topographic reconnaissance survey from Kachemak Bay northward to Turnagain Arm. The work included the revision and original mapping of part of the Sunrise placer district, and later the survey of the drainage basin of Resurrection River, near Seward. In all, an area of 3,100 square miles was surveyed, besides which the mapping of about 600 square miles was revised for publication on a scale of 1:250,000, with 200-foot contours.

J. W. Bagley, who began work in Kenai Peninsula on July 25 and continued it, so far as weather permitted, until October 13, made detailed topographic surveys of an area of 86 square miles (scale 1:62,500) in the Moose Pass region and also covered some 360 square miles by reconnaissance surveys, besides revising the mapping of an area of 170 square miles. These surveys were made by phototopographic methods.

G. C. Martin, assisted by Harmon Lewis, carried a geologic reconnaissance northward from Port Graham to Kenai River, thence eastward to the Alaska Northern Railway. In addition, Mr. Martin made some special geologic investigations in other parts of the

[1] Mr. Wright has submitted his report since the close of the fiscal year.

peninsula. The Martin party mapped an area of 800 square miles on a scale of 1:250,000.

B. L. Johnson was assigned to the study of the developments of auriferous lodes in the northern half of Kenai Peninsula. He made a more or less detailed examination of most of the important lodes and gold placers of this district and mapped the geology of the area covered by Mr. Bagley's survey in the Moose Pass region.

Susitna basin.—S. R. Capps completed a geologic reconnaissance of the Yentna placer district. The area covered was about 2,000 square miles, and the work included the examination of all the important gold placers of the district.

Yukon basin.—L. M. Prindle, assisted by J. B. Mertie, completed the areal reconnaissance mapping of the larger part of the Circle quadrangle, covering an area of about 4,000 square miles. Mr. Prindle also made a study of the placers of Fourth of July Creek.

Henry M. Eakin completed the geologic reconnaissance mapping of the part of the Rampart quadrangle previously covered by topographic surveys. He also carried the work west of the Yukon, over a previously unmapped area, of which some topographic sketch maps were made. The Eakin party mapped an area of about 2,000 square miles and also examined the gold placers of the Rampart, Hot Springs, and Gold Mountain districts.

The investigation of the water resources of the Yukon-Tanana region, which was begun at Fairbanks in 1907, was continued. E. A. Porter carried on investigations in the Fortymile district, where 27 gaging stations were maintained for 17 weeks and 80 measurements were made; in the Eagle district, where 6 stations were maintained for 15 weeks and 28 measurements made; and in the Seventymile district, where 9 stations were maintained for 14 weeks and 46 measurements made. C. E. Ellsworth worked in the Birch Creek district, where 15 stations were maintained for an average of 15 weeks and 78 measurements were made; in the Fairbanks district, where 10 stations were maintained for an average of 15 weeks and 74 measurements made; and in the Salchaket district, where 1 station was maintained for 15 weeks and 3 measurements were made.

Northeastern Alaska.—By courtesy of the boundary commissioner, Mr. O. H. Tittmann, the Survey was enabled to attach a geologist to the party which was engaged in surveying the boundary north of Porcupine River. A. G. Maddren, assisted by J. M. Jessup, was detailed for this work. Field work began on the Porcupine and was extended northward. Topographic maps prepared by the boundary surveyors (scale 1:45,000) were used as a base, and the areal mapping covered about 400 square miles, in addition to which about 200 square miles were mapped in a reconnaissance way.

Northwestern Alaska.—P. S. Smith, with C. E. Giffin, topographer, carried an exploration up Alatna River, across the divide to the

Noatak, and down that river to the Arctic Ocean at Kotzebue Sound. An area of about 10,000 square miles was mapped topographically, and the principal geologic features of about 8,000 square miles of this area were mapped.

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 1910 was completed in April, 1911, and published as Bulletin 480. This report contained the preliminary figures on mineral production, which were changed but little when the final figures were transmitted in August for inclusion in the Survey's annual volume "Mineral resources of the United States" for the calendar year 1910. The preliminary figures for mineral production in 1911 are included in the progress report for 1911, transmitted in June, 1912, and now in press as Bulletin 520.

FIELD OPERATIONS FOR SEASON OF 1912.

For many years the appropriation for continuing the investigation of the mineral resources of Alaska has been included in the annual urgent deficiency bill, and usually the money has been available not later than the 1st of February, so that parties have been dispatched to the remote parts of Alaska with the assurance that funds were available for continuing their work throughout the field season. Without such assurance the entering upon expensive field work would not be justified. In 1912, unfortunately, the Alaska item was put in the sundry civil bill, and the funds did not become available until after June 30. This condition has made necessary an entire change of field plans. Though supplies had been dispatched at heavy expense to Valdez Creek, to be used by parties which should extend surveys into the Broad Pass region, these surveys had to be abandoned because of the uncertainty of the appropriation. Other projected surveys in the Susitna and Matanuska basins also had to be given up.

The funds available until June 30 made it possible only to take up some of the more urgent work. A. G. Maddren was sent to continue geologic work north of the Porcupine in cooperation with the boundary survey parties. C. E. Ellsworth and R. W. Davenport were dispatched to continue stream gaging in the Yukon-Tanana region. In cooperation with the National Geographic Society, G. C. Martin undertook a study of the recent volcanic eruption in the Alaska Peninsula. H. M. Eakin left for the Ruby Creek district, in the Yukon basin, about the end of the fiscal year. No other surveys or investigations were possible before June 30.

OFFICE WORK.

During the year two professional papers (Nos. 69 and 70) and six bulletins (Nos. 448, 467, 480, 485, 500, and 504) relating to Alaska

have been issued. Three separates of parts of Bulletin 520 have also been published. Three bulletins (Nos. 498, 501, and 502) are in press. All these publications contain topographic maps. There have also been issued as sale publications two detailed topographic maps, those of Copper Mountain and vicinity and Kasaan Peninsula.

The following reports have been completed and illustrations for them are being prepared:

Coastal glaciers of Prince William Sound and Kenai Peninsula, by U. S. Grant and D. F. Higgins. (Bulletin 526.)

The surface water supply of Seward Peninsula, by F. F. Henshaw and G. L. Parker; with sketch of geography and geology, by P. S. Smith, and placer mining, by Alfred H. Brooks; including topographic reconnaissance map. (Water-Supply Paper 314.)

A geologic reconnaissance of the Fairbanks quadrangle, Alaska, by L. M. Prindle; with a detailed description of the Fairbanks district, by L. M. Prindle and F. J. Katz; including detailed and reconnaissance geologic and topographic maps. (Bulletin 525.)

In addition to these the following reports have been submitted during the year:

Geology of the Nome and Grand Central quadrangles, by F. H. Moffit; including detailed geologic and topographic maps.

The Hanagita-Bremner region, by F. H. Moffit; including reconnaissance geologic and topographic maps.

The Yentna district, by S. R. Capps; including reconnaissance geologic and topographic maps.

The Rampart quadrangle, by H. M. Eakin; including reconnaissance geologic and topographic maps.

The following reports are in hand:

Geology and ore deposits of Kasaan Peninsula and the Copper Mountain region, Prince of Wales Island, by C. W. Wright; including detailed geologic and topographic maps.

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

Kenai Peninsula, by G. C. Martin, B. L. Johnson, and U. S. Grant; including reconnaissance geologic and topographic maps.

The Koyukuk-Chandalar gold region, by A. G. Maddren; including reconnaissance geologic and topographic maps.

The Iditarod-Innoko region, by A. G. Maddren; including reconnaissance geologic and topographic maps.

The Circle quadrangle, by L. M. Prindle, including reconnaissance geologic and topographic maps.

The Noatak-Kobuk region, by Philip S. Smith; including reconnaissance geologic and topographic maps.

The following maps have been completed during the year and will be published as illustrations to reports:

Reconnaissance map of the Chitina quadrangle, by D. C. Witherspoon, T. G. Gerdine, and E. G. Hamilton; scale, 1:62,500; contour interval, 200 feet.

Reconnaissance map of the Koyukuk-Chandalar region, by T. G. Gerdine, D. C. Witherspoon, and A. G. Maddren; scale, 1:500,000; contour interval, 200 feet.

GEOLOGIC RESULTS.

Mr. Moffit's investigations in the Bremner River region show that the series of sediments which have been assigned to the Valdez group include Carboniferous and Mesozoic rocks. In Kenai Peninsula Mr. Martin and Mr. Johnson have found that Jurassic rocks are included in the Sunrise group, heretofore regarded as chiefly Paleozoic. Mr. Brooks found two excellently defined systems of fissuring in the Port Valdez region, and similar systems were found by Mr. Johnson in the northern part of Kenai Peninsula, where Mr. Johnson also discovered a close connection between igneous intrusion and auriferous mineralization. A similar relation between intrusion and mineralization was noted by Mr. Capps in the Yentna placer district, where, too, Mr. Capps found a heavy series of Tertiary gravels resting conformably on Eocene coal measures. These Tertiary beds are in turn overlain by glacial deposits. This goes to show that the heavy gravel sheet of this district, formerly believed to have been deposited during the retreat of the ice, is of preglacial age.

In the Rampart region Mr. Eakin was able to segregate a series of Mesozoic sediments which had formerly been grouped with the Paleozoic. While mapping the Circle district Mr. Prindle found some Quaternary lavas and also evidence of a small amount of local glaciation. Mr. Maddren divided the rocks along the international boundary north of the Porcupine into four groups, as follows: (1) Quartzites, phyllites, and slates (pre-Ordovician); (2) heavy limestone, with some shale, sandstone, and chert (Carboniferous); (3) sandy and calcareous shales (Triassic); (4) quartzites and slates, with some conglomerates (Mesozoic?). There is also considerable granite (Mesozoic?) in this region.

In northwestern Alaska the facts of most general geologic interest contributed by the geologic survey of the Alatna-Noatak region made by P. S. Smith included the finding of small existing glaciers in the headwaters of Alatna and Noatak rivers, the collection of Carboniferous fossils from ledges at several places in the Noatak Valley, and the determination from fossils found in float that Triassic rocks occur within the Noatak basin.

DIVISION OF MINERAL RESOURCES.

The scope of the work of the division of mineral resources during the fiscal year 1912 has been practically the same as that of the preceding year. The statistical work of the division was authorized by the act of August 7, 1882. The earlier reports contain chiefly statistical estimates prepared by experts on the subjects treated, together with more or less extended reviews of market conditions and of supply and demand, with special contributions on mining localities,

mining methods, and technical progress. During more recent years most of the chapters comprised in 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 which directs the Geological Survey to classify the public lands and examine the geologic structure, mineral resources, and products of the national domain. This plan has brought eminently satisfactory results, in that it gives to the statistical work the benefit of the cooperation of the geologist trained in economic work and, on the other hand, gives to the geologist the opportunity to study the industrial and commercial conditions which affect the demand for the minerals. No less attention has been given to the statistical phase in these later years, but more comprehensive studies have been made of the sources of the mineral production and the application of the products in the useful arts. The volumes have in this way grown into a cyclopedia of information concerning the mineral resources of the United States. Knowledge of the storehouses from which the future supplies are to be drawn is considered to be of prime importance—of greater value, indeed, than the record of past mining achievement which is presented in the statistical compilations.

Recent volumes have contained general maps showing the areas producing coal, the precious and semiprecious metals, iron ore, petroleum, natural gas, cement materials, gypsum, salt, and various other minerals, with brief descriptive notes. The report for 1911 will contain maps showing the localities producing the different kinds of building stones in the Eastern States. These will be followed by similar maps showing the areal distribution of building materials. There is also in preparation a chapter on the useful minerals of the United States. This will contain brief descriptions of the minerals and the localities in which they occur and indicate whether or not they are at present mined or are still undeveloped.

The plan of cooperation between the Geological Survey and certain State surveys in collecting mineral statistics continued in force in connection with the report for 1911. The 18 States which cooperated were Alabama, Georgia, Illinois, Iowa, Kansas, Kentucky, Maryland, Michigan, Missouri, New Jersey, North Carolina, Oklahoma, Oregon, Pennsylvania, Texas, Virginia, Washington, and Wisconsin. As this cooperation becomes better appreciated, both by the Federal Survey and the State surveys, and is better understood by the producers, it works more and more smoothly. Its results in 1911 were the most satisfactory yet obtained. The plan obviates a duplication of a considerable amount of work and 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 1910 and 1911. The report for 1909, which had been delayed on account of the cooperative arrangement with the Bureau of the Census, was issued during the early part of the fiscal year 1911. The report for 1910 was published early in the calendar year 1912, and the work on the report for 1911 was well advanced at the close of the fiscal year. Thus work on three different reports on the mineral resources of the United States was carried on during the fiscal year 1912. Although the report for 1910 was not completed until early in the calendar year 1912, the separate chapters on all of the subjects except three were published during the calendar year 1911. The following table gives the estimated percentage of schedules returned at the close of the fiscal years (June 30) 1909, 1910, 1911, and 1912 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, and 1912.

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

Preliminary estimates of the production of coal, cement, copper, lead, zinc, gold, silver, petroleum, quicksilver, and tungsten in 1911, with reviews of the conditions which prevailed during the year, were given to the press in the form of special press bulletins late in December, 1911, and in January and February, 1912.

Advance statements giving the official figures covering the production of copper, lead, and zinc, in 1911, have also been published. Advance chapters from the report for 1911 on the following subjects (30 in all) have been published or are in press at the close of the fiscal year: Potash salts, asbestos, bauxite and aluminum, talc and soapstone, graphite, sulphur and pyrite, salt, monazite and zircon, iron-ore reserves of Michigan, sand-lime brick, mica, phosphate rock, fuller's earth, quicksilver, cement, abrasive materials, precious stones, gypsum, chromite, borax, magnesite, tin, salt and bromine, asphaltum, pottery, anthracite coal, fuel briquetting, gold and silver in the Eastern States, iron ore and pig iron, and manganese ores.

The number of employees in Washington who devote their entire time to the work of the division of mineral resources is 28, and 8 persons are employed in the offices of the division outside of Washington, at Salt Lake City, Denver, and San Francisco. In addi-

tion to these, 19 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 55 connected with this work.

During the year 164,490 pieces of first-class mail matter (chiefly statistical inquiries) were sent out by the division and 61,109 pieces were received.

Edward W. Parker continued as administrative head of the division, and Waldemar Lindgren exercised supervision over the preparation of chapters on metalliferous ores and a report on platinum. In addition to his administrative duties Mr. Parker prepared 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, glass sand, etc., gypsum, iron ore, lime, manganese, and stone; B. S. Butler, copper; A. T. Coons, slate; D. T. Day, asphalt and bituminous rock, natural gas, and petroleum; J. S. Diller, asbestos and talc and soapstone; J. P. Dunlop, lead and zinc in the Central States and secondary metals; H. S. Gale, borax, magnesite, and nitrates; F. L. Hess, antimony, arsenic, nickel and cobalt, etc., and tin; H. D. McCaskey, gold, silver, and copper in the Central and Eastern States and quicksilver; G. C. Matson, mineral waters; Jefferson Middleton, clay, clay-working industries, fuller's earth, quartz and feldspar, and sand-lime brick; W. C. Phalen, abrasive materials, barytes, bauxite and aluminum, chromite, mineral paints, potash salts, salt and bromine, sodium salts, strontium, and sulphur and pyrite; C. E. Siebenthal, lead and zinc; D. B. Sterrett, gems and precious stones, mica, and monazite and zircon; W. T. Thom, summary of the mineral production; and F. B. Van Horn, phosphate rock. In addition to preparing his reports, Mr. McCaskey has exercised 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.

DIVISION OF CHEMICAL AND PHYSICAL RESEARCH.

During the fiscal year the chemical laboratory reported 388 quantitative analyses and 778 qualitative determinations, chiefly of minerals sent for examination by persons not connected with the Survey.

George F. Becker, the geologist in charge of the division, has been engaged chiefly in studying the effect of radioactivity on the cooling of the earth. He contrived a new device for determining the viscosity of liquids and spent some time in consultations on the effect of electrolytic action due to difference of potential of sulphides on the decomposition of ores. He also completed a paper showing that the formulas of "imaginary geometry" are applicable to the study of rock strains.

F. W. Clarke supervised the publication of the new edition of his "Data of geochemistry" (Bulletin 491) and also prepared a paper on geochemical statistics.

George Steiger was occupied with routine quantitative analyses and experimental work to show the exact conditions to be observed in the colorimetric determination of manganese.

Chase Palmer made a number of analyses of rocks and minerals and did research work on a selenide mineral containing gold. His paper entitled "The geochemical interpretation of water analyses" was published as Bulletin 479.

R. C. Wells analyzed some rocks from the Canal Zone and other localities and did research work on the fractional precipitation of silicates and hydroxides.

W. T. Schaller made numerous chemical and mineralogical determinations and quantitative rock analyses, including the description of several new mineral species. His "Mineralogical notes," series 1 and 2, were published as Bulletins 490 and 509 of the Survey. Mr. Schaller resigned from the Survey March 31 for the purpose of studying abroad, and Walter F. Hunt, of Ann Arbor, Mich., was appointed to fill temporarily the vacancy caused by his resignation.

J. G. Fairchild analyzed phosphate rocks, limestones, and some minerals and also elaborated and published a method for determining phosphoric acid in phosphate rock.

The work in the physical laboratory, under the direction of C. E. Van Orstrand, has continued along the same lines as heretofore, except that the experiments on elasticity and plasticity have been discontinued temporarily pending the appointment of an assistant. The experiments on the diffusion of solids have been continued throughout the year, and the scope of the investigation has been extended to include a study of the variation of diffusion with both pressure and temperature. Two mathematical tables have been completed. The first consists of sixteen hundred 18-place values of the circular sine and cosine, and the second consists of twenty-five hundred 10-place values of the inverse gudermannian, each to radian argument. A table of the ascending exponential has been begun. A portion of the table on the probability integral will be ready for publication in a few months.

LAND-CLASSIFICATION BOARD.

ORGANIZATION.

The land-classification board began the fiscal year 1911–12 with the organization and the personnel of the preceding fiscal year. Changes have since been effected through reorganization, resignations, and new appointments, so that at the end of the year the board, now a definitely organized branch of the Geological Survey,

has a staff of 30 permanent employees. Of this number 12 are professional workers, either geologists or engineers of the various grades, 4 are technical, and 14 are clerical or subclerical. In addition to these, temporary or occasional service has been rendered by about 22 others, of whom 14 are geologists and engineers of the field branches who either have been assigned to the board for short periods or have acted in an advisory capacity as members of the various classification sections. The remaining nonpermanent employees have held technical or clerical appointments.

Much the most important change of the year was that effected by the Director's order of May 1, 1912, by which the status of the board was changed from that of a section in the geologic branch to an independent branch coordinate in responsibilities and functions with the geologic, topographic, and water-resources branches. The new branch, retaining its old name, land-classification board, includes two divisions—that of mineral classification and that of hydrographic classification—and each of these divisions contains a group of sections dealing directly with a particular resource or a particular problem. The branch is organized as follows:

Land-classification board.

Administration.

W. C. Mendenhall, chief of board.
N. C. Grover, chief engineer.
Elsie Patterson, secretary.

Division of mineral classification.

W. C. Mendenhall, geologist in charge.
Coal section—George H. Ashley, chairman.
Oil section—M. W. Ball, chairman.
Phosphate section—A. R. Schultz, chairman.
Metalliferous section—A. R. Schultz, chairman.

Division of hydrographic classification.

N. C. Grover, chief engineer in charge.
Water-power section—W. B. Heroy, chairman.
Irrigation section—Herman Stabler, chairman.

The reorganization made a definite change in the relations of the board to the field branches of the Survey. The order creating the new branch defined its duties as the consideration of questions of Survey policy in matters relating to land classification and the preparation of reports thereon to the Director, and the receiving from other branches and the recording of all data valuable in the administration of the public lands. In the fulfillment of these functions the board prepares all letters or papers relating to the classification of the public lands and the administration of the public domain.

The most important changes in the staff have been the appointment of A. R. Schultz, assistant geologist, as chairman of the phosphate section on August 16, 1911; the resignation of W. R. Calvert, effective on April 1, 1912; and the appointment of George H. Ashley to take the place made vacant by Mr. Calvert's resignation.

Mr. Schultz was at first placed in charge of the phosphate work of the board, which had fallen greatly in arrears because of the inadequacy of the force, and later his authority was extended to include the work of the section on metalliferous deposits.

Mr. Ashley, State geologist of Tennessee for two years prior to his reappointment on the Geological Survey as a member of the land-classification board, replaced Mr. Calvert as chairman of the coal section.

SPECIAL FEATURES.

The work of the board during the last year has in general followed the lines along which its activities have been exercised during the two preceding years. There has been increase in the volume rather than change in the type of work. Orders from the Secretary of the Interior, however, have resulted in some expansion other than that in volume merely. On January 11 and 18 orders were issued that all entries and selections which are not specifically excepted from reservation under the act of June 25, 1910 (36 Stat., 847), and under which a vested right has not accrued should be submitted to the Geological Survey by the Commissioner of the General Land Office for report as to any mineral or power values involved. Under these and earlier orders and cooperative agreements, approximately 12,000 cases of various types, including right-of-way applications and enlarged-homestead petitions, were referred to the Geological Survey during the fiscal year and action was taken on about 10,000 of these. In the special-agent cases and the requests for information from the General Land Office and the Indian Office, which form a very large percentage of the total referred cases, the mineral or power values of the lands are chiefly involved, and in all cases where the Survey's records showed that the lands were nonmineral and had no power or reservoir values the General Land Office was saved the necessity of field examinations.

The value to the department of the orders of January 11 and 18, 1912, is indicated in the fact that in only 292 of the 2,844 cases reported upon by the Survey under these orders since March 1 has it been necessary to recommend examination in the field by the agents of the General Land Office. The time and expense of making such field examinations were saved in the great majority of the remaining 2,552 cases, and even if this represents a higher percentage than will be maintained on the average, the result is a marked saving to the department as a whole and indicates a distinct advance in efficiency.

Action taken on requests for information under cooperative agreement of March 5, 1912.

State.	Received.	Acted on.							Pending.
		Mineral.	Non-mineral.	Field examination recommended (mineral).	Power.	Non-power.	Field examination recommended (power).	Total.	
Alabama	7	.....	.....	6	.....	6	.....	6	1
Alaska	71	1	63	.....	2	23	.....	65	6
Arizona	110	.....	38	.....	2	45	.....	47	63
Arkansas	5	0	0	0	0	0	0	0	5
California	301	4	80	63	2	209	5	227	74
Colorado	83	3	27	0	1	58	0	64	19
Florida	31	0	2	0	0	29	0	29	2
Idaho	308	0	72	27	0	131	0	132	176
Kansas	3	0	2	0	0	2	0	2	1
Louisiana	15	0	1	0	0	1	0	1	14
Michigan	1	0	1	0	0	1	0	1	.....
Minnesota	77	0	10	0	0	17	0	24	53
Mississippi	1	0	0	0	0	0	0	0	1
Montana	840	0	177	35	4	366	0	371	469
Nebraska	15	0	14	0	0	14	0	14	1
Nevada	97	0	0	1	0	3	0	3	94
New Mexico	712	1	27	5	0	461	0	462	250
North Dakota	69	0	8	0	0	44	0	44	25
Oregon	409	1	24	38	7	308	1	318	91
South Dakota	8	1	3	0	0	3	0	4	4
Utah	410	6	5	0	2	154	0	157	253
Washington	382	0	17	19	19	267	0	287	95
Wisconsin	9	0	2	0	0	2	0	2	7
Wyoming	871	44	384	92	3	579	1	584	287
	[a] 4,835	61	957	286	42	2,723	7	[b] 2,844	[b] 1,991

[a] A large number of these cases were received prior to the adoption of the cooperative agreement of Mar. 5, 1912.

[b] Certain of these cases are accompanied by reports as to mineral character and are included as minera cases in the table below, showing the action taken on reports by Land Office field agents during the year

The table below shows the action taken on reports on the mineral or power value of lands rendered by Land Office field agents during the year and submitted to the Survey for a recommendation of appropriate action.

Work of Land Office field service showing mineral character and power-site and reservoir possibilities of lands.

State.	Pending July 1, 1911.	Received July 1, 1911, to June 30, 1912.	Acted on.			Total acted on.	Pending July 1, 1912.
			Approved.	Part approved.	Disapproved.		
Arizona	.....	18	13	.....	.....	13	5
Arkansas	.....	1	.....	.....	1	1	.....
California	18	163	93	1	23	117	64
Colorado	40	171	144	1	39	184	27
Florida	3	3	2	.....	3	5	1
Idaho	14	163	120	4	41	165	12
Louisiana	10	32	41	.....	1	42	.....
Minnesota	.....	24	.....	.....	.....	.....	24
Montana	57	529	456	9	87	552	34
Nevada	0	42	30	.....	1	31	11
New Mexico	1	487	231	2	3	236	252
North Dakota	5	179	102	.....	10	112	72
Oregon	54	679	589	4	8	601	132
South Dakota	.....	.....	.....	.....	.....	.....	.....
Utah	116	451	453	2	11	466	101
Washington	3	275	218	3	20	241	37
Wyoming	39	149	157	2	12	171	17
	360	3,366	2,649	28	260	2,937	789

In addition to the cases shown in the foregoing table, the Land Office, in compliance with departmental order of April 27, 1911, has requested information as to power-site value in 188 cases involving lands recommended for elimination from national forests or included in restorations of administrative sites, of which number 164 were received during the fiscal year. The Survey has complied with 172 of these requests, and 16 are pending at the end of the fiscal year.

Work has continued throughout the year under the departmental order of March 27, 1911, requiring a report by the Geological Survey as to the mineral character and power or reservoir value of lands included in tribal allotments or proposed town sites on Indian lands. By order of the First Assistant Secretary of August 23, 1911, the preparation of these reports has been made special, although this preference has at times necessitated the neglect of other work. The Indian Office has forwarded 4,876 such requests for data during the year. The Survey has furnished information in 3,385 cases, and 1,494 cases are now pending.

Another feature of the work of the year that is of special interest was the establishment of a new type of reserve by recommending to the department the withdrawal from entry, by presidential action, of certain lands in the arid West that are known to be valuable in protecting the public range, because of the water supplies on them. Only three desert water reserves of this type have thus far been created. because the energies of the board have been so largely absorbed by its regular work that it could give but little attention to this feature. The information available in the Survey, however, is gradually being assembled, and as a result the creation of other reserves will be recommended to the Secretary during the fiscal year 1912–13.

By direction of the Secretary of the Interior an attempt has been made, in cooperation with officials of the Forest Service, to devise regulations for water-power development under the act of February 15, 1901 (31 Stat., 790), which shall provide for uniform administration by the departments of the Interior and of Agriculture on the public lands and the national forests. A draft of proposed regulations prepared in conference with the Forest Service was informally transmitted to the office of the Secretary of the Interior.

In connection with its work under the Carey Act the Geological Survey has continued to render to the Secretary, through the Commissioner of the General Land Office, full and detailed reports on the water supply available, the duty of water, the control of lands, the feasibility of the structures involved and of the project as a whole, and the protection afforded to the settlers under the contract with the State. It has urged that the investigation of these matters shall be much more thorough than in the past in order that the interests of settlers on Carey Act projects may be fully safeguarded.

To this end it has drafted and recommended to the Secretary for adoption detailed changes in the regulations governing the presentation by the States of applications for the segregation of lands under that act.

In the matter of internal organization and procedure there has been an endeavor to simplify and systematize the work of the Board, to the end that the available force might become more efficient and with a given expenditure of energy might produce a larger and more accurate output. Among the devices adopted for this purpose have been certain types of form letters, to be used in the simpler Land Office and Indian Office cases, and a series of "safety maps," prepared for each of the public-land States, to facilitate answers to inquiries as to mineral or power values. Two groups of these maps are in course of preparation—one by the division of mineral classification and the other by the division of hydrographic classification. On maps in the first group all areas known or suspected to contain mineral deposits of any type are colored in accordance with a definite plan. The remaining white areas may thereafter be automatically clear-listed as to mineral values. Similarly in the division of hydrographic classification maps have been prepared on which all areas known or suspected to contain reservoir sites or lands valuable for power development are appropriately colored. Thereafter the lands remaining white on these maps may be automatically clear-listed without special search of the records and the literature.

DIVISION OF MINERAL CLASSIFICATION.

The division of mineral classification receives from the geologic branch the results of the field work of its force and prepares from them the official classifications of mineral lands. Its work deals primarily with the classes of deposits whose reservation from entry is authorized by the withdrawal act (36 Stat., 847), namely, coal, oil and gas, and phosphate, but it also passes on the character of lands applied for under the nonmineral-land laws. An important special case of the latter type arising during the past year has been the classification of Northern Pacific Railroad grant lands under the act of February 26, 1895 (28 Stat., 683).

COAL.

The fiscal year 1911–12 has been notable, as regards the classification of coal lands, principally in that for the first time the lands classified and restored have much exceeded in area those withdrawn for classification, so that at the end of the year there was a substantial reduction in the area of land withdrawn. Heretofore, though the examinations have resulted in an increase in the area classified and restored each year and so have subtracted from the area with-

drawn, new information has led to the withdrawal of additional lands whose area has far exceeded that of the lands restored. Although no prediction on this point can be made with absolute certainty, it is probable that the area of withdrawn lands will continue to be decreased.

Classifications.—During the fiscal year 847,601 acres were classified as coal land and valued at $14,751,472 and 13,794,262 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, where the appraised values under the regulations are the minimum fixed by law. Other large areas that are known to contain some coal have been withdrawn pending classification, and much of this land has been examined, classified, and restored to entry. Examination of some of these areas has revealed considerable land containing workable coal and work on other areas has shown that the workable coal is of small amount, so that much of the land withdrawn could be restored as noncoal as a result of relatively rapid work. On the other hand, the field work in areas containing thick and high-grade coals has been done with greater detail and care, covering smaller areas than in previous years, so that the total value of coal lands priced is not large as compared with the total value of lands priced in earlier years. No small part of the work has been the classification of lands in the Indian reservations that were to be thrown open to settlement. The following table shows the progress of coal-land classification by States during the year:

Coal land classified during the year ended June 30, 1912.

State.	Outstanding June 30.	Area classified as coal land and appraised (acres).		Area classified as non-coal land (acres).		Valuation fixed.		Minimum valuation.		Average price per acre.	
		Under old regulations.	Under new regulations.	Under old regulations.	Under new regulations.	Under old regulations.	Under new regulations.	Under old regulations.	Under new regulations.	Old regulations.	New regulations.
Arizona	1911	.....	.....	.....	42,492	.....	.....	.....	.....	.....	.....
	1912	.....	.....	.....	42,492	.....	.....	.....	.....	.....	.....
Arkansas	1911	60,715	.....	70,038	.....	$1,473,762	.....	$1,214,280	.....	$24.30	.....
	1912	60,715	.....	70,038	.....	1,473,762	.....	1,214,280	.....	24.30	.....
California	1911	.....	7,720	.....	6,242	.....	$585,086	.....	$154,404	.....	$75.80
	1912	.....	7,720	.....	6,242	.....	585,086	.....	154,404	.....	75.80
Colorado	1911	.....	2,873,929	882,897	4,542,167	.....	167,775,104	.....	50,309,589	.....	58.40
	1912	.....	2,880,215	882,897	4,988,539	.....	168,374,600	.....	50,435,309	.....	58.50
Idaho	1911	.....	.....	.....	1,280,553	.....	.....	.....	.....	.....	.....
	1912	.....	.....	.....	6,710,572	.....	.....	.....	.....	.....	.....
Montana	1911	201,743	3,310,605	3,489,322	6,845,842	3,075,233	91,388,414	3,000,433	73,397,947	15.20	27.60
	1912	198,863	3,973,132	3,489,322	11,721,135	2,955,833	102,365,003	2,942,833	83,564,170	14.90	25.80
New Mexico	1911	363,767	590,447	2,065,217	739,739	6,714,123	14,547,541	6,702,063	6,821,729	18.50	24.60
	1912	363,767	590,285	2,065,217	798,951	6,714,123	14,566,039	6,702,063	6,818,289	18.50	24.70
North Dakota	1911	230,814	.....	.....	1,020,999	4,584,255	.....	4,584,255	.....	19.90	.....
	1912	230,814	.....	.....	1,020,999	4,584,255	.....	4,584,255	.....	19.90	.....
Oregon	1911	.....	1,897	893,318	176,785	.....	49,909	.....	37,919	.....	26.30
	1912	.....	1,897	893,318	176,785	.....	49,909	.....	37,919	.....	26.30
South Dakota	1911	.....	.....	.....	4,835,334	.....	.....	.....	.....	.....	.....
	1912	.....	82,217	.....	6,517,626	.....	831,270	.....	831,270	.....	10.10
Utah	1911	.....	636,479	712,675	1,212,838	.....	36,576,849	.....	8,287,783	.....	57.50
	1912	.....	670,306	602,771	1,719,120	.....	38,323,592	.....	8,678,513	.....	57.20
Washington	1911	.....	40	627,198	6,240	.....	2,000	.....	800	.....	50.00
	1912	.....	40	607,238	32,036	.....	2,000	.....	800	.....	50.00
Wyoming	1911	1,273,798	5,873,921	1,760,217	8,073,626	21,899,566	359,905,292	20,080,162	89,853,555	17.20	61.30
	1912	1,271,638	5,907,836	1,693,403	8,822,622	21,737,722	360,484,168	20,044,162	90,387,983	17.10	61.10
Total areas recorded as classified	1911	2,130,837	13,295,038	10,500,882	28,782,857	37,746,939	670,830,195	35,581,193	228,863,726	17.70	50.50
	1912	2,125,797	14,113,648	10,304,204	42,577,119	37,465,695	685,581,667	35,487,593	240,908,657	17.60	48.50
		a—5,040	818,610	a—196,678	13,794,262	a—281,244	14,751,472	a—93,600	12,044,931	55.80	18.10

a Reductions during the year from former classification under old regulations, comprising lands either rewithdrawn or reclassified under new regulations.

The sale of coal lands at the new figures has continued at a moderate rate during the last year as during the years immediately preceding. In all, 7,951.05 acres were sold, for $402,521.78, an average price of $50.62 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, with the increasing 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. The 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, as it was feared by some it might be. Further, a comparison of the sales of coal land for the five years preceding and following the adoption of the classification policy shows a gain in the receipts from the sale of coal lands, with a slight decrease in the acreage sold. The following table shows the relations of the sales for the two five-year periods immediately preceding and following July 1, 1907:

Sales of coal land at all prices in the United States, exclusive of Alaska, from 1902 to 1911.

Five years prior to July 1, 1907.

Fiscal year	Entries.	Acres.	Receipts.	Average price per acre.
1902–3	252	38,007.88	$498,997.00	$13.13
1903–4	190	28,827.42	395,209.90	13.74
1904–5	158	20,456.35	277,402.40	13.56
1905–6	244	42,143.39	538,683.70	12.54
1906–7	157	20,387.02	303,255.60	14.80
	1,001	149,822.06	2,013,548.60	13.44

Five years since July 1, 1907.

1907–8	299	58,047.10	$647,584.55	$11.15
1908–9	182	26,590.68	502,743.65	18.90
1909–10	189	26,074.16	657,175.80	25.20
1910–11	83	15,284.89	251,323.03	16.44
1911–12	76	7,951.05	402,521.78	50.62
	829	133,947.88	2,461,348.81	18.30

Under the regulations now in force a large share of the coal land will continue to be classified at the minimum price. Practically all the land in the Dakotas is being so priced, and much of that in Montana, besides a considerable percentage of the land classified in other States, so that purchases will continue to be made mainly at the minimum prices. As indicating that the higher-priced coal lands also sell, notwithstanding the higher prices, the following table is given, showing the prices at which coal lands have been sold, the num-

ber of entries at the different prices, the acres sold at those prices, and the receipts:

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	352	50,067.25	$501,553.13	$100.00	1	38.48	3,848.00
12.50	1	56.03	700.38	120.00	1	40	4,800.00
14.50	1	40	580.00	130.00	1	38.54	5,010.20
15.00	16	2,470.55	37,058.25	135.00	1	80	10,800.00
17.50	1	40	700.00	140.00	1	120	16,800.00
20.00	276	54,655.65	809,481.20	145.00	1	40	5,800.00
25.00	41	11,691.68	144,671.70	155.00	1	40	6,200.00
30.00	25	3,239.81	97,194.30	170.00	1	39.89	6,781.30
33.00	1	40	1,320.00	180.00	1	40	7,200.00
35.00	2	239.78	8,392.30	270.00	1	39.79	10,743.30
36.00	1	40	1,440.00	370.00	1	41.40	15,318.00
40.00	9	840.72	33,628.80	375.00	1	41.73	15,648.75
45.00	1	280	12,600.00	385.00	2	83.14	32,008.90
49.00	1	40	1,960.00	390.00	1	41.64	16,239.60
50.00	70	8,338.63	415,023.00	395.00	2	124.63	49,228.85
65.00	.....	200	13,000.00	400.00	2	83.15	33,260.00
70.00	1	40.79	2,855.30	405.00	3	166.51	67,436.55
75.00	2	161.23	12,092.25	410.00	2	83.39	34,189.90
90.00	2	204.96	18,446.40				
92.00	1	40	3,680.00		829	133,947.88	2,461,348.81
95.00	1	38.51	3,658.45				

Withdrawals and restorations.—As predicted in the report on this subject for 1911, the area of lands withdrawn during the fiscal year 1911–12 has been small as compared with that withdrawn during preceding years and for the first time has been 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, 1911. Of the withdrawals made during 1911–12 that in Colorado, in the Denver Basin, involves only a relatively small amount of public land. The continued striking of workable coal in water wells in this area made it seem desirable to withdraw all the public land in the basin.

Coal lands withdrawn during the fiscal year 1911–12.

State.	Outstanding July 1, 1911.	New withdrawals during fiscal year.	Restorations during fiscal year.	Outstanding June 30, 1912.
	Acres.	*Acres.*	*Acres.*	*Acres.*
Arizona	118,718	.....	.....	118,718
California	239,903	.....	.....	239,903
Colorado	5,517,338	3,004,889	277,164	8,245,063
Idaho	6,985,417	11,520	5,430,019	1,566,918
Montana	19,890,471	20,189	2,268,369	17,642,291
Nevada	92,141	.....	.....	92,141
New Mexico	5,809,490	.....	59,050	5,750,440
North Dakota	18,454,490	.....	80	18,454,410
Oregon	3,521	.....	.....	3,521
South Dakota	2,375,263	.....	1,508,454	866,809
Utah	6,221,314	654,834	511,365	6,364,783
Washington	2,210,807	41,745	46,362	2,206,190
Wyoming	7,013,543	19,716	368,957	6,654,302
	74,932,416	3,752,893	10,469,820	68,215,489

Application for classification.—Increased understanding of the operation and effect of the act of June 22, 1910, is resulting in a decrease in the number of applications for the classification of lands included in coal withdrawals. A few entrymen, however, because entries under that act can not be commuted or because of other requirements or restrictions, object to patents reserving coal to the United States and therefore file applications to have lands classified as noncoal. Most of the affidavits by which such applications are supported are valueless, and therefore few such requests can be granted, since the withdrawals are made for the purpose of retaining title to the coal in the Government until information adequate for classification is obtained. The following table shows the action taken on cases of this class since the passage of the act under which they are made.

Applications for classification of withdrawn coal lands.

Year.	Received.	Approved.	Denied.	Pending.
1910–11	46	4	36	6
1911–12	18	1	22	1
	64	5	58	1

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.

There is a notable decrease in these applications from year to year, also due, doubtless, to the fact that the act of June 22, 1910 (36 Stat., 583), provides for homestead and desert-land entries on coal lands with a reservation of the coal to the United States. During the fiscal year following the passage of the act (1910–11) the number of applications was only a little over one-third that of the preceding year. The number received during the year 1911–12 is only a little over one-half that received during 1910–11, showing that the entryman who looked upon a reservation of coal to the Government as a cloud on the title is coming to realize that a restricted patent with the safeguards provided by the act referred to is not in any sense clouded. That the passage of the act of April 30, 1912,

extending the provisions of the act of June 22, 1910, to State selections, soldiers' additional homesteads, and isolated tract sales will result in a still further decrease in the number of applications for reclassification is indicated by the fact that of the 26 applications received during the year 7 were made in a single State. The following table shows the action on these applications since they first began to be received:

Applications for reclassification of coal lands.

Year.	Received.	Approved.	Part approved.	Denied.	Pending.
1909–10	126	3	3	116	4
1910–11	48	0	0	21	[a] 29
1911–12	29	0	0	53	[b] 4
	203	3	3	190	4

[a] One case canceled by relinquishment and one returned to entryman.
[b] One case recalled by General Land Office.

OIL.

No legislation providing for the disposition of oil and gas in the public domain has been enacted during the year, and these minerals must be acquired, if at all, under the wholly unsatisfactory placer law, which adequately protects neither the Government nor the oil operator. In order to retain in public ownership all lands that are probably oil-bearing, pending the passage of a satisfactory oil and gas law, the withdrawn area has been increased during the year by 803,753 acres. A relatively small area in the West Side fields of California was withdrawn because of recent developments showing that the productive territory extends farther under the San Joaquin Valley than had at first been supposed. A withdrawal was made of over a million and a quarter acres in a little-known region in east-central Utah, which is indicated as a result of a preliminary examination by Survey geologists to be favorable for oil accumulation. Restorations were made of areas in California, New Mexico, and Wyoming, which were found not to be valuable for oil or gas. The following table shows the action during the year, by States:

Summary of withdrawals of oil lands, fiscal year 1911–12, in acres.

State.	Outstanding July 1, 1911.	New withdrawals.	Restorations.	Outstanding June 30, 1912.
Arizona	230,400			230,400
California	1,592,704	23,947	640	1,616,011
Colorado	87,474			87,474
Louisiana	414,720			414,720
New Mexico	419,901		419,901	0
Oregon	74,849			74,849
Utah	581,566	1,370,760		1,952,326
Wyoming	568,815		170,413	398,402
Total	3,970,429	1,394,707	590,954	4,774,182

PHOSPHATE.

The examination of phosphate deposits in the Rocky Mountain region was begun by the United States Geological Survey in 1909 and has been continued every year since that time. During the summer of 1911 deposits of phosphate rock similar in character to the deposits of eastern Idaho, and at the same geologic horizon, were discovered in west-central Montana, in the vicinity of Garrison, Elliston, and Philipsburg, by United States Geological Survey parties making examinations of Northern Pacific Railway lands. These discoveries proved that valuable phosphate beds extend much farther north and are distributed over a much wider territory than had formerly been supposed.

The phosphate discoveries made in examining the Northern Pacific lands, together with the phosphate examinations in eastern Idaho and western Wyoming, show that considerable areas now known to contain phosphate deposits were not included in the phosphate withdrawals. In order to protect these newly discovered phosphate beds and reserve them for future use pending the enactment of appropriate legislation for their disposition, all public lands containing valuable phosphate beds not included in existing phosphate reserves were withdrawn from entry. Any lands in a phosphate reserve that were examined and found to contain no phosphate deposits were restored to agricultural entry. Withdrawals and restorations have been made to cover all the phosphate lands examined in the summer of 1911, except those examined in western Wyoming, in the vicinity of the Gros Ventre Mountains. As soon as the data obtained in the examination are assembled the limits of the phosphate reserve in this region will be so modified as to include only lands shown by the examination to contain phosphate.

The year 1911–12 has been very productive as regards the examination of phosphate land. The area examined in detail and in a reconnaissance way, together with the area examined in connection with the Northern Pacific grant lands, greatly extended the knowledge of the western phosphate field. The field examinations this year, as in previous years, have materially increased the area withdrawn, so that at the end of the year the area covered by outstanding withdrawals is nearly a million acres more than a year ago. The field examinations each year have increased the area restored to agricultural entry and subtracted from the outstanding withdrawals all areas found to contain no phosphate. New information gathered each year has led to the withdrawal of additional lands not previously known to contain phosphate beds, and thus far the withdrawn lands far exceed the restored lands in area. As further field examinations are made the results will likely be reversed, and the restoration will exceed the withdrawals as soon as most of the

phosphate land is included within the reserves, and thereafter field examinations will continue to cut down the area of the outstanding withdrawals.

Phosphate deposits must be acquired, if at all, under the present mining laws applicable to lode or placer claims, neither of which is satisfactory for the disposition of the stratified sedimentary phosphate beds. A number of measures, including a bill providing for "the acquiring of title to public lands classified as and carrying phosphate deposits," similar in tenor to the act of March 3, 1909, providing " for the protection of the surface rights of entrymen on coal land," were introduced during the second session of the Sixty-second Congress, but thus far none has become law.

During the year the regulations governing the withdrawals and restorations of phosphate lands have been so modified as to exclude from the phosphate reserves all deposits that do not contain phosphate in sufficient quantities to warrant holding them for this mineral. All sandstones, shales, and limestones containing less than 30 per cent of tricalcium phosphate are not considered phosphate deposits. Phosphate beds that are 6 feet or more thick and that 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.

The area withdrawn as a result of the examinations made in Montana comprises 240,911 acres. Detailed and reconnaissance examinations made in Idaho resulted in withdrawing 354,717 acres of phosphate land and restoring 349,049 acres to agricultural entry. As a result of the Survey's reconnaissance examinations in Wyoming, 826 acres were restored to entry and 597,591 acres were withdrawn pending detailed examination. In Florida 2,199 acres were restored to entry. A summary of the outstanding withdrawals follows.

Withdrawals of phosphate lands, fiscal year 1911–12, in acres.

State.	Outstanding July 1, 1911.	New withdrawals.	Restorations.	Outstanding June 30, 1912.
Florida	37,839	.....	2,199	35,640
Idaho	952,388	354,717	249,049	1,058,056
Montana	33,950	240,911	.....	274,861
Utah	107,745	.....	.....	107,745
Wyoming	1,267,494	597,591	826	1,864,259
	2,399,416	1,193,219	252,074	3,340,561

METALLIFEROUS DEPOSITS.

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

Montana and Idaho. The classification 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 undertaken by the Survey during the field season of 1910, when 176,031 acres were classified as mineral and 112,434 acres as nonmineral. During the summer of 1911 three parties continued examinations of the Northern Pacific grant lands and succeeded in examining all the remaining tracts except a small number of parcels in Tps. 44 and 45 N., R. 9 E., and a few scattered tracts not listed to the Survey until after the close of the field season. A few of the Northern Pacific tracts not listed by the General Land Office until after the close of the field season were examined in the course of the work, as they lay adjacent to some of the lands investigated. The results of the classification work for the two years are shown in the following table:

Lands in Northern Pacific Railroad grant in Montana and Idaho classified by United States Geological Survey.

[Areas in acres.]

	Classified prior to July 1, 1911.	Classified during fiscal year 1911-12.	Classified June 30, 1912.
Mineral	176,031	20,278	196,309
Nonmineral	112,514	137,036	249,550
	288,545	157,314	445,859

Examinations of lands within the Blackfeet and Flathead Indian reservations, Mont., have also been made for the Indian Office by the Survey, in order to separate mineral from nonmineral lands as a basis for sales and allotments.

DIVISION OF HYDROGRAPHIC CLASSIFICATION.

The division of hydrographic classification considers reports on field examinations involving water supply and water utilization on the public lands and prepares classifications and correspondence based thereon. The scope and the amount of this work are fully set forth in the following paragraphs.

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 an act of June 25, 1910 (36 Stat., 847), and sections 13 and 14 of another act of June 25, 1910 (36 Stat., 858, 859). On July 1, 1911, the area included in outstanding withdrawals was 1,515,423 acres. During the year, as a result of additional informa-

tion largely secured through field investigations by the topographic and water-resources branches, 353,444 acres additional were withdrawn and 55,114 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. The total area withdrawn in connection with water powers on June 30, 1912, was 1,813,753 acres.

The following table shows the action taken during the last year and the areas outstanding, classified by States:

Power-site reserves, fiscal year 1911–12.

State.	Outstanding July 1, 1911.	New withdrawals during fiscal year.	Restorations during fiscal year.	Outstanding June 30, 1912.
	Acres.	*Acres.*	*Acres.*	*Acres.*
Arizona	213,390	3,019	23,448	192,961
California	53,689	115,383	4,064	165,008
Colorado	209,174	39,278	3,799	244,653
Idaho	229,692	72,432	6,667	295,457
Minnesota	8,388	2,866	.....	11,254
Montana	127,687	31,097	7,678	151,106
Nevada	15,375	.....	80	15,295
New Mexico	9,706	4,830	.....	14,536
Oregon	161,795	24,367	1,919	184,243
Utah	347,252	27,778	.....	375,030
Washington	80,386	29,734	6,979	103,141
Wyoming	58,889	2,660	480	61,069
	1,515,423	353,444	55,114	1,813,753

Applications for reclassification.—Thirty-two applications for the reclassification of lands included in power-site reserves have been filed by persons desirous of acquiring title to public lands so withdrawn. In 13 cases the lands desired were released from withdrawal because the lands were shown on investigation not to be valuable for power purposes. Fifteen applications were refused because of the power value of the lands requested.

Right-of-way applications.—The water-power possibilities involved or affected by applications for rights of way for railroads, irrigation canals and reservoirs, and water-power developments have been, as heretofore, reported upon by the Geological Survey.

During the fiscal year 600 applications were received and 798 were reported upon, so that 128 applications were pending report at the close of the year, as compared with 326 at the close of the preceding fiscal year. The character of the applications received and the action taken thereon are shown in the following table:

Applications for rights of way.

	Railroad.	Irrigation.	Water-power.	Miscellaneous.	Total.
Pending July 1, 1911	110	183	22	11	326
Received July 1, 1911, to June 30, 1912	132	399	29	40	600
Acted on July 1, 1911, to June 30, 1912	198	512	44	44	798
Pending June 30, 1912	44	70	7	7	128

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 surveyed by the Geological Survey and the lands included therein withdrawn from entry under the two withdrawal acts.

The area included in such withdrawals at the close of this fiscal year is shown in the following table:

Reservoir-site withdrawals.

State.	Outstanding July 1, 1911.	New withdrawals during fiscal year.	Restorations during fiscal year.	Outstanding June 30, 1912.
Arizona	.....	23,040	.....	23,040
Montana	.....	15,640	.....	15,640
North Dakota	1,091	478	.....	1,569
Oregon	16,884	.....	.....	16,884
South Dakota	.....	8,542	.....	8,542
Washington	18,553	13,000	.....	31,553
	36,528	60,700	.....	97,228

Carey Act segregations.—During the year 31 applications for the segregation of lands under the Carey Act have been considered by the board, including five applications pending at the beginning of the fiscal year and seven resubmitted cases on which report had previously been made. These lists were referred to the Survey for report on the water supply available, the general feasibility of the projects, and the mineral or nonmineral character of the lands. Eight of the lists were recommended for approval, and the remaining 22 were reported as having insufficient water supply or inadequate plans of irrigation. In only three cases were the conditions such that the rejection of the applications was recommended. In general, attention was called to the defects in the project as presented, and recommendations were made that the State be allowed to amend, by decrease of area to be irrigated, by increase of storage capacity, or by such other means as appeared to be necessary to make the development reasonably safe, not only to the developing company but also to the investors in the bonds and to the settlers on the land. One list was awaiting report at the end of the year.

Irrigation projects.—In addition to determining power possibilities affected, the board reports on right-of-way applications filed in connection with irrigation projects, stating the general character and feasibility of the project and the control of the lands irrigable thereunder in the interest of the project. The purpose of such investigations is to effect the proper utilization of the water resources of the public lands and to prevent the title to public lands becoming

clouded by easements which are sought for canals and reservoirs that are not feasible of construction or which are filed for purely speculative purposes.

ENLARGED HOMESTEADS.

The scope of the act of February 19, 1909 (35 Stat., 639), commonly known as the enlarged-homestead act, was broadened by the act of June 13, 1912 (Public, No. 191), by the extension of its general provisions to the States of North Dakota and California. Classification of lands in the other 10 States to which the acts apply has proceeded along the lines previously followed. The area designated has, however, been much smaller than in previous years, owing primarily to the fact that the great bulk of the nonirrigable lands had already been opened to entry. The problems arising in connection with the designations are becoming increasingly complex and the reaching of a proper decision as to the character of lands frequently requires exhaustive field examination.

Designations under the general provisions of the act rest primarily upon the determination of the fact that the lands are "not susceptible of successful irrigation at a reasonable cost from any known source of water supply," although the arability of the lands, climatic conditions, and forest cover are also taken into consideration. The information upon which recommendations are based is obtained through field investigations by engineers and geologists of the Geological Survey and, in part, from reports of special agents of the General Land Office. Both the surface and the underground water supply available are considered in making these determinations.

The nonresidence provisions, applicable to the States of Utah and Idaho, require additional investigation to determine whether or not the lands "have upon them such a sufficient supply of water suitable for domestic purposes as would make continuous residence upon the lands possible." In this work not only are the quantity and quality of surface waters investigated, but the possibility of obtaining water for domestic purposes from wells is also considered.

The work of the fiscal year is summarized in the following table:

Summary of enlarged-homestead designations.

State.	Outstanding July 1, 1911.	New designations during fiscal year.	Cancellations during fiscal year.	Outstanding June 30, 1912.
	Acres.	*Acres.*	*Acres.*	*Acres.*
Arizona	26,589,917	389,320	19,458	26,959,779
Colorado	20,354,509	11,027	.....	20,365,536
Idaho:				
Sections 1–5 only	5,336,838	91,731	3,941	5,424,628
Section 6	3,841	5,723	[a] 1,763	7,801
	5,340,679	97,454	5,704	5,432,429

[a] Cancellation of designation under sec. 6, approved Mar. 2, 1912; acreage transferred to secs. 1–5 only.

Summary of enlarged-homestead designations—Continued.

State.	Outstanding July 1, 1911.	New designations during fiscal year.	Cancellations during fiscal year.	Outstanding June 30, 1912.
	Acres.	*Acres.*	*Acres.*	*Acres.*
Montana	31,853,530	175,566	320	32,028,776
Nevada	49,512,960	.....	.....	49,512,960
New Mexico	16,306,675	136,977	.....	16,443,652
Oregon	11,213,661	144,227	.....	11,357,888
Utah:				
Sections 1–5 only	6,765,780	177,891	.....	6,943,671
Section 6	1,374,947	16,380	[a] 189,727	1,201,600
	8,140,727	194,271	.....	8,145,271
Washington	3,402,896	.....	.....	3,402,896
Wyoming	17,538,941	52,671	3,639	17,587,973
	190,254,495	1,201,513	218,848	191,237,160

[a] Cancellation of designation under sec. 6, approved Feb. 16, 1912; 189,478 acres transferred to secs. 1–5 only.

There has been a large increase in the number of petitions for designation referred to the land-classification board. Previous to July 1, 1911, a total of 594 petitions had been filed; during the present fiscal year 511 petitions were received. Owing to the fact that but a small force could be assigned to make the necessary field investigations, only 299 petitions were disposed of during the fiscal year. The geographic distribution of the petitions and the action taken are indicated in the following table:

Action on enlarged-homestead petitions during the fiscal year ended June 30, 1912.

State.	Outstanding July 1, 1911.	Received during the year.	Designations made.			Acted on during the year	Pending.
			All.	Part.	Refused.		
Arizona	1	5	2	4	0	6	0
Colorado	5	10	1	1	1	3	12
Idaho	79	256	16	17	82	115	220
Montana	24	134	38	24	38	100	58
Nevada	0	0	0	0	0	0	0
New Mexico	11	32	16	10	12	38	5
Oregon	8	33	2	7	7	16	25
South Dakota	0	1	0	0	1	1	0
Utah	3	7	0	1	1	2	8
Washington	3	15	0	0	2	2	16
Wyoming	3	18	2	5	9	16	5
	179	511	77	69	153	299	349

WATER RESERVES.

The withdrawal from entry of lands on which are situated springs, streams, or other watering places, which are valuable because of their control of adjacent public range, was initiated during the year. Six public water reserves were created during the year in the States of Utah and Wyoming, involving 23,143 acres in Utah and 62,979 acres in Wyoming.

TOPOGRAPHIC BRANCH.

ORGANIZATION.

The organization of the topographic branch remained the same as at the close of the last fiscal year, except for the termination of the duties of one inspector, and is as follows:

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

On account of the increase in work in the Pacific division, due to increase in State cooperation in water-power investigations and in other features, a reorganization of that division has been made, to take effect July 1, 1912, as follows:

Northwestern division (Washington, Oregon, Idaho), T. G. Gerdine, geographer in charge.
Pacific division (California, Arizona, Utah, Nevada, Hawaii), George R. Davis, geographer in charge.

PERSONNEL.

The technical corps of the topographic branch was increased during the year by the appointment of 1 assistant topographer, 21 junior topographers, and 2 draftsmen. It was reduced 14 by transfers, resignations, and deaths. With these changes the technical force now includes 1 chief geographer, 10 geographers, 10 topographic engineers, 42 topographers, 43 assistant topographers, 55 junior topographers, and 11 draftsmen—a total of 172. In addition, 60 technical field assistants were employed during a whole or a part of the field season. One geographer, two topographers, and one assistant topographer are on leave without pay.

PUBLICATIONS.

The work of the topographic branch for the fiscal year is represented by 114 maps and 17 book publications, namely, Bulletins 458, 464, 466, 468, 469, 472, 473, 476, 477, 481, 482, 486, 487, 488, 489, 493, and 496, titles and brief summaries of which are given on pages 25–31; and a preliminary edition of 300 copies of the instructions relating to triangulation, traverse, levels, and the adjustment of instruments was issued. At the close of the year manuscripts for Bulletins 514, 515, and 518 (Results of spirit leveling in New York, Pennsylvania, and Ohio, respectively) were at the Government Printing Office; in addition, the manuscripts for eight bulletins have been assembled

and transmitted for publication as Results of spirit leveling in Florida (Bulletin 516), Alabama (Bulletin 517), Tennessee (Bulletin 519), Illinois, Kentucky, and Indiana, Results of triangulation and primary traverse in Ohio, and Results of triangulation and traverse in the United States.

ALLOTMENTS.

The total appropriations for topographic surveys for the fiscal year 1912 were:

Topographic surveys	$359,200
Surveying national forests	75,000
	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 1912.

	Topographic surveys.	Surveying national forests.
Administrative expenses of Survey	$19,136	$3,918
Clerical assistance and supervision	15,580	3,190
Map editing	3,336	684
Purchase and repair of instruments, stationery, etc	12,118	2,482
Millionth-scale map	20,000	.....
Atlantic division, field work, in Alabama, Delaware, Florida, Georgia, Louisiana, Maine, Maryland, Mississippi, New Hampshire, New York, North Carolina, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, and West Virginia	69,945	.....
Central division, field work, in Arkansas, Oklahoma, Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio, and Wisconsin	59,945	.....
Rocky Mountain division, field work, in Colorado, Montana, Nebraska, New Mexico, Oklahoma, Texas, and Wyoming	66,300	19,663
Pacific division, field work, in Arizona, California, Idaho, Montana, Oregon, Utah, and Washington, and Territory of Hawaii	82,840	45,063
Work by land-classification board	10,000	.....
	359,200	75,000

COOPERATION.

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

Allotments for cooperative work.

California	$14,000
California river surveys, not met by Federal allotment	7,000
Illinois	13,750
Iowa	2,350
Kentucky	10,000
Maine	4,700
Maryland	1,825
Michigan	2,000
Minnesota	10,000
Missouri	6,000

Nebraska	$1,500
New York	10,000
Ohio	28,400
Oklahoma	1,000
Oregon	15,000
Pennsylvania	5,328
Virginia	4,250
Washington	13,750
West Virginia	12,000
Hawaii	15,000
	177,853

GENERAL OFFICE WORK.

Progress maps were kept up to date and new ones compiled when necessary; field notes in connection with horizontal and vertical control work were copied and catalogued; the report of the committee appointed by the Secretary of the Interior to determine the areas of the various acquisitions by the United States was submitted and accepted; and 205 examination papers for the junior topographer and topographic aid civil-service examinations were rated.

SUMMARY OF RESULTS.

The condition of topographic surveys to June 30, 1912, 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 28,136 square miles, making the total area surveyed to date in the United States 1,160,396 square miles,[1] or 38.34 per cent of the entire country. In addition, 5,274 square miles of resurvey were completed, making the total area of actual surveys during the year 33,410 square miles.

In connection with these surveys 7,378 linear miles of primary levels were run, making 237,808 miles of primary and precise levels run since the authorization of this work by Congress in 1896. In the course of this work 1,923 permanent bench marks were established. In addition, 1,261 linear miles of river surveys were run.

Triangulation stations to the number of 73 were occupied and 53 were permanently marked. Primary traverse lines aggregating 3,621 miles were run, in connection with which 404 permanent marks were set. In the course of this work 22,937 square miles were covered by primary control.

The area covered by topographic surveys in Alaska during the fiscal year 1911–12, as reported in detail on pages 74–78, was 14,706

[1] Includes 1,223 square miles of water area in Maryland not previously reported during the progress of field work but now added, as the total area of the State has been surveyed.

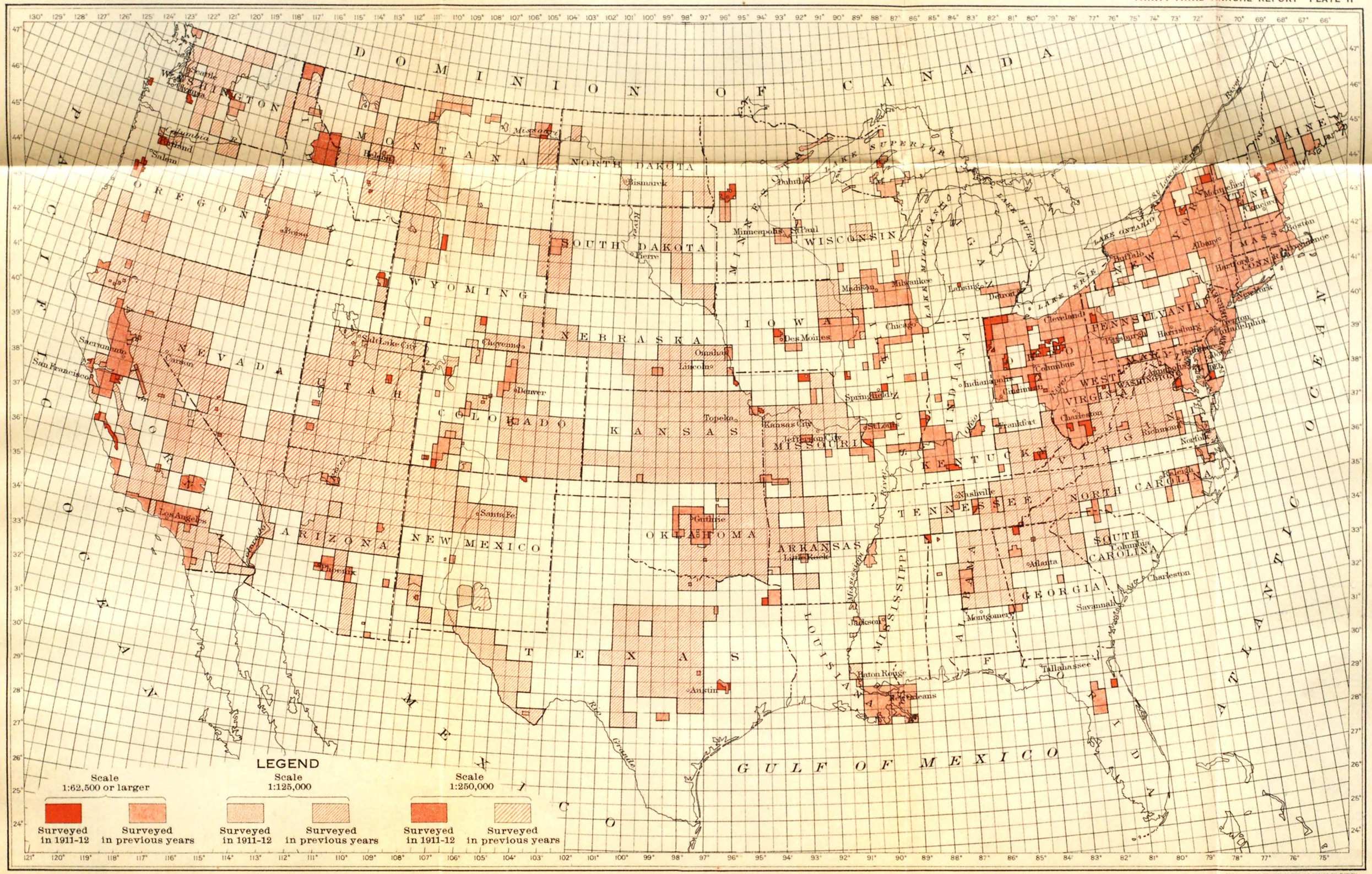
square miles—246 for publication on the scale of 1:62,500 and 14,460 for publication on the scale of 1:250,000.

Topographic surveys were also carried on in Hawaii, the area mapped during the fiscal year being 281 square miles, for publication on the scale of 1:31,680, making the total area in Hawaii surveyed to date 879 square miles. In connection with the surveys in Hawaii, 77 miles of primary and precise levels were run and 20 permanent bench marks established, making the total number of miles of primary and precise levels run by this survey in Hawaii 439.

Present condition of topographic surveys of the United States and new areas surveyed in 1911–12.

	New area surveyed in 1911–12.	Total area surveyed to June 30, 1912.	Percentage of total area of State surveyed to June 30, 1912.
	Square miles.	*Square miles.*	
Alabama	74	18,713	36
Arizona	25	64,461	57
Arkansas	337	21,380	40
California	3,985	103,311	65
Colorado	1,351	44,095	42
Connecticut	.....	4,965	100
Delaware	194	1,202	51
District of Columbia	.....	70	100
Florida	259	2,080	4
Georgia	.....	17,337	29
Idaho	5,071	24,080	29
Illinois	1,017	12,110	21
Indiana	.....	3,041	8
Iowa	290	11,066	19
Kansas	.....	64,159	78
Kentucky	445	17,587	43
Louisiana	28	8,311	17
Maine	349	8,620	26
Maryland	.....	[a] 12,327	100
Massachusetts	.....	8,266	100
Michigan	268	5,385	9
Minnesota	837	5,138	6
Mississippi	55	1,889	4
Missouri	436	35,479	51
Montana	1,448	55,171	38
Nebraska	120	26,094	34
Nevada	.....	50,675	46
New Hampshire	.....	3,380	36
New Jersey	.....	8,224	100
New Mexico	1,951	35,530	29
New York	686	41,605	84
North Carolina	.....	17,661	34
North Dakota	.....	9,716	14
Ohio	4,165	32,988	80
Oklahoma	524	39,215	55
Oregon	1,142	19,812	20
Pennsylvania	269	23,876	53
Rhode Island	.....	1,248	100
South Carolina	.....	5,640	18
South Dakota	.....	18,594	24
Tennessee	118	20,911	50
Texas	580	67,387	25
Utah	.....	67,905	79
Vermont	77	3,753	39
Virginia	.....	29,980	70
Washington	1,025	22,619	32
West Virginia	.....	24,170	100
Wisconsin	.....	11,789	21
Wyoming	1,010	27,381	28
	28,136	1,160,396	.....
Hawaii	281	879	.....

[a] Includes 1,223 square miles of water area not reported during progress of field work.



LEGEND

Scale 1:62,500 or larger		Scale 1:125,000		Scale 1:250,000	
Surveyed in 1911-12	Surveyed in previous years	Surveyed in 1911-12	Surveyed in previous years	Surveyed in 1911-12	Surveyed in previous years

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

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

100 0 100 200 300 400 500 Miles

ENGRAVED AND PRINTED BY THE U.S.GEOLOGICAL SURVEY

ATLANTIC DIVISION.

FIELD WORK.

SUMMARY.

During the season topographic mapping was carried on in Alabama, Delaware, Florida, Georgia, Louisiana, Maine, Maryland, Mississippi, New Hampshire, New York, Pennsylvania, Tennessee, Vermont, Virginia, and West Virginia. This work comprised the survey of five quadrangles and the resurvey or revision of six quadrangles. In addition, 12 quadrangles were partly surveyed and 10 quadrangles were partly resurveyed or revised. The total new area mapped was 2,109 square miles—2,081 for publication on the scale of 1:62,500 and 28 for publication on the scale of 1:24,000. The area resurveyed was 1,392 square miles—1,329 for publication on the scale of 1:62,500, 43 for publication on the scale of 1:24,000, 19 for publication on the scale of 1:12,000, and 1 for publication on the scale of 1:9,600. In connection with this work 1,269 miles of primary levels were run and 327 permanent bench marks were established.

Primary triangulation and primary traverse were carried on at different times by four parties, the work being distributed over portions of Alabama, New York, North Carolina, Pennsylvania, South Carolina, Virginia, and West Virginia. The total area covered by this primary control was about 3,424 square miles, of which 3,198 square miles were controlled by primary traverse, 1,056 miles being run and 102 permanent marks set. Twenty-three triangulation stations were occupied and 17 were marked. The result of this work was to make control available in eighteen 15-minute quadrangles.

Topographic surveys in Atlantic division from July 1, 1911, to June 30, 1912.

State.	Contour interval.	For publication on scale of—						Total area surveyed.	Primary levels.		Primary traverse.	
		1:62,500.		1:24,000.		1:12,000; resurvey.	1:9,600; resurvey.		Distance run.	Bench marks.	Distance run.	Permanent marks.
		New.	Resurvey.	New.	Resurvey.							
	Feet.	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Mi.*		*Mi.*	
Alabama	20	74	.....	.....	.....	.....	.....	74	138	22	611	55
Delaware	10	194	.....	.....	.....	.....	.....	194	18	4	.....	.....
Florida	10	259	.....	.....	.....	.....	.....	259	.....	.....	.....	.....
Georgia	50	.....	235	.....	.....	.....	.....	235	47	15	.....	.....
Louisiana	5	.....	.....	28	.....	.....	.....	28	.....	.....	.....	.....
Maine	20	349	.....	.....	.....	.....	.....	349	57	15	.....	.....
Maryland	20	.....	129	.....	.....	.....	.....	129	.....	.....	.....	.....
Mississippi	20	55	.....	.....	.....	.....	.....	55	.....	.....	.....	.....
New Hampshire	20	.....	.....	.....	43	19	1	63	54	11	.....	.....
New York	20	686	.....	.....	.....	.....	.....	686	165	52	148	11
North Carolina	.....	.....	.....	.....	.....	.....	.....	.....	78	26	70	17
Pennsylvania	20	269	.....	.....	.....	.....	.....	269	102	28	72	6
South Carolina	.....	.....	.....	.....	.....	.....	.....	.....	27	9	23	5
Tennessee	20-50	118	10	.....	.....	.....	.....	128	.....	.....	60	2
Vermont	20	77	.....	.....	.....	.....	.....	77	51	.....	.....	.....
Virginia	20	.....	36	.....	.....	.....	.....	36	[a]316	89	72	6
West Virginia	50	.....	919	.....	.....	.....	.....	919	216	56	.....	.....
	.....	2,081	1,329	28	43	19	1	3,501	1,269	327	1,056	102

[a] 124 miles double primary levels.

DETAILS OF WORK BY STATES.

Alabama.—At the beginning of the fiscal year an agreement for the continuation of cooperative topographic surveys in Alabama was made between the State geologist and the United States Geological Survey, each to contribute $10,000 toward the work. Owing to the fact that the State money has not yet been made available by the State legislature, all expenses of the work in Alabama during the fiscal year were paid from Federal funds, and the State will contribute its share toward the continuation of the work as soon as practicable. The survey of the Alabama portion of the Florence quadrangle, in Colbert and Lauderdale counties, was begun by W. H. S. Morey, T. F. Slaughter, R. A. Kiger, and Roscoe Reeves, the area mapped being 13 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of this area C. W. Arnold ran 62 miles of primary levels; and for the control of this and the Gravelly Springs, Rogersville, Tuscumbia, Russellville, Haleysville, Glen Allen, Guin, Fayette, Gordo, Samantha, and Tuscaloosa quadrangles, in Colbert, Lauderdale, Franklin, Lawrence, Winston, Marion, Fayette, Pickens, and Tuscaloosa counties, C. B. Kendall and F. W. Crisp ran 484 miles of primary traverse and set 45 permanent marks.

In addition to the cooperative work in Alabama, the Adger and Searles quadrangles, in Tuscaloosa and Jefferson counties, were controlled by F. W. Crisp and C. W. Arnold, 76 miles of primary levels being run, in connection with which 22 permanent bench marks were established, and 127 miles of primary traverse being run, in connection with which 10 permanent marks were set.

Delaware.—The survey of the Delaware portion of the Seaford quadrangle, in Sussex County, was completed by J. M. Whitman, R. L. Harrison, and J. H. Le Feaver, the area mapped being 194 square miles, for publication on the scale of 1:62,500, with a contour interval of 10 feet. For the control of this quadrangle Mr. Le Feaver ran 18 miles of primary levels and established 4 permanent bench marks.

Florida.—The survey of the Palatka quadrangle, in Putnam and St. John counties, was completed by W. H. Griffin and J. H. Le Feaver, the area mapped being 259 miles, for publication on the scale of 1:62,500, with a contour interval of 10 feet.

Georgia-Tennessee.—The resurvey of the Cohutta quadrangle (northeast quarter of the old Dalton 30-minute quadrangle), comprising 235 square miles in Murray, Fannin, and Gilmer counties, Ga., and 10 square miles in Polk County, Tenn., was completed by E. I. Ireland, C. W. Arnold, and Roscoe Reeves, for publication on the scale of 1:62,500, with a contour interval of 50 feet. For the control of this quadrangle Mr. Arnold ran 47 miles of primary levels and established 15 permanent bench marks.

Louisiana.—The survey of the Baxter Bayou and Delta Bridge 7½-minute quadrangles, in the Tensas Basin, was continued by W. N. Vance and Olinus Smith, the area mapped being 28 square miles in West Carroll and Tensas parishes, for publication on the scale of 1:24,000, with a contour interval of 5 feet.

Maine.—For the continuation of cooperative topographic surveys in Maine the State Survey Commission allotted $4,700 and the United States Geological Survey $4,500. The survey of the Bryant Pond quadrangle, comprising 214 square miles in Oxford County, was completed, and that of the Bethel quadrangle, in the same county, was begun, the area mapped being 135 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. This work was done by Hersey Munroe, R. A. Kiger, Olinus Smith, J. B. Metcalfe, and K. E. Schlachter. For the control of these quadrangles K. F. Maxcy ran 57 miles of primary levels and established 15 permanent bench marks.

Maryland.—For the continuation of cooperative topographic work in Maryland the State geologist and the United States Geological Survey each allotted $1,825. The resurvey of the Maryland portions of the Nanjemoy (northeast quarter of the old Fredericksburg 30-minute quadrangle) and Indian Head (southeast quarter of the old Mount Vernon 30-minute quadrangle) 15-minute quadrangles, in Charles and Prince George counties, was completed by R. L. Harrison, the area resurveyed being 129 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. In addition to this work, Mr. Harrison revised the culture on the Brandywine and Prince Frederick 15-minute quadrangles, comprising the north half of the old Patuxent 30-minute quadrangle, and the Wicomico 15-minute quadrangle, comprising the northwest quarter of the old Nomini 30-minute quadrangle, all in Charles and Prince Georges counties.

Mississippi-Alabama-Tennessee.—The survey of the Iuka quadrangle, in Tishomingo County, Miss., Colbert and Lauderdale counties, Ala., and Hardin County, Tenn., was completed by J. F. McBeth and R. A. Kiger, the area mapped being 117 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. Of the area mapped, 55 square miles lies in Mississippi, 61 square miles in Alabama, and 1 square mile in Tennessee.

New Hampshire.—To meet the needs of the administration of the Weeks Act a special resurvey was made of an area covering 63 square miles in the White Mountains, Grafton County—1 square mile for publication on the scale of 1:9,600, with a contour interval of 20 feet; 19 square miles for publication on the scale of 1:12,000, with a contour interval of 20 feet; and 43 square miles for publication on the scale of 1:24,000, with a contour interval of 20 feet. This work was done by

Hersey Munroe, E. I. Ireland, W. H. S. Morey, Olinus Smith, R. A. Kiger, J. B. Metcalfe, J. H. Le Feaver, Roscoe Reeves, and E. E. Witherspoon. For the control of portions of this area, Messrs. Kiger, Witherspoon, and K. E. Schlachter ran 54 miles of primary levels and established 11 permanent bench marks. All expenses incurred in connection with this work were paid from the appropriations made in the Weeks Act.

New York.—The State engineer and surveyor of New York allotted $10,000 for continuation of cooperative topographic surveys in the State, and the Federal Survey allotted a like sum for the same purpose. The survey of the Lowville, Dannemora, and Lyon Mountain quadrangles, in Lewis, Clinton, and Franklin counties, was completed by C. E. Cooke, J. M. Whitman, R. C. McKinney, J. I. Gayetty, W. H. S. Morey, Olinus Smith, J. B. Metcalfe, and J. H. Le Feaver, the area mapped being 553 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. The survey of the Number Four and Bonaparte quadrangles, in Herkimer, Lewis, Jefferson, and St. Lawrence counties, was begun by Messrs. Whitman, McKinney, Morey, Le Feaver, Roscoe Reeves, and E. E. Witherspoon, the area mapped being 133 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of the Lyon Mountain, Dannemora, and Number Four quadrangles and of the Ellenburg quadrangle, in Clinton County, R. A. Kiger, J. M. Perkins, and K. E. Schlachter ran 165 miles of primary levels and established 52 permanent bench marks. For the control of the Bonaparte quadrangle and of the Edwards and Gouverneur quadrangles, in Lewis, Jefferson, and St. Lawrence counties, C. B. Kendall ran 104 miles of primary traverse and set 7 permanent bench marks, and for the control of the Chateaugay quadrangle, in Franklin County, Mr. Kendall ran 44 miles of primary traverse and set 4 permanent marks. For the control of the Corning quadrangle, in Steuben County, G. T. Hawkins occupied 7 and marked 3 triangulation stations.

North Carolina-South Carolina.—For the control of the Gastonia quadrangle, in Gaston and Lincoln counties, N. C., and of the Pleasant Ridge quadrangle, in Gaston and Lincoln counties, N. C., and York County, S. C., F. W. Crisp and C. W. Arnold ran 105 miles of primary levels, establishing 35 permanent bench marks, and 93 miles of primary traverse, setting 22 permanent marks. Of this control, 27 miles of primary levels and 23 miles of primary traverse were run in the South Carolina portion of the Pleasant Ridge quadrangle, in connection with which 9 permanent bench marks and 5 permanent traverse marks were set.

Pennsylvania.—The Topographic and Geological 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 Stoneboro and Mercer quadrangles, in Mercer, Crawford, Butler, and Lawrence counties, was completed by Robert Muldrow and R. C. McKinney, the area mapped being 269 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of the Mercer quadrangle Howard Mellinger ran 47 miles of primary levels and established 13 permanent bench marks. For the control of the Northeast quadrangle, in Erie County, K. W. Trimble ran 55 miles of primary levels and established 15 bench marks and G. T. Hawkins ran 72 miles of primary traverse and set 6 permanent marks, and for the control of the Stahlstown and Wind Gap quadrangles, in Westmoreland, Monroe, and Northampton counties, Mr. Hawkins occupied and marked 7 triangulation stations.

Tennessee.—The survey of the Hollow Springs quadrangle, in Coffee, Bedford, Cannon, and Rutherford counties, was completed by T. F. Slaughter, the area mapped being 117 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of the Murfreesboro quadrangle, in Rutherford County, Oscar Jones ran 60 miles of primary traverse and set 2 permanent marks. (See also pp. 108 and 109.)

Tennessee-North Carolina.—Revision of culture was completed by J. I. Gayetty over a portion of the Murphy quadrangle, in Polk and Monroe counties, Tenn., and Cherokee County, N. C.

Vermont.—The survey of the Woodstock quadrangle, in Windsor and Rutland counties, was completed by W. H. S. Morey and H. L. Dodge, the area mapped being 77 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of this quadrangle Mr. Dodge ran 51 miles of primary levels.

Virginia.—For the continuation of cooperative topographic surveys in Virginia in 1912 the State geologist allotted $4,250, to be met with an equal amount by the Federal Geological Survey. As the State money was available for expenditure in June, field work was begun at that time, all expenses being borne by the State. For the control of the Pocahontas, Tazewell, Grundy, Bristol, Abington, Jonesville, Pound, Clintwood, and Estillville quadrangles, in Tazewell, Mercer, Russell, Lee, and Wise counties, L. F. Biggs and R. C. Seitz ran 233 miles of double primary levels and established 69 permanent bench marks.

In addition to the cooperative work in Virginia, the resurvey of the Fairfax quadrangle (the northwest quarter of the Mount Vernon 30-minute quadrangle), in Fairfax, Prince William, and Loudoun counties, was begun by Robert Muldrow and R. C. McKinney, the area resurveyed being 36 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of this

quadrangle E. E. Witherspoon ran 83 miles of primary levels and established 20 permanent bench marks and G. T. Hawkins ran 72 miles of primary traverse and set 6 permanent marks.

West Virginia.—For the continuation of cooperative topographic surveys in West Virginia the State geologist allotted $12,000 and the United States Geological Survey allotted $10,000. The resurvey of areas previously mapped resulted in the completion of the work on the Logan, Marshes, Flat Top, and Beckley (formerly called Red Star) quadrangles, the West Virginia portion of the Louisa quadrangle, and portions of the Crawford and Packs Ferry quadrangles, in Logan, Boone, Wyoming, Raleigh, Mercer, Summers, Fayette, Upshur, and Lewis counties. The total area mapped was 919 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet, the work being done by E. I. Ireland, Fred McLaughlin, J. H. Le Feaver, C. W. Arnold, S. A. Judson, and Roscoe Reeves. For the control of these areas and of the Hinton and Meadow Creek quadrangles Mr. McLaughlin, L. F. Biggs, Mr. Arnold, and Mr. Witherspoon ran 216 miles of primary levels and established 56 permanent bench marks and C. B. Kendall occupied 9 triangulation stations and marked 7.

OFFICE WORK.

The drafting of the following sheets was completed: Searle, Ala.; Cohutta, Ga.; Bryant Pond and Buckfield, Maine; Brandywine and Wicomico, Md. (revision); Iuka, Miss.-Ala.-Tenn.; Dannemora, Lyon Mountain, and Lowville, N. Y.; Rochester, N. Y. (revision); Mercer and Stoneboro, Pa.; Hollow Springs, Tenn.; Woodstock, Vt.; Flat Top, Logan, Beckley, and Marshes, W. Va.

Progress in the drafting of additional sheets was made as follows: Palatka, Fla., 15 per cent; Delta Bridge, La., 80 per cent; Baxter Bayou, La., 25 per cent; Indian Head, Md.-Va. (resurvey), 43 per cent; Nanjemoy, Md.-Va. (resurvey), 43 per cent; Bethel, Maine, 20 per cent; Murphy, N. C.-Tenn. (revision), 23 per cent; Louisa, W. Va., 33 per cent.

In the computing section the following computations and adjustments were made:

Primary-level circuits were adjusted and geographic positions were computed for the Tuscumbia (Ala.) and Florence (Ala.-Tenn.) quadrangles. Primary-level circuits in the Iuka quadrangle (Ala.-Miss.-Tenn.) were adjusted. Geographic positions were computed for the Barton, Chickasaw, Cottondale, Fayette, Glen Allen, Gordo, Guin, Haleysville, Mantua, Powers, Russellville, Samantha, and Tuscaloosa (Ala.) and Gravelly Springs and Rogersville (Ala.-Tenn.) quadrangles.

Geographic positions were computed for the Arredondo, Ates Creek, Citra, Dinner Island, Eureka, Green Cove Springs, Hague,

Hawthorn, Interlachen, Lawtey, Palatka, Starke, and Welaka quadrangles (Fla.).

Primary-level circuits in the Cohutta and Spring Place quadrangles (Ga.-Tenn.) were adjusted.

Primary-level circuits in the Bethel, Bryant Pond, and Norway quadrangles (Maine) were adjusted.

Primary-level circuits in the Indian Head and Nanjemoy quadrangles (Md.-Va.) were adjusted.

Primary-level circuits were adjusted in the Dannemora, Lowville, Lyon Mountain, and Number Four quadrangles (N. Y.). Geodetic distances and positions were computed in the Corning, Elmira, and Hammondsport quadrangles (N. Y.).

Computations of positions of international boundary monuments between New York and Canada along the north borders of the Chateaugay, Ellenburg, Malone, Moira, Mooers, and Rouses Point quadrangles (N. Y.) were made.

Primary-level circuits in the Mercer quadrangle (Pa.) were adjusted. Geodetic distances and positions were computed in the Mauch Chunk, Somerset, Stahlstown, Wilpen, Windber, and Windgap quadrangles (Pa.). Geographic positions were computed and primary-level circuits were adjusted for the Northeast quadrangle (Pa.-N. Y.).

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

Primary-level circuits were adjusted and geodetic distances and positions were computed for the Beckley, Crawford, Flat Top, and Sandrun quadrangles (W. Va.). Primary-level circuits in the Logan and Marshes quadrangles (W. Va.) were adjusted. Geodetic distances and positions in the Meadow Creek and Packs Ferry quadrangles (W. Va.) were computed.

Level lists were revised and assembled, after all necessary computations had been made, and transmitted to the editor for publication as bulletins for Alabama (Bulletin 517), Florida (Bulletin 516), New York (Bulletin 514), Pennsylvania (Bulletin 515), and Tennessee (Bulletin 519).

CENTRAL DIVISION.

FIELD WORK.

SUMMARY.

During the season topographic mapping was carried on in Arkansas (extending over a small area in Oklahoma), Illinois, Iowa, Kentucky, Michigan, Minnesota, Missouri, and Ohio. This work comprised the survey of 12 quadrangles and the resurvey of 1

quadrangle, in addition to which 40 quadrangles and 2 river projects were partly surveyed, 3 quadrangles were partly resurveyed, and 1 quadrangle was partly revised. The total new area mapped was 7,815 square miles—357 for publication on the scale of 1:125,000, 7,408 for publication on the scale of 1:62,500, and 50 for publication on the scale of 1:24,000. The area resurveyed was 554 square miles, for publication on the scale of 1:62,500. In connection with this work 3,664 miles of primary levels were run and 957 permanent bench marks established.

Primary traverse was carried on at different times by five 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 10,207 square miles, 2,359 linear miles of primary traverse being run and 228 permanent marks set. The result of this work was to make control available in 102 quadrangles and 1 river project.

Topographic surveys in central division from July 1, 1911, to June 30, 1912.

State.	Contour interval.	For publication on scale of—				Total area surveyed.	Primary levels.		Primary traverse.	
		1:125,000; new.	1:62,500.		1:24,000; new.		Distance.	Bench marks.	Distance.	Permanent marks.
			New.	Resurvey.						
	Feet.	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Miles.*		*Miles.*	
Arkansas	50	337				337				
Oklahoma	50	20				20				
Illinois	10–20		967	4	50	1,021	420	146	1,078	91
Indiana							[a] 66	29		
Iowa	20		290			290	115	31	115	10
Kentucky	20–50		445	444		889	252	54		
Michigan	20		268			268	[b] 371	94	304	40
Minnesota	10–20		837			837	235	68	677	61
Missouri	20		436	106		542	150	17	75	6
Ohio	10–20		4,165			4,165	2,055	518		
Wisconsin									110	20
		357	7,408	554	50	8,369	3,664	957	2,359	228

[a] 66 miles precise levels. [b] 68 miles precise levels.

DETAILS OF WORK BY STATES.

Arkansas-Oklahoma.—The survey of the De Queen quadrangle, in Polk, Howard, and Sevier counties, Ark., and McCurtain County, Okla., was completed by H. H. Hodgeson, W. R. Schreiner, and L. H. Williams, the area mapped being 357 square miles, for publication on the scale of 1:125,000, with a contour interval of 50 feet. Of this area 20 square miles lies in Oklahoma.

Illinois.—The governor of Illinois allotted $10,000 for the continuation of cooperative topographic surveys in Illinois, and the United States Geological Survey allotted a like sum. The governor

also made an additional allotment of $3,750 for a survey of the overflowed lands within the State, which was met by an allotment of $1,250 by the Federal Survey. The mapping of the Colchester quadrangle, in McDonough, Hancock, and Schuyler counties, was completed, the area mapped being 128 square miles, and that of the Illinois portion of the Renault quadrangle, in Randolph and Monroe counties, was also completed, the area mapped being 159 square miles. The survey of the Sumner quadrangle, comprising 233 square miles in Lawrence, Edwards, Richland, and Wabash counties; of the Lincoln quadrangle, comprising 228 square miles in Logan County; and of the Illinois portion of the Crystal City quadrangle, comprising 28 square miles in Monroe County, was completed. The survey of the Centralia quadrangle, in Marion, Clinton, Bond, and Washington counties, was begun, the area mapped being 191 square miles. The resurvey of the Ottawa quadrangle, in Lasalle County, was begun, the area mapped being 4 square miles. This work was all for publication on the scale of 1:62,500, with contour intervals of 10 and 20 feet, and was done by Frank Tweedy, C. W. Goodlove, L. L. Lee, F. W. Hughes, J. B. Leavitt, S. R. Truesdell, and W. S. Gehres. For the control of these areas and of the Macomb quadrangle, in McDonough and Schuyler counties, C. R. French and R. G. Clinite ran 240 miles of primary levels and established 83 permanent bench marks. For the control of the Centralia quadrangle and of the Vandalia, Ottawa, Streator, Alto Pass, Carbondale, Jonesboro, Du Quoin, Iuka, Richview, Mount Vernon, Ina, and Pinkneyville quadrangles, in Marion, Jefferson, Washington, Franklin, Perry, Clinton, Fayette, Lasalle, Jackson, and Union counties, J. R. Ellis and P. W. McMillen ran 278 miles of primary traverse and set 23 permanent marks. For the control of the Forreston, Oregon, Freeport, Lena, Mount Carroll, Amboy, Pecatonica, Dixon, Rochelle, Walnut, Woosung, Jacksonville, Pearl, Jerseyville, Rushville, Winchester, Macomb, Vermont, Roodhouse, Edwardsville, Carlinsville, Brighton, Harvel, Hettick, Litchfield, Staunton, Mulberry Grove, New Douglas, and Coffeen quadrangles, in Stephenson, Ogle, Carroll, Jo Daviess, Winnebago, Lee, Bureau, Whiteside, Morgan, Greene, Jersey, Schuyler, Scott, McDonough, Fulton, Macoupin, Montgomery, Christian, Bond, and Madison counties, J. H. Wilson ran 636 miles of primary traverse and set 54 permanent marks.

Under the allotment for overflowed lands L. L. Lee and J. B. Leavitt completed the survey of the Spoon River project, in Fulton County, the area mapped being 26 square miles. The survey of the Embarrass River project, in Jasper and Cumberland counties, was completed by Messrs. Lee and Leavitt and H. W. Peabody, the area mapped being 24 square miles. This work was for publication on the scale of 1:24,000, with a contour interval of 5 feet. For the con-

trol of the Spoon River project Mr. Leavitt ran 33 miles of primary levels and established 10 permanent bench marks. For the control of the Embarrass River project R. G. Clinite ran 27 miles of primary levels and established 18 permanent bench marks. For the control of the Saline River project, in Saline, Gallatin, Williamson, and Hardin counties, Mr. Clinite ran 120 miles of primary levels and established 35 permanent bench marks and J. R. Ellis ran 164 miles of primary traverse and set 14 permanent marks.

Indiana.—For the control of the Paoli, New Albany, New Salisbury, and Salem quadrangles, in Lawrence, Washington, Orange, Clark, Floyd, and Harrison counties, E. L. McNair ran 66 miles of precise levels and established 29 permanent bench marks.

Iowa.—The State geologist of Iowa allotted $1,750 for the continuation of cooperative topographic surveys in Iowa, and the Federal Survey allotted an equal amount. In the spring of 1912 an additional sum of $600 was made available by the State geologist for field work on the Boone and Story City quadrangles. The survey of the Madrid quadrangle, comprising 223 square miles in Boone and Dallas counties, and of the unmapped portion of the Slater quadrangle, covering 67 square miles in Polk and Story counties, was completed by W. L. Miller, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of the Madrid quadrangle Howard Clark ran 36 miles of primary levels and established 10 permanent bench marks.

For the control of the Boone and Story City quadrangles, in Story, Boone, Hamilton, and Webster counties, S. R. Archer ran 79 miles of primary levels and established 21 permanent bench marks, and for the control of these areas and of the Ogden and Nevada quadrangles, in Greene, Boone, Webster, Story, and Hamilton counties, J. R. Ellis ran 115 miles of primary traverse and set 110 permanent bench marks.

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 Dunmor quadrangle, comprising 238 square miles in Ohio, Logan, Butler, and Muhlenberg counties, and of the unmapped portion of the Drakesboro quadrangle, covering 36 square miles in the same counties, was completed, and the survey of the Little Muddy quadrangle, in Butler, Warren, and Logan counties, was begun, the area mapped being 171 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. This work was done by C. W. Goodlove, W. A. Reiter, N. E. Ballmer, and C. W. Wardle. The resurvey of the Buckhorn (formerly called Crockettsville) and Troublesome quadrangles, comprising the north half of the old Hazard 30-minute quadrangle, in Breathitt, Perry, Leslie, and Knott counties, was completed by J. R. Eakin, J. B. Leavitt, L. B.

Roberts, S. R. Archer, Edward Hyatt, jr., I. B. Gilbert, Stanley Hargen, and W. H. Phelps, the area resurveyed being 444 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. For the control of the Dunmor, Drakesboro, and Little Muddy quadrangles C. W. Wardle and E. C. Bibbee ran 178 miles of primary levels and established 40 permanent bench marks. For the control of the Troublesome quadrangle Mr. Archer ran 74 miles of primary levels and established 14 permanent bench marks.

Michigan.—For the continuation of cooperative topographic surveys in Michigan the State geologist allotted $2,000, which was met with a like sum by the United States Geological Survey. The mapping of the Michigan portions of the Pioneer, Alvordton, Wauseon, and Swanton quadrangles, covering 144 square miles in Lenawee, Amboy, Hillsdale, and Monroe counties, was completed, for publication on the scale of 1:62,500, with a contour interval of 10 feet, the work being done by J. H. Jennings, W. N. Vance, Fred Graff, jr., H. W. Peabody, N. E. Ballmer, and W. H. Rayner. The Ohio portions of these quadrangles were surveyed in cooperation with the State of Ohio, as reported on pages 119–120. For the control of these areas and of the Hudson quadrangle, in Hillsdale and Lenawee counties, Howard Clark, C. R. French, A. D. Duck, F. J. Mabrey, Philip Flitman, and C. W. Howell ran 63 miles of primary levels and established 20 permanent bench marks. For the control of the Grand Rapids, Hastings, Lowell, Muir, Ionia, Vermontville, Jenison, and Holland quadrangles, in Kent, Ionia, Clinton, Eaton, Barry, Ottawa, and Allegan counties, L. D. Townsend ran 186 miles of primary levels and established 45 permanent bench marks. For the control of the Springport, Marshall, Homer, Spring Arbor, Hillsdale, and Reading quadrangles, in Jackson, Calhoun, Eaton, Ingham, and Hillsdale counties, J. R. Ellis ran 50 miles of primary traverse and set 5 permanent marks.

In addition to the cooperative work in Michigan the survey of the Houghton quadrangle, in Houghton County, was continued by A. M. Walker, L. D. Townsend, and Howard Clark, the area mapped being 124 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of the Houghton quadrangle Mr. Clark ran 54 miles of primary levels and established 10 permanent bench marks, and for the control of this area and of the Beacon Hill, Winona, Greenland, Paynesville, Rubicon, and Sidnaw quadrangles, in Houghton, Ontonagon, and Baraga counties, E. L. McNair ran 68 miles of precise levels and established 19 permanent bench marks.

Michigan-Wisconsin.—For the control of the Watersmeet, Kenton, Star Lake, State Line, Beechwood, Iron River, Sagola, Norway, Iron Mountain, Commonwealth, Three Lakes, Monico, Elcho, Antigo,

Hermansville, Bark River, and Escanaba quadrangles, in Ontonagon, Houghton, Gogebic, Iron, Dickinson, Delta, and Menominee counties, Mich., and Forest, Florence, Oneida, Vilas, and Langlade counties, Wis., E. L. McNair ran 364 miles of primary traverse and set 55 permanent marks, of which 110 miles were run and 20 marks set in Wisconsin and 254 miles were run and 35 permanent marks set in Michigan.

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. The survey of the unmapped portions of the Underwood quadrangle, covering 192 square miles in Ottertail County; of the Fergus Falls quadrangle, covering 169 square miles in Ottertail County; and of the Ashby quadrangle, covering 87 square miles in Douglas, Grant, and Ottertail counties, was completed. The survey of the Battle Lake quadrangle, in Ottertail County, was begun, the area mapped being 181 square miles; that of the Perham quadrangle, in Ottertail and Becker counties, was begun, the area mapped being 196 square miles; and that of the Dora quadrangle, in Ottertail and Becker counties, was begun, the area mapped being 12 square miles. These areas were mapped for publication on the scale of 1:62,500, with contour intervals of 10 and 20 feet, and the work was done by C. L. Sadler, F. B. Barrett, O. H. Nelson, L. B. Roberts, and W. A. Reiter. For the control of the Perham quadrangle J. M. Ray ran 78 miles of primary levels and established 23 permanent bench marks and J. R. Ellis ran 42 miles of primary traverse and set 5 permanent marks. For the control of the Dora and Pelican Rapids quadrangles, in Ottertail and Becker counties, Mr. Ray ran 157 miles of primary levels and established 45 permanent bench marks; and for the control of these areas and of the Barnesville, Hawley, Lake Park, Flom, Faith, Ogema, Many Points, Detroit Lake, Senjen, Lonnrot, and New York Mills quadrangles, in Becker, Ottertail, Clay, Norman, Williams, and Clearwater counties, Mr. Ellis and P. W. McMillan ran 348 miles of primary traverse and set 34 permanent marks. For the control of the Cross Lake, Emily, Aitkin, McGregor, Seavey, Wealthwood, Deerwood, Brainerd, Rucker, Onamia, and Opstead quadrangles, in Cross Lake, Aitkin, Crow Wing, Mille Lacs, and Kanabec counties, E. L. McNair and A. D. Duck ran 287 miles of primary traverse and set 22 permanent marks.

Missouri.—For the continuation of cooperative topographic surveys in Missouri the State geologist allotted $6,000 and the United States Geological Survey allotted an equal amount. The survey of the Green City quadrangle, comprising 228 square miles in Putnam, Adair, and Sullivan counties, and of the unmapped portion of the Queen City quadrangle, covering 208 square miles in Schuyler,

Adair, and Putnam counties, was completed by W. J. Lloyd, F. W. Hughes, W. S. S. Johnson, and W. S. Gehres, for publication on the scale of 1:62,500, with a contour interval of 20 feet. The resurvey of the Mecca quadrangle (the northeast quarter of the old Kansas City 30-minute quadrangle), in Clay, Clinton, and Platte counties, was begun by H. H. Hodgeson and J. B. Leavitt, the area mapped being 106 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of the Green City and Queen City quadrangles P. W. McMillan and James Rayburn ran 83 miles of primary levels and established 17 permanent bench marks. For the control of the Mecca quadrangle Mr. Leavitt and P. W. McMillan ran 67 miles of primary levels, and for the control of this area and of the Kansas City, Independence, and Gower quadrangles, in Platte, Clay, and Clinton counties, J. R. Ellis ran 75 miles of primary traverse and set 6 permanent marks.

Ohio.—The governor of Ohio allotted $28,400 in addition to the unexpended balance of last year's fund, amounting to about $3,000, for the continuation of the cooperative topographic survey of that State and the United States Geological Survey allotted $15,000. The survey of the unmapped portions of the Jackson quadrangle, covering 87 square miles in Jackson, Vinton, and Ross counties; of the New Comerstown quadrangle, covering 154 square miles in Coshocton, Tuscarawas, and Holmes counties; of the Celina quadrangle, covering 51 square miles in Mercer and Van Wert counties; of the Van Wert quadrangle, covering 174 square miles in Paulding and Van Wert counties; of the Circleville quadrangle, covering 80 square miles in Pickaway, Ross, and Fairfield counties; of the Navarre quadrangle, covering 178 square miles in Starke, Holmes, Wayne, and Tuscarawas counties; of the Era quadrangle, covering 210 square miles in Pickaway, Ross, and Madison counties; and of the Sidney quadrangle, covering 168 square miles in Shelby, Logan, Champaign, and Auglaize counties, was completed. The survey of the Paulding quadrangle, covering 225 square miles in Paulding County; of the Bryan quadrangle, covering 224 square miles in Williams and Defiance counties; and of the Roxabel quadrangle, covering 231 square miles in Ross County, was completed. The survey of the Ohio portions of the Berne quadrangle, covering 48 square miles in Mercer and Van Wert counties; of the Bobo quadrangle, covering 48 square miles in Van Wert and Paulding counties; of the Halls Corners quadrangle, covering 48 square miles in Paulding County; of the Butler quadrangle, covering 48 square miles in Williams and Defiance counties; of the Edon quadrangle, covering 39 square miles in Williams County; of the Pioneer quadrangle, covering 179 square miles in Williams County; of the Alvordton quadrangle, covering 184 square miles in Williams and Fulton counties; of the Wauseon quadrangle, covering

190 square miles in Fulton County; and of the Swanton quadrangle, covering 197 square miles in Fulton and Lucas counties, was completed. The Michigan portions of the last four quadrangles were mapped in cooperation with that State, as reported on page 117. The survey of the following quadrangles was begun: Millersburg, in Holmes and Wayne counties, the area mapped being 86 square miles; Fredericktown, in Knox, Licking, and Morrow counties, 159 square miles; Cardington, in Morrow, Marion, and Delaware counties, 202 square miles; Perrysville, in Richland, Knox, and Ashland counties, 122 square miles; Shauck, in Richland, Knox, and Morrow counties, 65 square miles; Coshocton, in Coshocton and Holmes counties, 119 square miles; Gambier, in Knox County, 197 square miles; Siam, in Seneca and Huron counties, 118 square miles; Loudonville, in Ashland and Holmes counties, 92 square miles; Troy, in Shelby, Logan, Champaign, and Miami counties, 203 square miles; and Brinkhaven, in Coshocton, Knox, and Holmes counties, 39 square miles. The total area mapped in Ohio was 4,165 square miles, for publication on the scale of 1:62,500, with contour intervals of 10 and 20 feet. The work was done by J. H. Jennings, G. S. Smith, W. H. Griffin, Merrill Hackett, W. L. Miller, W. N. Vance, A. P. Meade, Fred Graff, jr., S. G. Lunde, J. A. Duck, A. J. Ogle, F. W. Hughes, H. W. Peabody, J. L. Lewis, O. G. Taylor, J. H. Wilson, W. S. S. Johnson, L. D. Townsend, N. E. Ballmer, Howard Clark, W. H. Rayner, L. B. Glasgow, L. H. Williams, and C. W. Howell.

A small area in the West Columbus quadrangle, in Franklin, Pickaway, and Fairfield counties, was revised by Mr. Duck.

For the control of the Celina quadrangle C. W. Howell ran 5 miles of primary levels. For the control of the Bryan quadrangle Mr. Howell, A. D. Duck, C. R. French, and C. E. Mills ran 101 miles of primary levels and established 27 permanent bench marks. For the control of the Sidney quadrangle E. C. Bibbee ran 7 miles of primary levels and established 2 permanent bench marks. For the control of the Paulding quadrangle Mr. Mills ran 69 miles of primary levels and established 18 permanent bench marks. For the control of the Swanton quadrangle F. J. Mabrey ran 77 miles of primary levels and established 18 permanent bench marks. For the control of the Fredericktown, Cardington, Perrysville, and Shauck quadrangles Mr. Bibbee, Philip Flitman, Mr. Mabrey, Mr. Howell, and Howard Clark ran 286 miles of primary levels and established 78 permanent bench marks. For the control of the Era quadrangle J. J. McNulta ran 72 miles of primary levels and established 21 permanent bench marks. For the control of the Butler quadrangle Mr. Clark and Mr. Howell ran 18 miles of primary levels and established 6 permanent bench marks. For the control of the Wauseon quadrangle Mr. Clark ran 98 miles of primary levels and established 25

permanent bench marks. For the control of the Roxabel quadrangle Mr. McNulta ran 127 miles of primary levels and established 25 permanent bench marks. For the control of the Edon quadrangle Mr. French ran 23 miles of primary levels and established 6 permanent bench marks. For the control of the Halls Corners quadrangle Mr. Duck ran 24 miles of primary levels and established 6 permanent bench marks. For the control of the Troy quadrangle Mr. McNulta and Mr. Bibbee ran 86 miles of primary levels and established 32 permanent bench marks. For the control of the Pioneer quadrangle Mr. Howell, Mr. Duck, and Mr. French ran 96 miles of primary levels and established 29 permanent bench marks. For the control of the Alvordton quadrangle Mr. Howell, Mr. Clark, and Mr. Flitman ran 73 miles of primary levels and established 17 permanent bench marks.

For the control of the Mount Gilead, Shiloh, Bellefontaine, Georgetown, St. Paris, Bucyrus, Brinkhaven, Siam, Norwalk, Gambier, Loudonville, Sandusky, and Waynesville quadrangles, in Morrow, Marion, Crawford, Richland, Huron, Champaign, Clark, Logan, Brown, Seneca, Coshocton, Holmes, Knox, Erie, Green, Montgomery, Sandusky, Wayne, and Ashland counties, Messrs. Flitman, Mills, Bibbee, McNulta, Archer, Clark, and Howell ran 893 miles of primary levels and established 208 permanent bench marks.

OFFICE WORK.

The drafting of the following sheets was completed: De Queen, Ark.-Okla.; Colchester, Lincoln, Sumner, Embarrass River drainage, and Spoon River drainage, Ill.; Galena, Ill.-Iowa; Madrid and Slater, Iowa; Troublesome, Dunmor, Buckhorn, Drakesboro, and Monticello, Ky.; Ashby and Fergus Falls, Minn.; Queen City, Mo.; Alvordton, Pioneer, Swanton, and Wauseon, Ohio-Mich.; Celina, Circleville, Era, Jackson, Bryan, Navarre, New Comerstown, Paulding, Sciotoville, Sidney, and Van Wert, Ohio.

Progress in the drafting of additional sheets was made as follows: Crystal City, Ill., 10 per cent; Renault, Ill., 80 per cent; Little Muddy, Ky., 52 per cent; Grand Rapids, Mich., 12 per cent; Houghton, Mich., 77 per cent; Battle Lake, Minn., 55 per cent; Underwood, Minn., 23 per cent; Berne, Ohio, 22 per cent; Bobo, Ohio, 22 per cent; Butler, Ohio, 22 per cent; Edon, Ohio, 18 per cent; Halls Corners, Ohio, 22 per cent; Roxabel, Ohio, 45 per cent; Troy, Ohio, 25 per cent.

In the computing section the following computations and adjustments were made:

Primary-level circuits were adjusted and geographic positions were computed for the Carbondale, Centralia, Equality, Marion, Odell, Ottawa, Stonefort, and Streator (Ill.), and Shawneetown (Ill.-Ky.)

quadrangles. Primary-level circuits were adjusted in the Avon, Canton, Galesburg, Hardinville, Moonshine, Newton, and Rosehill (Ill.), Birds and Vincennes (Ind.-Ill.), and Crystal City and Renault (Ill.-Mo.) quadrangles. Geographic positions were computed for the Amboy, Brighton, Carlinville, Coffeen, Dixon, DuQuoin, Edwardsville, Forreston, Freeport, Harvel, Hettick, Hoyleton, Iuka, Jacksonville, Lena, Litchfield, Macomb, Marseilles, Morrisonville, Mount Carroll, Mount Vernon, Mulberry Grove, Oregon, Pearl, Pecatonica, Pinckneyville, Richview, Rochelle, Roodhouse, Rushville, Sandwich, Staunton, Vandalia, Vermont, Walnut, and Winchester (Ill.) and Alto Pass, Hardin, and Jonesboro (Ill.-Mo.) quadrangles.

A precise-level circuit in the Paoli and Salem (Ind.) and New Albany (Ind.-Ky.) quadrangles was adjusted.

Primary-level circuits were adjusted in the Madrid, Slater, and Story City quadrangles (Iowa). Geographic positions were computed for the Boone, Nevada, Ogden, and Story City quadrangles (Iowa).

Primary-level circuits were adjusted in the Buckhorn, Creelsboro, Daysville, Drakesboro, Dunmor, Glenmore, Jabez, Lee City, Little Muddy, Monticello, Nortonville, Russellville, Salmons, and Troublesome quadrangles (Ky.).

Precise and primary level circuits were adjusted and geographic positions were computed for the Houghton quadrangle (Mich.). Precise level circuits were adjusted and geographic positions were computed for the Greenland, Paynesville, Rubicon, Sidnaw, and Winona quadrangles (Mich.). Primary-level circuits were adjusted and geographic positions were computed for the Adrian, Grand Rapids, Hudson, Ionia, Jenison, Lowell, and Muir quadrangles (Mich.). Primary-level circuits in the Holland (Mich.) and Edon (Ind.-Ohio-Mich.) quadrangles were adjusted. Geographic positions were computed for the Allegan, Bark River, Beacon Hill, Blissfield, Cedar Springs, Crystal Falls, Dundee, Escanaba, Hardwood, Hastings, Hermansville, Hillsdale, Homer, Kalamazoo, Kenton, Marshall, Norway, Sagola, Schoolcraft, Spring Arbor, Springport, Watersmeet, and Wayland (Mich.), Beechwood, Commonwealth, Iron River, Menominee special, and State Line (Mich.-Wis.), and Centerville and Reading (Mich.-Ind.) quadrangles.

Primary-level circuits were adjusted and geographic positions were computed for the Detroit Lake, Dora, Pelican Rapids, and Perham quadrangles (Minn.). Primary-level circuits in the Battle Lake and Underwood quadrangles (Minn.) were adjusted. Geographic positions were computed for the Aitkin, Barnesville, Brainerd, Deerwood, Emily, Flom, Hawley, Lake Park, Lonnrot, Many Points, New York Mills, Ogema, Senjen, Twin Valley, Ulen, and Wealthwood quadrangles (Minn.).

Primary-level circuits were adjusted in the Edna, Green City, and Queen City (Mo.) and Rulo (Mo.-Nebr.) quadrangles. Geographic positions were computed for the Independence, Mecca, and Plattsburg (Mo.) and Kansas City (Mo.-Kans.) quadrangles.

Primary-level circuits were adjusted and geographic positions were computed for the Bellefontaine, Brinkhaven, Bryan, Bucyrus, Cardington, Celina, Fredericktown, Gambier, Mount Gilead, Norwalk, Paulding, Perrysville, Plimpton, St. Paris, Shauck, Shiloh, Siam, and Van Wert (Ohio), Berne, Bobo, Butler, and Halls Corner (Ind.-Ohio), and Swanton (Ohio-Mich.) quadrangles. Primary-level circuits were adjusted in the Bainbridge, Chillicothe, Circleville, Era, Greenfield, Mount Sterling, Napoleon, Roxabel, Sandusky, Sardinia, Sidney, Troy, West Columbus, and Westerville (Ohio), Alvordton, Pioneer, and Wauseon (Ohio-Mich.), and Georgetown (Ohio-Ky.) quadrangles. Primary-traverse positions were computed for the Alger, Ashland, Continental, Defiance, Delaware, Delphos, East Liberty, Kenton, Larue, Mechanicsburg, Milford Center, New London, Richwood, South Charleston, Sycamore, and West Salem quadrangles (Ohio).

Geographic positions were computed for the Antigo, Brodhead, Browntown, Elcho, Monico, Monroe, Robbins, and Three Lakes (Wis.) and Star Lake (Wis.-Mich.) quadrangles.

Level lists were revised and assembled, after all necessary computations had been made, and transmitted to the editor for publication as bulletins for Illinois, Indiana, Kentucky, and Ohio. Primary traverse and triangulation lists for Ohio for 1898 to 1911, inclusive, were revised and assembled, after all necessary computations had been made, and transmitted for publication as a bulletin.

ROCKY MOUNTAIN DIVISION.

FIELD WORK.

SUMMARY.

During the season topographic mapping was carried on in Colorado, Montana, Nebraska, New Mexico, Oklahoma, Texas, and Wyoming. This work comprised the survey of 4 quadrangles and the resurvey of 1 quadrangle and 1 special area, in addition to which 20 quadrangles and 2 national parks were partly surveyed, 6 quadrangles were partly resurveyed, and 1 quadrangle was partly revised. The total new area mapped was 6,366 square miles—4,498 for publication on the scale of 1:125,000 and 1,868 for publication on the scale of 1:62,500. The area resurveyed was 2,312 square miles—1,899 for publication on the scale of 1:125,000, 218 for publication on the scale of 1:62,500, 180 for publication on the scale of 1:31,680, and 15 for publication on the scale of 1:9,600. In connection with this work,

1,251 miles of primary levels were run and 330 permanent bench marks were established. River-profile surveys were also made on two streams, the total distance traversed being 292 miles.

Primary triangulation was carried on at different times by one party, the work being distributed over portions of Colorado and New Mexico. The total area covered by this primary control was about 3,500 square miles, 27 triangulation stations being occupied and 21 marked. The result of this work was to make control available in 5 quadrangles and 1 special area.

Topographic surveys in Rocky Mountain division from July 1, 1911, to June 30, 1912.

State.	Contour interval.	For publication on scale of—						Total area surveyed.	Primary levels.	
		1:125,000.		1:62,500.		1:31,680.	1:9,600.			
		New.	Resurvey.	New.	Resurvey.	Resurvey.	Resurvey.		Distance run.	Bench marks.
		Sq. mi.	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Miles.*	
Colorado	25, 50, 100	770	880	581	.....	.....	15	2,246	199	62
Montana	20, 100	653	.....	197	.....	180	.....	1,030	64	18
Nebraska	20	.....	.....	120	.....	.....	.....	120	117	35
New Mexico	50, 100	1,825	.....	126	.....	.....	.....	1,951	96	21
Oklahoma	50	504	1,019	.....	.....	.....	.....	1,523	573	141
Texas	25	.....	.....	580	.....	.....	.....	580	73	18
Wyoming	20, 25, 50	746	.....	264	218	.....	.....	1,228	129	35
		4,498	1,899	1,868	218	180	15	8,678	1,251	330

DETAILS OF WORK BY STATES.

Colorado.—The survey of the Mesa Verde National Park, in La Plata and Montezuma counties, was completed by R. W. Berry and C. A. Ecklund, the area mapped being 115 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. The survey of the Red Mesa quadrangle, comprising 238 square miles in La Plata County, was completed by Messrs. Berry and Ecklund, for publication on the scale of 1:62,500, with a contour interval of 50 feet. The survey of the unmapped portion of the Hahns Peak quadrangle, lying partly in the Park Range National Forest, Routt and Jackson counties, was completed by Gilbert Young and C. W. Rowell, the area mapped being 385 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet, and the survey of the Meeker quadrangle, comprising 228 square miles in Rio Blanco and Moffat counties, was completed by the same party for publication on the scale of 1:62,500, with a contour interval of 50 feet. The survey of the Chromo quadrangle (formerly called Price), lying partly in the San Juan and Rio Grande national forests, Archuleta County, was continued by S. T. Penick, the area mapped being 385

square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. The resurvey of the Leadville mining district (formerly mapped as the Leadville special area), comprising 15 square miles in Lake and Eagle counties, was completed by E. P. Davis and S. E. Taylor, for publication on the scale of 1:9,600, with a contour interval of 25 feet. The resurvey of the Castle Rock quadrangle, in El Paso, Elbert, and Douglas counties, was completed by C. G. Anderson and G. W. Lucas, the area mapped being 755 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet, and the resurvey of a portion of the Ignacio quadrangle, lying partly in the San Juan National Forest, La Plata County, was completed by Mr. Anderson, the area resurveyed being 125 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. For the control of the Mesa Verde National Park and of the Hahns Peak, Red Mesa, and Meeker quadrangles Mr. Rowell and R. M. Copeland ran 184 miles of primary levels and established 52 permanent bench marks. For the control of the Leadville mining district Mr. Taylor ran 15 miles of primary levels and established 10 permanent bench marks and R. B. Robertson occupied 9 triangulation stations and marked 8.

A profile survey of a section of Grand River, in Colorado and Utah, was made by R. C. Seitz, the distance traversed being 192 miles, of which 131 miles was in Mesa, Garfield, Grand, Eagle, and Routt counties, Colo., and 61 miles in Emory County, Utah.

Montana.—The survey of the unmapped portions of the Brockton quadrangle, covering 103 square miles in Dawson County, and of the Homestead quadrangle, covering 94 square miles in Valley County, was completed by J. H. Wilke and C. P. McKinley, for publication on the scale of 1:62,500, with a contour interval of 20 feet. The survey of the unmapped portion of the Marias Pass quadrangle (formerly called Midvale), lying partly in the Glacier National Park and in the Blackfeet, Flathead, and Lewis and Clark national forests, Teton and Flathead counties, was completed by R. T. Evans and F. L. Whaley, the area mapped being 433 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet; and the survey of the unmapped portion of the Nyack quadrangle, lying partly in the Glacier National Park and in the Blackfeet and Flathead national forests, Flathead County, was continued by Mr. Evans, W. J. Forster, Lee Morrison, and C. C. Holder, the area mapped being 220 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. The resurvey of several townships comprising portions of the Divide and Willis quadrangles (previously reported as the Melrose special), in Silver Bow, Beaverhead, and Madison counties, was continued by R. H. Reineck, the area mapped being 180 square miles, for pub-

lication on the scale of 1:31,680, with a contour interval of 50 feet. For the control of the Brockton and Homestead quadrangles Mr. McKinley ran 64 miles of primary levels and established 18 permanent bench marks.

The profile survey of Clark Fork, in Montana and Idaho, was continued by R. C. Seitz, the distance traversed being 100 miles, of which 87 miles was in Sanders County, Mont., and 13 miles in Bonner County, Idaho.

Nebraska.—The State geologist of Nebraska allotted $1,500 for cooperative topographic surveys in that State and the United States Geological Survey allotted a like sum. The survey of the Nebraska portion of the Nemaha quadrangle, covering 94 square miles in Richardson and Nemaha counties, was completed by R. H. Reineck and C. C. Gardner, for publication on the scale of 1:62,500, with a contour interval of 20 feet. The survey of the Falls City quadrangle, in Richardson County, was begun by Mr. Gardner and R. R. Monbeck, the area mapped being 26 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 Howe and Rulo quadrangles, in Nemaha, Holt, and Richardson counties, Mr. McKinley and C. P. Gross ran 117 miles of primary levels and established 35 permanent bench marks.

New Mexico.—The survey of the Alum Mountain quadrangle (formerly called Camp Vincent), in the Datil and Gila national forests, Grant and Socorro counties, was completed by A. B. Searle and F. H. Nelson, the area mapped being 476 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. The survey of the Raton quadrangle, in Colfax County, was continued by E. P. Davis and S. E. Taylor, the area mapped being 126 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. A survey was made by C. J. Ballinger of a portion of the Tularosa Desert, covering an area of 1,349 square miles, for publication on the scale of 1:125,000, with a contour interval of 50 feet. This work covered portions of the Tularosa, Gypsum Hills, Alamogordo, Tonuco, and Soudders quadrangles, in Otero County. For the control of the Raton quadrangle, Mr. Taylor and C. P. Gross ran 96 miles of primary levels and established 21 permanent bench marks and R. B. Robertson occupied 10 and marked 12 triangulation stations. For the control of the Alum Mountain quadrangle Mr. Robertson occupied 8 triangulation stations and marked 1.

Oklahoma.—The Director of the Oklahoma Geological Survey allotted $1,000 for cooperative topographic surveys in that State and the Federal Geological Survey allotted a like sum. The survey of the Hominy quadrangle, in Payne and Tulsa counties, was begun in cooperation, but after the expenditure of all cooperative funds field

work was continued under an additional Federal allotment. The area mapped was 566 square miles, for publication on the scale of 1:125,000, with a contour interval of 50 feet; of this area 62 square miles comprised a resurvey of a portion of the old Indian Territory survey. This work was done by Basil Duke, S. T. Penick, S. E. Taylor, C. P. McKinley, and C. W. Rowell. For the control of the Hominy quadrangle H. L. Caldwell ran 338 miles of primary levels and established 69 permanent bench marks.

In addition to the cooperative work in Oklahoma the resurvey of the Vinita quadrangle, comprising 957 square miles in Craig, Nowata, Mayes, Ottawa, Delaware, and Rogers counties, was completed by S. E. Taylor, C. P. McKinley, G. W. Lucas, and C. C. Holder, for publication on the scale of 1:125,000, with a contour interval of 50 feet. For the control of the Washunga quadrangle, in Grant and Kay counties, R. M. Copeland ran 235 miles of primary levels and established 72 permanent bench marks. (See also p. 114.)

Texas.—The survey of the Daingerfield quadrangle, comprising 250 square miles in Morris and Cass counties, was completed by C. P. McKinley and C. C. Holder, for publication on the scale of 1:62,500, with a contour interval of 25 feet, and that of the unmapped portions of the Gay Hill and Navasota quadrangles, covering 330 square miles in Burleson, Brazos, Washington, and Grimes counties, was completed by S. E. Taylor and C. A. Ecklund, for publication on the same scale and with the same contour interval. For the control of the Gay Hill and Navasota quadrangles Mr. Taylor and Mr. Ecklund ran 73 miles of primary levels and established 18 permanent bench marks.

Wyoming.—The survey of the Meeteetse quadrangle, comprising 215 square miles in Park County, and of the unmapped portion of the Oregon Basin quadrangle (formerly called Wiley), covering 49 square miles in Park County, was completed by C. C. Gardner, L. V. Fees, and C. C. Holder, for publication on the scale of 1:62,500, with a contour interval of 25 feet. The survey of the Cheyenne quadrangle, in Laramie County, was completed by Basil Duke and H. L. Caldwell, the area mapped being 746 square miles, for publication on the scale of 1:125,000, with a contour interval of 50 feet. The resurvey of the Hanna quadrangle (northeast quarter of the old Fort Steele 30-minute quadrangle), in Carbon County, was begun by F. E. Matthes, A. O. Burkland, J. H. Wilke, and C. J. Ballinger, the area mapped being 218 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet. For the control of the Meeteetse quadrangle Mr. Gardner ran 6 miles of primary levels and established 2 permanent bench marks, for the control of the Cheyenne quadrangle Mr. Caldwell ran 72 miles of primary levels and established 23 permanent bench marks, and for the control of

the Hanna quadrangle Mr. Ballinger ran 51 miles of primary levels and established 10 permanent marks.

In addition to this work, the Wyoming portion of the Patrick quadrangle, in Goshen County, was partly revised by Lee Morrison.

OFFICE WORK.

The drafting of the following sheets was completed: Hahns Peak, Mesa Verde National Park, Red Mesa, Castle Rock, Leadville mining district, Ignacio (portion resurveyed), Colo.; Brockton, Homestead, Marias Pass, Clark Fork, Mont.; Alum Mountain, Silver City (small area revised), and Alamo National Forest, N. Mex.; Cheyenne, Oregon Basin, Meeteetse, and Green River, Wyo.; Daingerfield and Navasota, Tex.; Antlers, Claremore, and Nowata, Okla. (revision).

Progress in the drafting of additional sheets was made as follows: Chromo, Colo., 52 per cent; Meeker, Colo., 78 per cent; Grand River, Colo., 70 per cent; Divide, Mont., 19 per cent; Willis, Mont., 7 per cent; Marston, Mont., 15 per cent; Nyack, Mont., 63 per cent; Nemaha, Nebr., 41 per cent; Raton, N. Mex., 60 per cent; Tularosa, N. Mex., 63 per cent; Alamagordo, N. Mex., 3 per cent; Gypsum Hills, N. Mex., 66 per cent; Soudders, N. Mex., 2 per cent; Tonuco, N. Mex., 1 per cent; Hanna, Wyo., 84 per cent.

In the computing section the following computations and adjustments were made:

Primary-level circuits were adjusted and geodetic distances and positions were computed for the Leadville quadrangle (Colo.). Primary-level circuits were adjusted in the Apishapa, Cortez, Elmoro, Hahns Peak, La Plata, Lewis Creek, Mancos, Meeker, North Park, Red Mesa, and Spanish Peaks quadrangles (Colo.).

Primary-level circuits in the Brockton and Sand Butte quadrangles (Mont.) were adjusted.

Primary-level circuits were adjusted and geodetic distances and positions were computed for the Raton quadrangle (N. Mex.). Geodetic distances and positions were computed for the Alum Mountain, Black Range, Laura Spring, Mogollon, Silver City, Steeple Rock, and Tonuco quadrangles (N. Mex.).

Primary-level circuits in the Navasota quadrangle (Tex.) were adjusted.

Primary-level circuits in the Cheyenne quadrangle (Wyo.) were adjusted.

PACIFIC DIVISION.

FIELD WORK.

SUMMARY.

During the season topographic mapping was carried on in Arizona, California, Idaho (including portions of quadrangles in Mon-

tana), Oregon, Utah, and Washington. This work comprised the survey of 4 quadrangles, the partial survey of 48 quadrangles and 1 national park, the partial resurvey of 2 quadrangles, the revision of 1 quadrangle and 1 special area, and the partial revision of 1 quadrangle. The total new area mapped was 11,846 square miles—6,913 for publication on the scale of 1:250,000, 2,648 for publication on the scale of 1:125,000, 1,364 for publication on the scale of 1:62,500, and 921 for publication on the scale of 1:31,680. The area resurveyed was 1,016 square miles—851 for publication on the scale of 1:125,000 and 165 for publication on the scale of 1:62,500.

In connection with this work 1,194 miles of primary levels were run and 309 permanent bench marks were established. In addition, profile surveys were made of 12 rivers, the distance traversed being 969 miles, in connection with which 100 square miles were surveyed for publication on the scale of 1:31,680.

Topographic surveys were made in the Territory of Hawaii, covering portions of one island, embracing parts of eight 15-minute quadrangles and one special area, the area mapped being 281 square miles, for publication on the scale of 1:31,680, in connection with which 77 miles of primary levels were run and 20 permanent bench marks were established.

Primary triangulation and primary traverse were carried on at different times by three parties, the work being distributed over portions of California, Oregon, and Washington. The total area covered by this primary control was about 5,806 square miles, of which 529 were controlled by primary traverse, 206 miles being run and 74 permanent marks set. Twenty-three triangulation stations were occupied and 15 were marked. The results of this work made control available in 5 quadrangles and 1 national park.

Topographic surveys in Pacific division from July 1, 1911, to June 30, 1912.

State.	Contour interval.	For publication on scale of—						Total area surveyed.	Primary levels.		Primary traverse.	
		1:250,000.	1:125,000.		1:62,500.		1:31,680.					
		New.	New.	Resurvey.	New.	Resurvey.	New.		Distance run.	Bench marks.	Distance run.	Permanent marks.
	Feet.	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Mi.*		*Mi.*	
Arizona	25	.....	.....	.....	25	.....	.....	25	.....	.....	.....	.....
California	5, 25, 100, 200	1,918	1,301	851	214	.....	552	4,836	56	13	.....	.....
Idaho	25,50,100,200	4,397	365	.....	309	.....	.....	5,071	424	117	.....	.....
Montana	200	598	.....	.....	.....	.....	.....	598	6	2	.....	.....
Oregon	5, 25, 100	.....	460	.....	365	.....	317	1,142	604	151	206	74
Utah	20, 50	.....	.....	.....	.....	165	.....	165	.....	.....	.....	.....
Washington	5, 10, 25, 100	.....	522	.....	451	.....	52	1,025	104	26	.....	.....
		6,913	2,648	851	1,364	165	921	12,862	1,194	309	206	74
Hawaii	10, 25, 50	.....	.....	.....	.....	.....	281	281	[a] 77	20	.....	.....

[a] 53 miles precise levels.

DETAILS OF WORK BY STATES.

Arizona.—The survey of the Phoenix quadrangle, in Maricopa County, was completed by T. P. Pendleton, the area mapped being 25 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet. Culture was also brought up to date on the part of this quadrangle previously mapped.

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. In the San Joaquin Valley the survey of the Holt, Woodward Island, Byron Hot Springs, and Bethany 7½-minute quadrangles and of the unmapped portions of the Stockton and Brentwood 7½-minute quadrangles, in San Joaquin, Contra Costa, and Alameda counties, was completed by Duncan Hannegan and J. L. Lewis, the area mapped being 296 square miles, for publication on the scale of 1:31,680, with a contour interval of 5 feet. The survey of the Union Island 7½-minute quadrangle, in San Joaquin County, was begun by Mr. Hannegan, J. P. Harrison, and Mr. Lewis, the area mapped being 27 square miles, for publication on the scale of 1:31,680, with a contour interval of 5 feet.

In the Salinas Valley the survey of the Metz, King City, San Ardo (the southwest quarter of the Priest Valley 30-minute quadrangle, which is being mapped on a scale of 1:125,000), and Bradley 15-minute quadrangles was begun and that of the Soledad 15-minute quadrangle was continued, the area mapped being 229 square miles in Monterey and San Luis Obispo counties, 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 Hartmann, jr., E. R. Bartlett, and R. M. LaFollette.

In addition to the regular cooperative surveys in California the State Board of Control (Water Powers) made an allotment of $7,000 for cooperative river surveys, the United States Geological Survey making no allotment but detailing its men to carry on the work. Under this plan profile surveys were made of the North, Middle, and South forks of American River, the Middle Fork of Feather River, Pit River, and Tuolumne River, the total distance traversed being 367 miles, in Sacramento, Placer, Eldorado, Butte, Plumas, Shasta, Lassen, Tuolumne, and Stanislaus counties. This work was done by J. G. Staack, J. P. Harrison, Charles Hartmann, jr., and T. J. Pendleton.

In addition to the cooperative work in California, the survey of the land area of the Monterey quadrangle, covering 148 square miles in Monterey County, was completed by C. F. Eberly and Cornelius Schnurr, for publication on the scale of 1:62,500, with a contour in-

terval of 25 feet. For the control of the Monterey quadrangle Mr. Schnurr ran 56 miles of primary levels and established 13 permanent bench marks. The survey of the Capitola quadrangle, in Monterey and Santa Cruz counties, was begun by E. R. Bartlett, the area mapped being 27 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet.

The survey of the unmapped portion of the Big Bar quadrangle, covering 16 square miles in the Trinity National Forest, was completed, and that of the Sawyers Bar quadrangle, in the same national forest, Trinity, Humboldt, and Siskiyou counties, was begun, the area mapped being 359 square miles, for publication on the scale of 1:250,000, with a contour interval of 200 feet. This work was done by J. P. Harrison. The resurvey of the Weaverville quadrangle (the northwest quarter of the old Red Bluff 1-degree quadrangle), lying partly in the Trinity National Forest, Trinity and Shasta counties, was completed by Oscar Jones, Bayard Knock, and K. W. Trimble, the area resurveyed being 851 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet.

The survey of the unmapped portion of the Bishop quadrangle, covering 205 square miles in Inyo and Mono counties, was completed, and that of the Long Valley quadrangle, lying partly in the Inyo and Mono national forests, Mono County, was begun by B. A. Jenkins, the area mapped being 435 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, San Bernardino and Kern counties, was begun by J. P. Harrison and L. R. Ebert, the area mapped being 1,543 square miles, for publication on the scale of 1:250,000, with a contour interval of 100 feet. For the control of this quadrangle C. F. Urquhart and Charles Hartmann, jr., occupied 16 and marked 14 triangulation stations.

The survey of the unmapped portion of the Caliente quadrangle, covering 301 square miles in Kern County, was completed by J. W. Muller and K. W. Trimble, for publication on the scale of 1:125,000, with a contour interval of 100 feet.

The survey of the Petaluma quadrangle, in Sonoma and Marin counties, was continued by Bayard Knock, the area mapped being 39 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet.

The survey of the unmapped portion of the Priest Valley quadrangle, lying partly in the Monterey National Forest, Monterey, San Benito, and Fresno counties (a portion of which was covered by the survey of the Coalinga oil district), was begun by B. A. Jenkins, D. H. Watson, and R. M. LaFollette, the area mapped being 360

square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet.

Idaho.—The survey of the Slug Creek quadrangle was completed and that of the Wayan, Freedom, Henry, and Preuss Range quadrangles, in Bear Lake and Bannock counties, was continued by Albert Pike, the area mapped being 309 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. Field work on 205 square miles of this area was done on a scale of 1:31,680. (Work on this same area was reported last year as done in the Wayan 30-minute quadrangle.) For the control of the Wayan quadrangle D. S. Birkett ran 37 miles of primary levels and established 11 permanent bench marks. For the control of the Chatcolet and Fernwood quadrangles, in Kootenai and Shoshone counties, Mr. Birkett ran 93 miles of primary levels and established 30 permanent bench marks.

A profile survey of Salmon River, in Idaho and Adams counties, was made by O. G. Taylor, the distance traversed being 108 miles.

Idaho-Montana.—The survey of the Idaho portions of the Taft and St. Regis quadrangles, in Shoshone County, was continued by J. E. Blackburn and C. L. McWhorter, the area mapped being 365 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. For the control of the Idaho portions of this area D. S. Birkett ran 29 miles of primary levels and established 8 permanent bench marks, and for the control of the Montana portion of this area Mr. Birkett ran 6 miles of primary levels and established two permanent bench marks.

The survey of the Priest Lake 1-degree quadrangle (formerly called Panhandle), lying partly in the Pend Oreille and Kaniksu national forests, Bonner, Kootenai, Lincoln, and Shoshone counties, Idaho, and Flathead and Sanders counties, Mont., was completed by T. P. Pendleton and J. W. Muller, the area mapped being 1,320 square miles, for publication on the scale of 1:250,000, with a contour interval of 200 feet. Of the area mapped 163 square miles lie in Montana. In connection with this work the Sand Point 30-minute quadrangle, forming the southeast quarter of the Priest Lake quadrangle, was completely revised.

The survey of the Lolo quadrangle, in the Clearwater National Forest, was completed, and that of the Washington Creek, Weippe, and Quartz quadrangles, in the same forest, was begun, the total area mapped being 3,675 square miles, for publication on the scale of 1:250,000, with a contour interval of 200 feet. Of this area 3,240 square miles lie in Clearwater, Idaho, and Nez Perce counties, Idaho, and 435 square miles in Missoula County, Mont. This work was done by T. M. Bannon, J. G. Staack, and S. G. Lunde. For the control of this area L. F. Biggs ran 265 miles of primary levels and

established 68 permanent bench marks, all of the control being in Idaho.

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 Brownsville, Lebanon, Monroe, Albany, and Corvallis 15-minute quadrangles, in Linn, Benton, and Marion counties, the total area mapped being 269 square miles, for publication on the scale of 1:31,680, with contour intervals of 5 and 25 feet. This work was done by E. R. Bartlett, A. J. Ogle, J. M. Rawls, and A. F. McNair. For the control of these areas Mr. Bartlett, E. M. Bandli, and A. G. Humphrey ran 189 miles of primary levels and established 45 permanent bench marks and C. F. Urquhart ran 149 miles of primary traverse and set 60 permanent marks.

The survey of the Oregon City and Boring quadrangles and the Oregon portion of the Troutdale quadrangle, in Clackamas and Multnomah counties, was continued by J. H. Wheat, A. E. Murlin, O. G. Taylor, L. R. Ebert, D. H. Watson, and H. S. Leicht, the area mapped being 365 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet. For the control of these areas E. M. Bandli ran 78 miles of primary levels and established 21 permanent bench marks and C. F. Urquhart and Mr. Bandli ran 57 miles of primary traverse and set 14 permanent bench marks.

The survey of the Pine quadrangle, lying partly in the Wallowa National Forest, Baker County, was continued by G. S. Smith, the area mapped being 460 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. For the control of this quadrangle D. S. Birkett ran 69 miles of primary levels and established 21 permanent bench marks.

In addition to the regular cooperative topographic work in Oregon, profile surveys of Deschutes and Metolius rivers were made in Crook, Sherman, and Wasco counties, in connection with water-power investigations being carried on by the water-resources branch in cooperation with the State of Oregon. The distance traversed in the Deschutes River survey was 253 miles, in connection with which an area of 48 square miles, included in the Lava, Cline Falls, and Maiden Peak quadrangles, was mapped, for publication on the scale of 1:31,680, with a contour interval of 5 feet. This work was done by A. T. Fowler and O. G. Taylor. For the control of this area Mr. Fowler, D. S. Birkett, and Paul Hegdahl ran 268 miles of primary levels and established 64 permanent bench marks. The Metolius River survey was begun in June, 1912, and included the traversing of 14 miles.

Utah.—The resurvey of the Sunnyside quadrangle (a portion of the old Price River quadrangle), in Carbon County, was completed by S. P. Floore, the area mapped being 165 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. The revision of the Tintic mining district, covering an area of 12 square miles in Juab and Utah counties, was completed by W. M. Beaman, for publication on the scale of 1:9,600, with a contour interval of 20 feet.

Washington.—The Board of Geological Survey of Washington allotted $13,750 for the continuation of cooperative topographic surveys and the United States Geological Survey allotted a like sum. The survey of the Cedar Lake quadrangle, lying partly in the Snoqualmie and Rainier national forests, King and Pierce counties, was completed by W. O. Tufts, L. R. Ebert, R. B. Kilgore, F. A. Danforth, and E. L. Thomason, the area mapped being 427 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. The survey of the Palisades quadrangle, in Grant County, was continued and that of the Malaga quadrangle, in Grant and Douglas counties, was begun by H. L. McDonald, the area mapped being 130 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet. The survey of the Wenatchee quadrangle, lying partly in the Wenatchee National Forest, Douglas County, was begun by Mr. McDonald, the area mapped being 20 square miles, for publication on the scale of 1:62,500, with a contour interval of 25 feet. For the control of the Malaga quadrangle Mr. McDonald ran 16 miles of primary levels and established 5 permanent bench marks. The survey of a portion of the Grays Harbor quadrangle, covering an area of 160 square miles in Chehalis County, was completed by Charles Hartmann, jr., R. R. Randell, and G. L. Hagman, for publication on the scale of 1:62,500, with a contour interval of 25 feet. For the control of the Grays Harbor quadrangle Mr. Hagman ran 88 miles of primary levels and established 21 permanent bench marks.

A profile survey of Wenatchee River, in Chelan County, was made by Charles Hartmann, jr., and T. H. Moncure, the distance traversed being 119 linear miles, in connection with which 26 square miles were mapped, for publication on the scale of 1:31,680, with contour intervals of 5 and 10 feet. A profile survey of Snoqualmie River, in King County, was made by R. M. La Follette, the distance traversed being 50 linear miles, in connection with which 15 square miles were mapped, for publication on the scale of 1:31,680, with contour intervals of 5 and 25 feet. A profile survey of Clealum River, in Kittitas County, was made by Mr. Moncure, the distance traversed being 58 linear miles, in connection with which 11 square miles were mapped,

for publication on the scale of 1:31,680, with a contour interval of 5 feet.

In addition to the cooperative work in Washington, the survey of the Mount Rainier National Park, in Pierce County, was continued by G. R. Davis and F. E. Matthes, the area mapped being 141 square miles, for publication on the scale of 1:62,500, with a contour interval of 100 feet. For the control of this area C. F. Urquhart occupied 7 triangulation stations and marked 1.

Washington-Oregon.—The survey of the Mount Hood quadrangle (formerly called the Mount Hood special area), in Skamania County, Wash., and Multnomah and Hood River counties, Oreg., was completed by R. M. La Follette, for publication on the scale of 1:125,000, with a contour interval of 100 feet, the work during this season covering an area of 95 square miles in the Washington portion.

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. The survey of the island of Hawaii was continued, the area mapped being 237 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 Hamakua, Kohala, Honomu, Mauna Kea, and Waipio 15-minute quadrangles and was done by C. H. Birdseye, A. O. Burkland, J. M. Rawls, J. H. Ballinger, and Sidney Birdseye. For the control of the Kohala quadrangle Sidney Birdseye ran 19 miles of primary levels and established 3 permanent bench marks, and for the control of the Honomu quadrangle Mr. Burkland ran 5 miles of primary levels and established 1 permanent bench mark.

In addition to the regular cooperative work, a special survey of the area embracing the proposed national park around Kilauea Crater, island of Hawaii, was made by C. H. Birdseye and Mr. Burkland for the Territorial Government, all expenses being borne by the Territory. The area mapped was 44 square miles, for publication on the scale of 1:31,680, with a contour interval of 25 feet. For the control of this area, J. M. Rawls ran 53 miles of precise levels and established 16 permanent bench marks.

OFFICE WORK.

The drafting of the following sheets was completed: Winkelman, Ariz.; Bakersfield, Ballarat, Bethany, Big Bar, Bishop, Brentwood, Byron Hot Springs, Caliente, Coalinga, Holt, Lida, Monterey, Mount Goddard, Panoche, Stockton, Weaverville, and Woodward Island, Cal.; special map of proposed Kilauea Volcano National Park, Hawaii; Slug Creek and Salmon River, Idaho; Lolo and

Priest Lake, Idaho-Mont.; Deschutes River, Oreg.; Mount Hood, Oreg.-Wash.; Sunnyside and Tintic mining district (revision), Utah; Cedar Lake, Clealum River, Tieton River, and Wenatchee River, Wash.

Progress in the drafting of additional sheets was made as follows: Phoenix, Ariz. (revision), 87 per cent; Long Valley, Cal., 45 per cent; Metz, Cal., 80 per cent; Petaluma, Cal., 32 per cent; Sawyers Bar, Cal., 20 per cent; Soledad, Cal., 98 per cent; Waipio No. 6, Hawaii, 73 per cent; Waipio No. 7, Hawaii, 5 per cent; Hamakua No. 5, Hawaii, 32 per cent; Preuss Range, Idaho, 45 per cent; Henry, Idaho, 20 per cent; Wayan, Idaho, 80 per cent; Washington Creek, Idaho, 13 per cent; Weippe, Idaho, 24 per cent; St. Regis, Idaho-Mont., 30 per cent; Taft, Idaho-Mont., 32 per cent; Quartz, Mont., 5 per cent; Albany, Oreg., 36 per cent; Boring, Oreg., 95 per cent; Brownsville, Oreg., 11 per cent; Cazadero, Oreg., 8 per cent; Corvallis, Oreg., 3 per cent; Lebanon, Oreg., 25 per cent; Monroe, Oreg., 50 per cent; Oregon City, Oreg., 45 per cent; Pine, Oreg., 60 per cent; Malaga, Wash., 48 per cent; Mount Rainier, Wash., 55 per cent; Palisades, Wash., 27 per cent; Snoqualmie River, Wash., 75 per cent; Wenatchee, Wash., 5 per cent; Cispus River, Wash., 30 per cent (field work by water-resources branch).

In the computing section the following computations and adjustments were made:

Primary-level circuits were adjusted and geodetic distances and positions were computed for the Avena, Clyde, Copperopolis, Manteca, Peters, and Trigo quadrangles (Cal.). Primary-level circuits in the Monterey quadrangle (Cal.) were adjusted. Geodetic distances and positions were computed in the Banta, Borax Flat, Byron, Holt, Lathrop, Oakdale, Stockton, Tracy, and Union Island quadrangles (Cal.).

Primary-level circuits were adjusted in the Chatcolet Station, Fernwood, Henry, Kamiah, Kendrick, Soda Springs, Summit Lake, Crags Mountains, Wayan, and Weippe (Idaho), Asotin and Lapwai (Idaho-Wash.), Fish Creek, Pot Mountain, and Taft (Idaho-Mont.), and Freedom, Montpelier, and Preuss Range (Idaho-Wyo.) quadrangles.

Primary-level circuits were adjusted and geographic positions were computed for the Albany, Lebanon, Oregon City, and Reedville quadrangles (Oreg.). Primary-level circuits were adjusted in the Baker City, Birch Creek, Brownsville, Cline Falls, Corvallis, Dufur, Lava, Madras, Maiden Peak, Monroe, Moro, Pine, and Prineville (Oreg.) and Goldendale (Oreg.-Wash.) quadrangles. Geographic positions for the Aumsville, Boring, and Salem quadrangles (Oreg.) were computed.

Primary-level circuits were adjusted in the Cape Elizabeth, Grays Harbor, Humptulips, Palisades, and Point Hanson quadrangles (Wash.). Geodetic distances and positions for the Mount Rainier quadrangle (Wash.) were computed.

INSPECTION OF TOPOGRAPHIC SURVEYING AND MAPPING.

The field time of the inspectors was divided between inspection duty and special topographic work. J. H. Renshawe spent the season in inspecting the current work of field parties in portions of the Atlantic and Central divisions. W. M. Beaman, after examining and revising the large-scale Tintic mining map, comprising 12 square miles in Juab and Utah counties, Utah, was engaged during the remainder of the field season in the inspection of river surveys and other current topographic work in the Rocky Mountain and Pacific divisions. F. E. Matthes spent the regular field season in topographic work on the map of the Mount Rainier National Park, Wash., completing 51 square miles, and in October spent two weeks in topographic work on the Hanna quadrangle, Wyo. Since January Mr. Matthes has been engaged in office drafting of his field sheet and the preparation of several reports on national parks for publication by the Department of the Interior.

The office duties of Messrs. Renshawe and Beaman involved a careful supervision of the inking and preparation of the final drawings of the topographic branch and their examination prior to submission for engraving or photolithography. Mr. Beaman's duties also included 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 to all topographic instruments were made under the supervision of E. M. Douglas, who is also in charge of the topographic records.

The principal instruments repaired in the Survey shop consist of 179 telescopic alidades, 67 Y levels, 10 prism levels, 14 transits, 60 tripods, 240 box compasses, 28 pocket, clinometer, and other compasses, and 30 Locke levels. In addition to these, over 1,700 smaller articles were repaired. The principal repairs made by outside contractors were those to leveling rods, for the repair of which the Survey has no facilities.

The additions to the topographic records consisted of 250 triangulation or primary traverse books, 370 level books, 225 vertical-angle

or stadia books, and 50 plane-table sheets, all of which have been numbered and catalogued.

MAP OF THE UNITED STATES.

Of the work in progress last year on the 1:1,000,000 scale map of the United States, under the direction of A. F. Hassan, base maps of the following States have been completed: Alabama (portions of sheets H and I 16), Delaware (portion of sheet J 18), Georgia (portions of sheets H and I 16 and 17), Mississippi (portions of sheets H and I 15 and 16), New Jersey (portions of sheets J and K 18), New York (portions of sheets K 17 and K and L 18), Pennsylvania (portions of sheets J and K 17 and 18), Tennessee (portions of sheets I 15 and I and J 16 and 17), and Wyoming (portions of sheets K and L 12 and 13). These State maps, with portions of other States which have been compiled, complete the bases of the following international sheets: North H 16, North H 17, North I 16, North J 18, and North K 18. Additional work included the lettering of 60 per cent of the base map of Montana (portions of sheets L and M 11, 12, and 13) and the compilation and inking of 35 per cent of sheets I and J 10 (California).

In addition to the work on the 1:1,000,000 scale map, 75 per cent of the contour revision of the three-sheet map of the United States was completed and 33 special maps were prepared for other branches of the Government.

WATER-RESOURCES BRANCH.

GENERAL SCOPE OF WORK.

The work of the water-resources branch has been continued under the administrative plan described in last year's report. Though the appropriation ($150,000) was the same as that for the previous year, the scope of the work has been considerably increased in certain sections of the country. This increase has been made possible by additional cooperative moneys allotted by certain States and, in New Hampshire, by the necessity for an intensive hydrometric investigation in the White Mountain area under the authority of the Weeks Act.

ALLOTMENTS.

The allotments of the appropriation for the fiscal year were as follows:

Administrative expenses of the Survey	$10,761.67
Clerical assistance	5,200.00
Computation, reports, and technical studies	9,200.00

Stream gaging in—	
New England and New York	$4,850.00
Virginia, South Carolina, North Carolina, Georgia, Alabama, Mississippi, and Tennessee	4,000.00
West Virginia, Kentucky, Ohio, Indiana, and Illinois	8,000.00
Minnesota	10,000.00
Texas	1,000.00
Southern Wyoming, Colorado, and New Mexico	8,175.00
Northern Wyoming, Montana, and North Dakota	7,000.00
Idaho, Utah, and Nevada	8,750.00
Washington and Oregon	12,000.00
California	5,580.00
Nevada and Arizona	4,870.00
Hawaii	5,000.00
Investigation of ground waters, including quality of waters	17,500.00
Land-classification board	11,644.00
Water-power investigations	14,969.33
Deschutes River investigation	1,500.00
	150,000.00

Of the total appropriation 83.5 per cent was allotted for work in the public-land States.

COOPERATION.

STATES.

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

Amounts allotted by States for cooperative work with United States Geological Survey in investigation of water resources.

California:		
State engineer	$9,000	
Conservation Commission	12,000	
Board of Control	4,000	
		$25,000.00
Colorado		167.10
Hawaii		12,000.00
Idaho		12,000.00
Illinois		2,191.37
Maine		1,350.00
Minnesota		16,000.00
Massachusetts		1,000.00
Montana		3,000.00
New York:		
State engineer	$1,500.00	
Water-Supply Commission	1,976.30	
Conservation Commission	10,000.00	
		13,476.30
New Mexico		4,258.15

Oregon:		
For stream gagings	$8,419.47	
For analyses of waters	2,000.00	
For Deschutes River investigation	3,000.00	
		$13,419.47
Tennessee		718.22
Utah		2,521.47
Vermont		1,000.00
Washington		4,419.31
Wyoming		200.00
		112,721.39

The work performed under the cooperative agreements is outlined in the following paragraphs.

California.—Three separate agreements have been in effect in California during the year. The first is a continuation of the one that has been in force during previous years, the State cooperating through the office of the State engineer under a continuing authority and appropriation enacted by the California Legislature in 1909. Under this agreement the sum of $9,000 has been expended by each party and the work has been confined to the maintenance of river-flow measurement stations previously established and a study of the occurrence and availability of underground waters. The second agreement was executed with the Conservation Commission of California, under which the commission allotted to the Geological Survey, for the purpose of establishing and maintaining 60 river-measurement stations, the sum of $12,500. The work under this agreement was carried on in connection with that provided under the agreement first mentioned. The third agreement was executed with the State Board of Control (Water Powers), under which the board allotted to the Geological Survey the sum of $4,000 to be used in the preparation of reports containing the results of all hydrometric investigations that have been maintained in the State since the beginning of the work there. The preparation of these reports was nearly completed at the end of the fiscal year.

Colorado.—Cooperation in Colorado was maintained through the office of the State engineer, who assumed the cost of maintaining certain flow-measurement stations, the total contribution being given in the foregoing table.

Hawaii.—The cooperative work in Hawaii, under an agreement executed by the Geological Survey and the Territorial government, consisted of the determination of stream flow, the measurement of precipitation, and incidental studies of water losses occasioned by seepage in irrigation canals. The sum of $5,000 was allotted by the Geological Survey and $12,000 by the Territory.

Idaho.—Two cooperative agreements between the Geological Survey and the Idaho State Land Board have been in force during the

year. The first, executed on July 1, 1911, provided for the expenditure of $5,000 by each party in the maintenance of stream-flow investigations. Owing to the increasing importance of the investigations in Idaho, the State was made a separate district of the Survey on September 1, 1911, and a new agreement was made covering the period between that date and January 1, 1913, under which the Geological Survey agreed to allot the sum of $8,600 and the State the sum of $11,350.

Illinois.—The cooperative work in Illinois has consisted of the maintenance of stream-flow measurement stations under the joint direction of the Geological Survey and the Rivers and Lakes Commission of Illinois. All the expenses of this work except those for supervision, computations, and publication of results have been borne by the State, the amount expended by it being $2,200.

Maine.—Under a cooperative agreement with the Maine State Water Storage Commission the sum of $1,350 was allotted for the maintenance of stream-flow measurements during the fiscal year.

Massachusetts.—A cooperative agreement between the Geological Survey and the governor of the Commonwealth of Massachusetts executed on January 2, 1912, provided that between that date and June 30, 1912, each party should contribute the sum of $1,000 for the measurement of the flow of streams within the Commonwealth.

Minnesota.—The Minnesota State Drainage Commission has cooperated with the Geological Survey during the fiscal year in the maintenance of stream-flow measurements and the survey of river profiles. The amount allotted by the commission was $16,000 and by the Survey $10,000.

Montana.—Cooperation was maintained between the Geological Survey and the Carey Land Act Board of Montana, under which each party expended the sum of $3,000 in the maintenance of stream-flow measurements.

New Mexico.—Cooperation with New Mexico has consisted in the payment of certain expenses by the State engineer. It involved the maintenance of stream-flow measurement stations previously established. The amount expended by the Geological Survey was $2,500 and by the State $4,258.

New York.—Two cooperative agreements were in force in New York, one with the State engineer and the other with the New York Conservation Commission and its predecessor, the Water-Supply Commission. The work was confined to the determination of stream flow for the purpose of municipal supply, development of water power, and flood prevention. The amount expended by the Geological Survey was $2,500, by the State engineer $1,500, and by the Conservation Commission $10,000.

Oregon.—The cooperation in Oregon, arranged with the office of the State engineer, consisted of three agreements—first, for the determination of stream flow; second, for a complete survey and investigation of the water powers of Deschutes and Metolius rivers; and, third, for an investigation or survey of the chemical composition of the river waters of the State for the purpose of determining their utility in municipal, agricultural, and manufacturing uses.

Tennessee.—Under an agreement with the State geologist of Tennessee a survey and stream-flow investigation of Doe River was begun for the purpose of making a report on the available water power of that stream. The expenditure by the State was $718.22, that by the Geological Survey was $254.54, and the difference will be expended during the present field season by the Survey to the end that the cost of the investigation may be equally divided between the two parties.

Utah.—The cooperative work carried on in conjunction with the State engineer of Utah during previous years, under which investigations were made of stream flow for use in irrigation and the development of water power, was continued during the past year, each party contributing the sum of $2,500.

Vermont.—The cooperative work in Vermont consisted of the determination of stream flow, and under the agreement executed by the Geological Survey and the governor of the State each party contributed the sum of $1,000.

Washington.—The cooperative work in Washington was in continuation of that maintained during previous years under an agreement executed by the governor, providing for investigation of stream flow for use in irrigation and the development of power and the preparation of reports on the water powers of the Cascade Range in conjunction with profile and reservoir surveys made by the topographic branch under a separate agreement.

Wyoming.—The State engineer of Wyoming and the Geological Survey have each expended the sum of $200 in the maintenance of stream-flow measurement stations within the State.

RECLAMATION SERVICE.

Under the direction of the Reclamation Service and at the expense of the reclamation fund 131 stations have been maintained on Government irrigation projects by the Geological Survey. The arrangement for this work was the same as that described in the report for the fiscal year ended June 30, 1911.

OFFICE OF INDIAN AFFAIRS.

A large amount of work has been performed by the water-resources branch at the request of the Commissioner of Indian Affairs in con-

nection with the classification of lands within Indian reservations with regard to water powers and reservoir sites. The following is a detailed statement of the work so performed:

Blackfeet Reservation.—An investigation of the power and reservoir-site possibilities of the Blackfeet Reservation was made under an allotment of $350. The report was completed and filed on July 31, 1911, at a cost of $147.75.

Camp McDowell Reservation.—An investigation in the Camp McDowell Reservation was performed under authority dated July 18, 1911, the allotment being $75. The report was filed March 21, 1912, the investigation being made at a total cost of $102.55.

Colville Reservation.—An investigation of the water-power and reservoir-site possibilities of the Sanpoil and Nespelem River basins was performed under authority dated April 11, 1911, the allotment being $500. The report thereon was filed September 27, 1911, the cost being $498.80. Under a second authority, dated November 24, 1911, a similar investigation was made of that portion of the Colville Reservation not covered by the investigation above mentioned, under an allotment of $150. The report was filed June 4, 1912, and the cost of the investigation was $99.90. In addition to the foregoing work the sum of $350 was allotted November 24, 1911, to be used in the maintenance of stream-flow investigations on the Colville Reservation up to June 30, 1912.

Crow Reservation.—Under authority dated March 30, 1911, an investigation of the Crow Reservation was made for the purpose of locating and establishing suitable river-flow measurement stations, the allotment therefor being $110. A report on this investigation was filed November 2, 1911, the cost of the work being $138.30. Under a further authority, dated November 29, 1911, the sum of $550 was allotted for the maintenance of stations established under the previous investigation, up to June 30, 1912.

Fort Hall Reservation.—Under an agreement dated February 25, 1911, the sum of $1,000 was allotted for the maintenance of river-flow measurement stations established in the Fort Hall Reservation under a previous agreement. Under further authority, dated July 1, 1911, the sum of $226 was allotted for an investigation of water-power and reservoir-site possibilities on the reservation. The report on this investigation was filed August 10, 1911, the cost thereof being $203.19.

Fort Peck Reservation.—An investigation of water-power and reservoir-site possibilities in the Fort Peck Reservation was authorized on August 4, 1911, the allotment therefor being $300. The report was filed November 7, 1911, the total cost of the work being $34.20.

Gila River Reservation.—Under an allotment of $100, dated September 8, 1911, an investigation of water-power and reservoir-site possibilities was made in the Gila River Reservation. The report was filed March 21, 1912, the total cost of the work being $113.72.

Klamath Reservation.—The Commissioner of Indian Affairs authorized, on March 30, 1911, the expenditure of $350 for the maintenance during the period ending June 30, 1912, of gaging stations established in the Klamath Reservation under a previous agreement. On March 30, 1911, the sum of $50 was allotted for a further reconnaissance of the Klamath Reservation for the purpose of locating and establishing additional gaging stations required in connection with the land-classification work. The report on this investigation was filed February 13, 1912, the cost of the work being $26.95. Under date of March 6, 1912, a further allotment of $300 was authorized for the maintenance of these stations up to June 30, 1912. An investigation of water-power and reservoir-site possibilities on this reservation was authorized October 12, 1911, the allotment therefor being $200. A report was filed October 20, 1911, at an expense of $49.95. The report was not acceptable, and a further investigation will be made during the present field season.

Menominee Reservation.—The maintenance of flow-measurement stations established in the Menominee Reservation under previous authority of the Office of Indian Affairs was continued during the past year under an allotment of $600 made on January 1, 1912.

Moki and Navajo reservations.—The work on the Moki and Navajo reservations consisted of investigations of the occurrence and availability of underground waters in continuation of a previous authority and a special allotment of $1,500 authorized by the Commissioner of Indian Affairs March 30, 1911.

Pine Ridge Reservation.—An investigation of water-power and reservoir-site possibilities in the Pine Ridge Reservation was authorized on February 20, 1912, under an allotment of $500. A report was filed June 11, 1912.

Quinaelt Reservation.—The work in the Quinaelt Reservation consisted of two parts. An investigation of water-power and reservoir-site possibilities was authorized September 14, 1911, under an indefinite allotment. A report was filed December 13, 1911, the cost of which was $139.22. In addition the Acting Commissioner allotted on January 19, 1912, the sum of $50 for the maintenance of a river-flow measurement station on the reservation.

Rosebud and Pine Ridge reservations.—An allotment of $225 was authorized on March 20, 1911, for the reconnaissance and establishment of river-flow measurement stations in the Rosebud and Pine Ridge reservations. A report thereon was filed October 21, 1911, the cost of which was $261.91. The maintenance of the stations, estab-

lished at a cost to June 30, 1912, of $490, was authorized November 24, 1911.

Rosebud Reservation.—An investigation of water-power and reservoir-site possibilities in the Rosebud Reservation was authorized on August 4, 1911, and the report filed October 21, 1911. The allotment for this work was $100, and the ultimate cost $98.50.

Salt River Reservation.—Under authority granted September 8, 1911, an examination of the Salt River Reservation for water-power and reservoir-site possibilities was undertaken under an allotment of $100. A report was filed on March 21, 1912, the total cost thereof being $102.52.

Standing Rock Reservation.—Under authority dated March 30, 1911, a reconnaissance of the Standing Rock Reservation for the purpose of locating and establishing stream-flow measurement stations was made during August and September, 1911, the allotment therefor being $150. A report was filed on October 21, 1911, the total cost of which was $103.76. Under date of November 24, 1911, an allotment of $350 was authorized for the maintenance to July 1, 1912, of the stations established under the foregoing investigation. A further investigation relative to water-power and reservoir-site possibilities was made under an allotment of $200, dated October 12, 1911. Report on this investigation was filed October 21, 1911, the ultimate cost thereof being $137.71.

Warm Springs Reservation.—On March 28, 1911, the Commissioner of Indian Affairs authorized a reconnaissance of the Warm Springs Reservation for the location and establishment of stream-flow measurement stations. The work was performed in June, 1911, and a report filed October 12, 1911. The allotment for this investigation was $60 and the ultimate cost $60.40. Under date of February 12, 1912, an allotment of $452 was authorized for the maintenance of the stations established until July 1, 1912. An investigation of water-power and reservoir-site possibilities on this reservation was begun under authority dated March 16, 1912, the allotment therefor being $400. The field work in this investigation was performed during the month of June, 1912, but no report thereon was received until the close of the fiscal year.

Yakima Reservation.—The work in the Yakima Reservation consisted of the maintenance of stream-flow measurement stations established under previous authority. The allotment authorized for the fiscal year on March 30, 1911, was $850.

FOREST SERVICE.

Cooperation with the Forest Service, described in the report for the fiscal year 1911, was continued during the past year. The num-

ber of stations maintained under this arrangement exceeds that for the previous year and is as follows:

Stream-gaging stations in national forests.

California	62	Oregon	19
Colorado	61	Utah	16
Idaho	20	Washington	18
Montana	18	Wyoming	12
New Mexico	7		

PUBLICATIONS.

The work of the water-resources branch is represented by the following publications issued during the year:

Bulletin 479; Water-Supply Papers 261, 266 to 269, 271 to 280, 282, 285 to 288, and 295. Titles and brief summaries of these publications are given on pages 29, 34–36. Water-Supply Papers 259, 283, 284, 289 to 294, 296, 298, 301, 304, and 311 were at the Government Printing Office at the close of the year. Seven manuscripts are in hand awaiting editorial work and 21 reports are in different stages of preparation. Reprints of the following water-supply papers, the original edition of which has been exhausted, were delivered during the year: 170, 172, 173, 174, 200, 201, 202, 203, 204, 206, 207, 208 (two reprints), 209 (two reprints), 210, 211, 213, 214 (two reprints), 219, 231, 232, 247, 248, 249, 255 (two reprints), 257, and 273. Bulletin 479 has also been reprinted.

DIVISION OF SURFACE WATERS.

ORGANIZATION.

The principal work of the division of surface waters consists of the measurement of the flow of rivers. In carrying on this work the United States has been divided into 15 districts, including Hawaii and Alaska.

In each district is maintained a central office under the superivision of a district engineer, with a corps of assistants. The following list gives the districts, the territory covered, and the district engineer and his headquarters:

Maine district, covering only the State of Maine. C. C. Babb, district engineer, State Capitol, Augusta, Me.

New York and New England district: New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, and New York. C. C. Covert, district engineer, Federal Building, Albany, N. Y.

Middle Atlantic district: Maryland, Virginia, and New Jersey. R. H. Bolster, district engineer, Washington, D. C.

Southeastern district: Alabama, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee. M. R. Hall, district engineer, Post Office Building, Atlanta, Ga.

Ohio Valley district: Illinois, Indiana, Iowa, Kentucky, Michigan, North Carolina, Ohio, Tennessee, Virginia, West Virginia, and Wisconsin: A. H. Horton, district engineer, Federal Building, Newport, Ky.

Upper Mississippi district: Minnesota and Wisconsin. W. G. Hoyt, district engineer, Old Capitol Building, St. Paul, Minn.

Upper Missouri district: Montana, North Dakota, and Wyoming. W. A. Lamb, district engineer, Montana National Bank Building, Helena, Mont.

Denver district: Colorado, Nebraska, New Mexico, South Dakota, and Wyoming. Robert Follansbee, district engineer, Chamber of Commerce Building, Denver, Colo.

Great Basin district: Utah, Wyoming, and Nevada. E. A. Porter, district engineer, Brooks Arcade, Salt Lake City, Utah.

Idaho district, covering only the State of Idaho. G. Clyde Baldwin, district engineer, Idaho Building, Boise, Idaho.

Columbia River district: Oregon and Washington. F. F. Henshaw, district engineer, Tilford Building, Portland, Oreg.

California district: California, Nevada, and Arizona. H. D. McGlashan, district engineer, Custom House, San Francisco, Cal.

Texas district, covering only the State of Texas. T. U. Taylor, district engineer, Austin, Tex.

Hawaiian district, covering the Territory of Hawaii. W. F. Martin, district engineer, Honolulu, Hawaii.

Alaskan district, covering the Territory of Alaska. C. E. Ellsworth, engineer in charge.

The results of the work performed in the several districts are analyzed in the respective district offices and are then transmitted to the Washington office, where they are reviewed and prepared for publication in the computing section, which is under the charge of R. H. Bolster, hydraulic engineer. The work of the computing section is important, as its examinations insure that the data are on a high standard and that they are presented in a uniform manner. This division also carried on special hydrologic studies, the results of which are published in special water-supply papers.

GAGING STATIONS AND COOPERATING PARTIES.

For making measurements of stream flow regular points of measurement, known as gaging stations, are established on the various streams. At these points sufficient data are collected for determining the daily flow. The distribution of the gaging stations by States is shown in the accompanying table, together with the number of stations established and discontinued. As a large part of the work is carried on in cooperation with other Federal bureaus, State organizations, and private parties, the table has been arranged to show the extent of such cooperation in each State. During the year 99 stations were discontinued and 278 stations established. At the end of the year the total number of stations maintained, exclusive of those in Alaska and Hawaii, was 1,232. In addition to the foregoing, records ready for publication for about 186 stations were received at the end of the year from private parties.

Gaging stations maintained by United States Geological Survey and cooperating parties at end of fiscal year 1911.

State.	Geological Survey alone.	Reclamation Service.	Forest Service.	Indian Office.	Army Engineers.	Weather Bureau.	Other Federal bureaus.	State cooperation.	Municipal cooperation.	Private parties.	Counted more than once.	Maintained May 31, 1911.	Established during year.	Discontinued during year.	Regular gagings.	Miscellaneous gagings.
Alabama	....	....	....	....	1	2	....	6	....	....	....	9	1	....	13	....
Arizona	6	2	....	....	....	....	....	....	1	2	....	11	2	1	176	4
California	....	7	62	1	....	2	5	94	10	13	1	193	77	4	929	287
Colorado	....	4	61	....	....	1	....	18	....	7	2	91	9	11	857	36
Connecticut	....	....	....	....	....	1	....	....	....	....	....	1	....	1	....	....
Georgia	1	....	....	....	....	9	....	....	....	8	....	18	1	....	43	6
Idaho	....	6	20	5	....	1	....	82	1	46	42	119	45	1	527	81
Illinois	....	....	....	....	....	1	....	22	....	....	....	23	....	1	53	....
Indiana	....	....	....	....	....	1	....	....	....	....	....	1	....	....	2	....
Iowa	....	....	....	....	....	....	....	4	....	1	....	5	4	....	5	....
Kentucky	....	....	....	....	....	....	....	....	....	....	....	....	....	3	....	7
Maine	....	....	....	....	....	....	1	17	....	3	3	18	....	1	177	....
Maryland	2	....	....	....	....	....	....	....	....	....	....	2	....	....	1	....
Massachusetts	....	....	....	....	....	....	....	7	....	4	2	9	....	1	22	....
Michigan	....	....	....	....	....	....	....	1	1	5	....	7	....	....	....	....
Minnesota	....	....	....	....	....	2	....	47	....	....	2	46	3	3	293	34
Mississippi	1	....	....	....	....	1	....	4	....	....	....	6	....	3	25	....
Montana	51	50	18	7	....	1	....	....	....	4	....	131	19	7	489	25
Nebraska	....	....	....	....	....	....	....	10	....	....	....	10	....	....	....	....
Nevada	2	3	....	....	....	1	3	4	....	....	....	13	3	....	37	....
New Hampshire	....	....	....	....	....	....	9	....	....	....	....	9	....	....	355	....
New Jersey	1	....	....	....	....	2	....	....	....	....	....	3	....	....	....	....
New Mexico	....	3	13	2	....	....	....	17	....	3	....	37	14	10	91	33
New York	....	....	....	....	1	3	....	38	2	3	6	41	4	....	227	8
North Carolina	1	....	....	....	....	2	....	....	....	6	1	8	2	....	20	2
North Dakota	7	....	....	....	....	....	....	....	....	....	....	7	1	2	61	1
Ohio	1	....	....	....	....	....	....	....	....	1	....	2	....	4	3	8
Oregon	4	1	13	8	1	3	....	40	4	56	3	127	22	21	363	58
Rhode Island	....	....	....	....	....	....	....	1	....	1	1	1	....	2	....	....
South Carolina	....	....	....	....	....	1	....	....	....	....	....	1	....	....	3	....
South Dakota	....	1	....	3	....	....	....	....	....	....	....	4	4	....	21	....
Tennessee	3	....	....	....	....	6	....	1	....	....	....	10	....	....	19	....
Texas	1	....	....	....	....	8	....	....	....	....	....	9	5	....	7	2
Utah	1	....	3	....	....	1	....	57	7	32	32	62	29	4	247	31
Vermont	....	....	....	....	....	....	....	10	....	7	6	11	3	....	21	....
Virginia	10	....	....	....	....	1	....	....	....	2	....	13	....	....	14	2
Washington	....	....	11	12	....	2	3	28	2	27	....	85	15	8	507	140
West Virginia	20	....	....	....	....	....	....	....	....	1	....	21	....	4	40	9
Wisconsin	....	....	....	2	....	....	....	....	....	5	....	7	....	1	3	....
Wyoming	....	4	12	....	....	....	....	42	....	....	2	61	15	6	209	14
	112	81	213	40	3	52	21	550	28	242	103	1,232	278	99	5,860	788

Records for 186 stations are obtained and furnished complete by outside parties.

During the past year special attention has been given to improvement in the accuracy of the results obtained. In this connection much new equipment has been installed, including many automatic gages for obtaining a continuous record of stage, which is necessary to determine accurately the daily flow of streams that have much diurnal fluctuation in stage. The methods in use in the Washington office and in the district offices were thoroughly reviewed, and standard methods of procedure in all lines of work were installed in all the offices, thereby increasing the efficiency and also raising the standard of the results.

In Alaska investigations were carried on in the Fortymile, Circle, and Fairbanks regions.

Sufficient data were collected in connection with the investigations in the Territory of Hawaii for publication in a report, which is now being prepared.

PUBLICATIONS.

To facilitate the use of Government reports relating to water supply, climate, and related subjects the United States has, by agreement between the Geological Survey and the Weather Bureau, been divided into 12 areas, and the progress report of stream gaging has been divided into 12 parts, each part covering one of these areas. The areas and the number of the corresponding reports giving the results for 1909, 1910, and 1911 are shown in the table below. The reports for 1911 have not yet been published.

Reports on surface-water supply of the United States.

[The numbers given are the serial numbers of the water-supply papers.]

	1909	1910	1911
North Atlantic coast	261	281	301
South Atlantic coast and eastern Gulf of Mexico	262	282	302
Ohio River basin	263	283	303
St. Lawrence River basin	264	284	304
Upper Mississippi River and Hudson Bay basins	265	285	305
Missouri River basin	266	286	306
Lower Mississippi River basin	267	287	307
Western Gulf of Mexico	268	288	308
Colorado River basin	269	289	309
Great Basin	270	290	310
California	271	291	311
North Pacific coast	272	292	312

RIVER-PROFILE SURVEYS.

During the year all river-profile surveys were performed by the topographic branch, except certain incidental surveying in the upper Mississippi district by W. G. Hoyt on Zumbro, Little Fork, Big Fork, Wild Rice, Prairie, and Kawishiwi rivers and on certain rivers draining into Lake Superior.

DIVISION OF GROUND WATERS.

The allotment for the work of the division of ground waters was $17,630. Of this amount, $12,570 was used for investigations of ground-water problems and $5,060 for investigations of the quality of water, including both surface and underground supplies.

An investigation of the underground water resources of the State of Connecticut was undertaken at the beginning of the fiscal year in cooperation with the State Geological and Natural History Survey. This investigation, which is to be extended over a period of two or more years, is under the supervision of Prof. H. E. Gregory, of Yale University and of the Survey staff, and the field work is conducted by A. J. Ellis, of the Geological Survey. It is one of the most detailed studies of ground water that has been undertaken in any of the Eastern States, and it will furnish the basis for a reliable estimate of the quantity of ground water available to the rapidly developing industrial communities of Connecticut.

A comprehensive report on the underground water of Iowa, which has been for some time in preparation in cooperation with the State Survey, was received in rough draft late in the previous fiscal year, has been advanced through the various stages of editorial revision, and is now in the hands of the Public Printer. This report (Water-Supply Paper 293) has been prepared under the supervision of Prof. W. H. Norton, of Cornell College, Mount Vernon, Iowa, and will be published as a joint product of the Federal and State surveys.

A report by Prof. C. H. Gordon, of the University of Tennessee, Knoxville, Tenn., on the geology and underground waters of northeastern Texas, was issued during the present fiscal year as Water-Supply Paper 276, and a similar report by the same author on the geology and underground waters of the Wichita region of north-central Texas (Water-Supply Paper 317) is now in the hands of the editor.

During the last few years the Geological Survey has made a series of investigations of the underground water resources and irrigation possibilities of the western half of Utah, in which numerous shallow-water tracts exist. The results of these investigations have been published in several water-supply papers, the report by O. E. Meinzer on the ground waters in Juab, Millard, and Iron counties having been issued during the present fiscal year as Water-Supply Paper 277. In July, 1911, the examination of Boxelder County, a part of Tooele County, and certain small areas in southern Idaho was undertaken by Everett Carpenter, junior geologist, and at the close of the fiscal year the report is well advanced.

Urgent requests have in recent years been made of the Survey for information as to the occurrence of underground supplies in various parts of New Mexico and the feasibility of utilizing such supplies for irrigation. To these requests the Survey has responded so far as was possible. During the present fiscal year a report by O. E. Meinzer on the geology and water resources of Estancia Valley and adjacent areas was issued as Water-Supply Paper 275, the field investigation of the area about Deming was practically completed, and a survey of the Tularosa Basin and some of the plateaus of central New Mexico was begun. The Deming investigation, which was begun in the previous year, has been conducted by N. H. Darton, geologist, whose report is now in preparation. The Tularosa survey is being made in cooperation with the New Mexico Agricultural Experiment Station, O. E. 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. The report that is being prepared will cover all important phases of the underground-water problems of the region but will be devoted especially to the problems of irrigation with ground water in the Tularosa Basin and of the development of supplies for range stock on the plateaus.

It will also contain a guide to desert watering places in a part of New Mexico.

The report on the geology and water resources of Sulphur Springs Valley, Ariz., produced in collaboration by O. E. Meinzer, of the Federal Survey, and R. H. Forbes and F. C. Kelton, of the State Experiment Station, has been completed during the present fiscal year. It will be issued both as a water-supply paper of the Survey and as a bulletin of the Arizona Experiment Station.

The special investigations which during the preceding two years were conducted for the Office of Indian Affairs in the Moki and Navajo reservations in Arizona and adjacent parts of New Mexico and Utah were continued during the present year by H. E. Gregory, who has from the beginning been in charge of the work. The results of these studies are not prepared for publication but are presented in the form of manuscript reports to the Commissioner of Indian Affairs and serve as guides to the agents and engineers of the Indian Office.

By direction of Assistant Secretary Thompson, W. C. Mendenhall was instructed on August 3, 1911, to visit the Mesa Verde National Park, in order to examine the water supplies developed and available there for the use of the park officials and tourists and to suggest, should there prove to be need of additional supplies, methods for their development. The examination was made in the early part of September, 1911, and a report embodying its results has been prepared.

Reports embodying the results of four independent underground water investigations in California are in process of preparation or publication. Extensive field investigations of the occurrence, quality, and recovery of the underground supplies of the great area known as the San Joaquin Valley were made previous to this fiscal year by W. C. Mendenhall, geologist in charge of underground-water investigations, R. B. Dole, and Herman Stabler. During the year 1911–12 the data thus acquired have been reduced in the office, and a report for publication has been written in part. A similar report on the San Jacinto Valley is in preparation. On account of the importance of the underground supplies for irrigation the results of these two investigations will be of exceptional value.

The report by G. A. Waring on California springs and the report by C. H. Lee on an intensive study of the water resources of a part of Owens Valley, Cal. (Water-Supply Paper 294), have both been completed during the present year and will be published in the near future. The researches in Owens Valley were made possible through the cooperation of the city of Los Angeles. The results obtained will be a valuable contribution to the knowledge of the laws governing the circulation and disposal of underground waters.

A special investigation of the effects of steps taken by certain southern California communities during recent years to measure the

absorption of flood waters and thereby add to the ground-water supplies has recently been undertaken by Mr. Lee, through cooperation with the California State Conservation Commission. This research will be continued during the year 1912–13.

The underground-water investigations on the Atlantic and Gulf Coastal Plain are conducted by the geologic branch in connection with other geologic work and are described elsewhere in this report.

Investigations of the quality of water were continued under the immediate direction of R. B. Dole, chemist. He devoted the first ten months of the year to the preparation of a report on the quality of surface waters of the United States and of sections of other reports of the Survey as follows: "The concentration of mineral water in relation to therapeutic activity," for the chapter of "Mineral resources" on the production of mineral waters in 1911; and chapters on the quality of underground waters for reports on the underground-water resources of Texas, Florida, Georgia, Mississippi, and California. During May and June Mr. Dole was transferred to the geologic branch for the purpose of making a field examination of potash deposits in the southwestern part of Nevada. He also refained supervision over the work of Walton Van Winkle, assistant chemist, in Oregon.

Walton Van Winkle was engaged in an investigation of the quality of surface waters in Oregon and their availability for use for household, agricultural, and manufacturing purposes. This work was maintained in cooperation with the State of Oregon, through the office of John H. Lewis, State engineer, and consisted of the analysis of samples of water taken daily at the regularly established sampling stations on the important streams of the State. The laboratory work was performed in suitable quarters gratuitously furnished by the Willamette University at Salem, Oreg.

DIVISION OF WATER UTILIZATION.

ORGANIZATION.

The work of the division of water utilization has been maintained under the general plan of organization described in the last annual report. E. C. LaRue and E. C. Murphy, engineers, have performed the greater portion of the field work involved in the examination of water-power withdrawals, rights of way, Carey Act segregations, and enlarged-homestead designations and the examination of lands for similar purposes within Indian reservations. The chief hydrographer has expended such portion of his time as could be spared from other duties in similar field work. The personnel of this division and the appropriation available for its work are entirely insufficient to meet suitably the demands made upon it. A discussion of the scope of the work and its condition on January 1, 1912, so far as

the field investigations are concerned, is contained in the following paragraphs.

CLASSIFICATION OF PUBLIC LANDS.

The enlarged-homestead acts of February 19, 1909, and June 17, 1910, and the withdrawal act of June 25, 1910, involve extensive field investigations and reports by the Geological Survey. Contemporaneous with these duties came the Secretary's policy of referring to the Survey for report applications for rights of way and for Carey Act segregations. This policy requires work nearly if not quite as extensive as that imposed by the two acts above referred to. In these ways there were thrown on the water-resources branch field duties which, if suitably performed, would more than double the work that was being previously done. Nevertheless an increase of $50,000 only has been granted to meet this new condition. It should be emphasized that all the Land Office work involving the determination of the suitability of lands for water power and irrigation falls upon this appropriation. In consequence of the lack of funds the work is far behind schedule, and that which has been done has not been performed as well as it should have been. It involves the establishment and maintenance of stream-flow stations as well as engineering investigations of a high character. The enlarged-homestead act, for example, places upon the Survey the determination of the practicable irrigability of land proposed for designation under the terms of the act. To determine this matter properly months of investigation are sometimes necessary. Private companies and the Reclamation Service have spent large sums of money to determine the irrigability of a single tract. The Reclamation Service has found it necessary to expend $217,000 for the purpose of ascertaining that five irrigation projects, covering 480,000 acres, were not feasible. Under the present conditions the Survey must make such determination on mere inspection, and there is danger that grievous errors may be made. Below is a statement of the status of the public-land classification work, so far as it relates to water utilization. It will be seen that at the present rate of progress the work as a whole is at least two years, and possibly three years, behind, which means that unless any recent application is taken up out of its regular order it can not be finally acted upon by the department inside of three years.

Enlarged-homestead designations in fiscal year 1912.

Designated during the year	acres	1,700,000
After field examination	do	613,000
From office data	do	857,000
From general information	do	230,000
Petitions now pending		200
Area represented	acres	2,000,000

As the boundaries of the designated areas are extended and refined the requests for examination and designation refer to smaller and more scattered areas, and the difficulty and expense of making the necessary investigations proportionately increase. Many of the tracts adjoin irrigable areas, and the determination of the character of the lands with respect to future irrigation requires much more careful investigation than was necessary in the earlier cases.

It is estimated that the examination of the area now on application, comprising about 80 townships, will require the work of two engineers for an entire field season. The office work of preparing the results for action and the making of proper records will require the entire time of one clerk, in addition to technical supervision.

Right-of-way applications.

Pending in Survey January 1, 1911	239
Received from General Land Office	834
Reported on during 1911	861
From office data	791
From field examination	90
Applications pending in field	89

These figures indicate that a little over 10 per cent of the applications received have been given special field examination. The other 90 per cent were reported upon from office information obtained from reports upon previous applications, from investigations of water-power withdrawals, or from topographic and water-supply data on file. Although the land-classification board might properly call for a field examination on many of these applications, such examination has not been requested, because of the knowledge that only a small number of applications could be promptly examined in the field. Action has thus been taken on meager data in many cases where it is probable that field investigation should have been made.

The number of applications pending report from the field at the close of the calendar year does not represent the accumulation of work of this character at the present time. It is believed that important data would be procured on over 50 per cent of the 212 applications pending on January 1, 1912, if field examination were possible. The 89 applications pending report from the field thus by no means represent the amount of field work which should be done during the coming field season.

About 150 right-of-way applications now pending require field investigations. They represent fully a year's work for four men. About one-half the time of two men is now employed, and no more can be assigned without a larger appropriation. At this rate the applications now pending can not all be acted on for at least four years.

Water-power withdrawals.

	Acres.
Withdrawn and requiring examination Jan. 1, 1911	1,149,618
Examined during 1911	398,330
Remaining unexamined	751,288
New withdrawals during 1911	358,445
Of which there must be examined	223,939
Grand total awaiting examination	975,227

This work will require at the present rate of progress two and one-half years to complete.

CAREY ACT SEGREGATION LISTS.

The reclamation of public lands by the States under the terms of the Carey Act and its amendments requires investigation by the Geological Survey to determine the sufficiency of the water supply and the feasibility of the plan of reclamation. There are ordinarily three stages in the development of a project—first, the temporary blanket withdrawal for one year of an area believed to include all the lands that will eventually be segregated for the project, in order that the State may work out a detailed plan of irrigation; second, the segregation of the irrigable lands for a period of 10 years in order that the irrigation works may be constructed and the lands reclaimed and settled; and third, the application of the States for patent, the lands having been reclaimed in accordance with the contract entered into at the time of segregation.

During the period of temporary withdrawal it is occasionally desirable that the project be examined in a general way in order to determine what steps are being taken to procure data by which to estimate the water supply available for the project. The necessity for field investigation arises, however, in most projects, in connection with the segregation of the lands. Here the determination of the acreage which the project may properly include requires a careful study of the water supply, water rights, and duty of water. In some projects where accurate stream measurements and records of appropriation are available, field investigation for this purpose is not essential, but where it is proposed to utilize sources of water supply which have not been accurately measured, or where the water rights are chaotic, examination on the ground is essential to the protection of the prospective settlers. Lastly, there must be an examination of the constructed project and a determination of the compliance of the State with the terms of its contract.

A necessity for field investigation arises also when a segregation becomes inactive because of the failure or suspension of the proposing company. In such cases the hardship falls upon the settlers, and the protection of their rights and those of the United States becomes a matter of the highest consequence.

During the calendar year 1911 the Geological Survey reported on the sufficiency of the water supply of 38 proposed segregations, the office work requiring the greater part of the time of an experienced engineer. In addition, field engineers were from time to time detailed to investigate particular projects, and more such investigations would have been requested if it had not been known that great delays in the handling of the cases would have resulted. Since the consideration of the Carey Act lists has been made "special," by order of the Secretary, the land-classification board has found it necessary to act from office information in every case where the information was not so meager as to make such action entirely impossible.

ACQUISITION OF LANDS FOR NATIONAL FORESTS.

The investigations of precipitation and run-off, begun near the close of the fiscal year 1911 in the White Mountain region of New Hampshire, have been continued throughout the year, and a preliminary report favorable to the purchase of lands in that region under the terms of the Weeks Act was rendered about June 1. Reference to that report is made elsewhere (pp. 18–19). These investigations were the most intensive that have ever been performed by the Geological Survey and it is doubtful if the features of the run-off of any stream have ever been studied with so much detail as were those that were selected for study in the White Mountain region. The work involved a refined determination of precipitation, in the form of both rain and snow, by the establishment and close observation of numerous gages set on the drainage areas at all different points of elevation and exposure. The studies of run-off were made by the careful establishment and equipment of gaging stations on the several streams and the correction of the channel at those stations in order that extreme refinement might be secured in the measurements of flow. All stations thus established were equipped with automatic recording gages, so that it has been possible to determine the volume of water passing the stations at any moment of the day. The prosecution of the work has made necessary the employment of a corps of engineers numbering at different times from four to eight and of an equal number of observers, whose duties were to make frequent records of precipitation as measured by the numerous gages.

PUBLICATION BRANCH.

BOOK-PUBLICATION DIVISION.

SECTION OF TEXTS.

The publications of the year consisted of 1 annual report, 1 monograph, 4 professional papers, 48 bulletins, 34 separate chapters from 5 bulletins, 21 water-supply papers, 2 annual reports on mineral resources (one published also in 54 separate chapters, all delivered in 1910–11, and the other in 51 separate chapters, 7 delivered in 1910–11 and 44 in 1911–12), 20 advance chapters from the annual report on mineral resources for 1911, 6 geologic folios, 2 lists of publications, 57 press bulletins, 12 monthly lists of new publications, one pamphlet entitled "Instructions to topographers of the United States Geological Survey," charts showing mineral and clay products and the production of coal in the United States to the close of 1910, and a circular concerning geologic folios. These publications were the Thirty-second Annual Report; Monograph LII; Professional Papers 69, 70, 73, and 75; Bulletins 448, 450, 451, 454 to 456 inclusive, 458, 464, 466 to 470 (published also in 11 advance chapters, 7 delivered in 1910–11 and 4 in 1911–12) inclusive, 4 advance chapters from 471, 472 to 479 inclusive, 480 (published also in 10 separate chapters), 481 to 497 inclusive, 499, 500, 504 to 507 inclusive, 509, 511, 512, 3 advance chapters from 520, and 13 advance chapters from 530; Water-Supply Papers 261, 266 to 269 inclusive, 271 to 280 inclusive, 282, 285 to 288 inclusive, and 295; Mineral Resources for 1909 (volume), Mineral Resources for 1910 (volume and 44 separates), and 20 advance chapters from Mineral Resources for 1911; Geologic Folios 178 to 183 inclusive; Lists of Publications, New Series Nos. 1 and 2; Press Bulletins 8 to 62, inclusive (also 2 special issues); and Monthly Lists of New Publications Nos. 44 to 55 inclusive. Titles and summaries of the publications of the regular series are given on pages 23–38.

The total number of printed pages in these publications was **17,846.** The publications of the previous year comprised 13,566 pages.

During the year 48,210 pages of manuscript were edited and prepared for printing, and proof sheets for 15,677 final printed pages were read and corrected, this work involving the handling of 5,648 galley proofs and 30,513 page proofs. The corresponding figures for 1910–11 were 40,648 pages of manuscript, 17,417 final printed pages, 5,787 galley proofs, and 32,706 page proofs. Indexes were prepared for 49 publications, covering 10,571 pages; the figures for the previous year were 74 publications and 14,400 pages.

At the close of the fiscal year seven persons were employed in this section. The water-resources branch has continued to render special assistance in copy preparing and proof reading.

SECTION OF ILLUSTRATIONS.

The personnel of the section of illustrations consisted of 10 draftsmen (including the draftsman in charge), 1 assistant map printer, and 1 draftsman-clerk.

During the year 5,006 illustrations were prepared and most of them were transmitted, to accompany 26 bulletins, 11 water-supply papers, 2 professional papers, 1 annual report, and 1 report on mineral resources. These illustrations included 251 maps, 1,679 diagrams, 2,237 paleontologic drawings, 9 landscape drawings, 504 photographs retouched, and 326 miscellaneous pieces.

The section received and compared critically 1,331 proofs, as well as all contract-printed illustrations delivered at the Government Printing Office.

The number of electrotypes furnished to outside applicants was 144.

At the close of the year material for the illustration of 28 reports was on hand, 23 being from 10 to 90 per cent completed.

SECTION OF MAP EDITING.

GEOLOGIC MAPS.

The geologic map of North America was completed and issued during the year. Six folios (Nos. 178 to 183, inclusive), which are listed on page 37, were published. The Apishapa (Colo.), Kenova (W. Va.-Ky.-Ohio), Murphysboro-Herrin (Ill.), and Raritan (N. J.) folios were completed with the exception of the descriptive text. The Barnesboro-Patton (Pa.), Ellijay (Ga.-N. C.-Tenn.), Philipsburg (Mont.), and Tallula-Springfield (Ill.) folios were well advanced in publication, and the Belleville-Breese (Ill.), Colorado Springs (Colo.), Eureka Springs-Harrison (Ark.), and San Francisco (Cal.) folios were begun.

The Castle Rock (Colo.), Berea-Cleveland (Ohio), Columbus (Ohio), Eastport (Me.), Minneapolis-St. Paul (Minn.), Niagara (N. Y.), and Silver City (N. Mex.) folios were awaiting editing at the close of the year.

The list of folios in course of publication and in preparation for publication, arranged in order of progress, is as follows:

Kenova, W. Va.-Ky.-Ohio (No. 184).
Murphysboro-Herrin, Ill. (No. 185).
Apishapa, Colo. (No. 186).
Raritan, N. J.
Philipsburg, Mont.
Ellijay, Ga.-N. C.-Tenn.
Barnesboro-Patton, Pa.
Tallula-Springfield, Ill.
San Francisco, Cal.
Colorado Springs, Colo.
Eureka Springs-Harrison, Ark.
Silver City, N. Mex.
Columbus, Ohio.
Eastport, Me.
Castle Rock, Colo.
Berea-Cleveland, Ohio.
Niagara, N. Y.
Minneapolis-St. Paul, Minn.

Three persons are employed in this subsection. A fourth man was employed during the early part of the year.

TOPOGRAPHIC MAPS.

At the beginning of the year 151 atlas sheets and special maps were on hand for publication. The accessions during the year were 119. The separate map publications during the year numbered 114, of which 90 were new engraved sheets, 14 revised sheets (of which 5 were reengraved), and 10 photolithographs. Sixty-five maps were in process of publication and 102 new maps were on hand awaiting action at the end of the year. The following statement shows the status of map editing June 30, 1912:

Status of work on engraved maps June 30, 1911, and June 30, 1912.

	1912	1911
Published during the year	114	86
In process of engraving	65	56
Not taken up	102	95

The manuscripts edited during the year comprise 103 topographic atlas sheets and other maps prepared for engraving; 10 State maps on scale of 1:500,000 and two large-scale contour maps, prepared for photolithography; corrections for 148 maps hitherto published; 13 maps published under contract; and 240 maps for illustration of 34 Geological Survey reports. The proof read comprises 96 new topographic maps, corrections to 83 old ones, and 23 maps published under contract. All but two of the 21 index circulars of the series 9–323 were revised and reprinted during the year, and an index map showing progress of topographic surveys in the State of Kentucky was prepared and printed for the State geologist.

Five men were employed in the work of this subsection during the whole year and two others during the second half of the year.

SECTION OF DISTRIBUTION.

The section of distribution received during the year 175 new books, 36 reprinted books, 6 folios, 42 geologic maps, 90 new topographic maps, 14 revised maps, 10 photolithographs, and 166 reprints of maps, a total of 539 publications. The total of all editions received was 437,501 books, 30,127 geologic folios, and 982,412 maps, a grand total of 1,450,040.

Reprints of the following publications were delivered to the Survey during the fiscal year 1912: Bulletins 452, 467, 470–B, 479, 480, 530–A, 530–B, 511; Water-Supply Papers 170, 172, 173, 174, 200, 201, 202, 203, 204, 206, 207, 208, 209, 210, 211, 213, 214, 219, 231, 232, 247, 248, 249, 255, 257, and 273; one advance chapter from Mineral Resources for 1911, namely, "The production of antimony, arsenic, bismuth, and selenium in 1911;" and Professional Paper 73.

There were distributed 437,637 books, 30,743 folios, 658,240 maps (including 529,656 sold), a total of 1,126,620.

The total amount received and turned into the Treasury as the result of sales of publications was $25,755.22, of which $21,356.27 was the proceeds of sales of topographic and geologic maps, an increase of $4,171.67 over the amount received in the fiscal year 1911.

Fifteen persons were employed in this section during the year.

DIVISION OF ENGRAVING AND PRINTING.

MAPS, FOLIOS, AND ILLUSTRATIONS.

During the fiscal year 114 topographic atlas sheets, with a total printing of 917,572 copies, and 2 special maps were published, and at the end of the year 65 sheets were in various stages of progress toward publication. The number of sheets published is 25 in excess of the number published in 1911.

Corrections were engraved on the plates of 163 maps hitherto published. Editions of 268 maps, including new sheets and reprints, were printed and delivered to the map room, an increase of 37 over the figure for 1911.

Six geologic folios were published, three of them in two forms, and 30,127 copies of eight different folios were printed and delivered, an increase of 9,237 copies over the figures for 1911. Eleven geologic folios were in various stages of progress toward publication.

Under contracts with the Government Printing Office awarded on competitive bids, illustrations were printed for the following Survey publications: Bulletins 448, 452, 467, 470-B, 471-B, 471-E, 478, 483, 485, 498, 500; Professional Papers 71, 73, 74, 75, 78; Water-Supply Papers 231, 277, 279; Mineral Resources—Production of coal in 1910, Production of cement in 1911, Production of salt and bromine in 1910.

For the Government Printing Office also the following items were printed and delivered: Illustrations for the Annual Report of the Governor of Arizona; Annual Report of the Governor of Alaska; Annual Report of the Superintendent of Crater Lake National Park; Annual Report of the Chief of Engineers, United States Army; Annual Report of the Chief Signal Officer, United States Army; Annual Report of the War Department, vol. 1; Annual Report of the Superintendent of Glacier National Park; Annual Report of the Governor of Hawaii; Annual Report of the Governor of New Mexico; Annual Report of the Superintendent of Sequoia and General Grant National Parks; Annual Report of the Superintendent of Yosemite National Park; Annual Report of the Commissioner of Indian Affairs; Annual Report of the Superintendent of the Coast and Geodetic Survey; Report of the Commissioner of Corporations on the Lumber Industry, Part I; Report of the Commissioner of Corporations on Transportation by Water in the United States, Part III

(Water Terminals); Report of the Commissioner of Corporations on Water-Power Conditions in the United States, Parts I and II; Report on the Platt and Wind Cave National Parks, Sullys Hill Park National Monuments, and Bird Reservations; Twenty-third Statistical Report on Railways in 1910; twenty Senate and House Documents; Special Publications Nos. 9 and 10 of the Coast Survey; Bulletin 36 of the Bureau of Mines; Bulletin 101 of the Bureau of Ethnology; Bulletin 222 of the Office of Experiment Stations; Bulletin of the Bureau of Fisheries, vol. 31 (1911); Catalogue of Charts and Plans, United States Atlantic Station; Population Bulletin of the United States. In addition to the above, the following separate illustrations were printed and delivered to the Government Printing Office: Ringlemann's Scale for Grading Density of Smoke; Stadia Diagram No. 1; Stadia Diagram No. 2; Diagram of Zone Tariff for Proposed Parcels Post; Hearings No. 30, White Earth Reservation; Survey of Oyster Bars in St. Marys County, Maryland; The Omaha Indians vs. the United States; Map of North America; Map of Peat Deposits; and Mineral Plat.

The following work was done for other Government departments and bureaus: For the Forest Service, maps of 63 national forests, 39 proclamation diagrams of national forests, map of North America (western half), map showing production of lumber by States and kinds, map of South America showing natural forest regions, index map of national forests, statistical diagram, stadia rod patterns, scales, and diagram of lookout station protractor; for the General Land Office, 1,189 township plats, 681 mineral plats, maps of Cœur d'Alene and Rosebud Indian reservations, and other miscellaneous work; for the Department of the Interior, maps of three national parks, two national monuments, seven bird reservations, and Hot Springs Reservation; for the Reclamation Service, a large amount of miscellaneous work; for the Office of Indian Affairs, 11 township plats and maps of 9 Indian reservations. Work was also done for the Interstate Commerce Commission, Civil Service Commission, War Department, United States Military Academy, Bureau of Mines, Bureau of Standards, Department of Agriculture, Weather Bureau, Smithsonian Institution, Department of Justice, Bureau of Insular Affairs, United States and Canada Boundary Survey, Biological Survey, House of Representatives, Army Service Schools, Army War College, Alaska Boundary Survey, and Post Office Department. This work for other branches of the Government amounted to about $40,000, for which the division was reimbursed by transfer of credit on the books of the United States Treasury.

Of contract and miscellaneous printing of all kinds, the total number of copies delivered was 2,150,859, which required 5,695,629

printings. The total number of copies printed, including topographic maps and geologic folios, was 3,129,308, requiring 10,744,192 impressions. On requisition of the Government Printing Office, 383 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, 104,421 square inches of new copper plates were made and 4,641 square inches were resurfaced, and 10,712 square inches of electrotypes were made.

PHOTOGRAPHIC LABORATORY.

The output of the photographic laboratory included 14,972 negatives, of which 11,356 were dry, 3,078 were wet, and 538 were paper, and 39,128 prints, of which 13,020 were maps and diagrams and 26,108 were photographs for illustrations.

ADMINISTRATIVE BRANCH.

EXECUTIVE DIVISION.

The work in the executive division was of the same scope as in other years, except for the transfer to it of the carpenter shop and the transfer from it to the section of distribution of the handling of local map sales—that is, sales to those who call in person to purchase maps.

Mails, files, and records.—During the year 411,847 pieces of incoming mail were handled in this division, of which 269,988 were distributed unopened to the various branches, divisions, and sections of the Survey and to individuals and 141,859 were opened and referred. The latter figure represents an increase of 5.56 per cent over that for the fiscal year 1911. No comparison can be made of the amount of mail distributed unopened during the years 1911 and 1912, as the record for last year covers only four months. Of the mail received, 2,664 pieces were registered, which is an increase over the preceding year of nearly 3 per cent.

Of the letters opened in this division 28,199 contained remittances for Survey publications, amounting to $26,909.31.

Practically the entire services of four clerks and about half the time of a fifth were required in recording, referring, and filing correspondence.

In December, 1911, a new method of handling outgoing mail for the entire Survey was adopted. Previous to that time boxes were located in various parts of the building, in which mail of all classes was deposited. This mail was collected and bagged by the wagon

driver. Under the new method these boxes have been discontinued, all mail, except large sendings of publications, being deposited in appropriate drops in a central mail room and there counted and bagged. This prevents mistakes in placing mail of different classes in the same bag and permits a record of the number of outgoing pieces of various classes. As this new plan has been in operation only a little over six months, it is impossible to give figures for the year.

As formerly, letters prepared in the various branches, divisions, and sections for the signature of the Secretary, the Director, and the chief clerk have been inclosed in envelopes and mailed by the executive division. The number of such letters mailed during the year was 83,184, an increase of nearly 17 per cent over last year. The number of pieces of outgoing registered mail was 18,097, a decrease of about 13 per cent.

With a view to devising and installing an improved system for the general files, the Survey employed, in December, 1911, an additional file clerk, who, during the last half of the fiscal year, was engaged in familiarizing himself with the method of filing already in use, examining filing systems in a number of other Government bureaus, and preparing, after a decision had been reached to adopt it, a subject classification in accordance with the Dewey system. This classification was completed at the close of the fiscal year in time to put it into operation on July 1, 1912.

A plan providing for a personnel file, to consist of separate folders for each member of the Survey holding a Secretary's appointment, containing correspondence and other papers relating to his appointment status and personnel record, was put into effect during the last half of the year. This file has been exceedingly useful.

Personnel.—The roll of those holding Secretary's appointments numbered at the close of the fiscal year 880 persons, compared with 862 at the close of the fiscal year 1911. The total number of changes in the personnel for the year was 765, which included original appointments, separations, promotions, extensions, and changes of status of every description. Of these, 177 were new appointments, 159 were separations, 383 were promotions, and 2 were reductions.

During the year 14,069 days of annual leave and 2,921 days of sick leave were granted, being about 67 per cent of the amount of annual leave and 14 per cent of the amount of sick leave which it is permissible to grant under the law; also 4,423 days of leave without pay. In addition to the above, the transfers to State pay rolls in cooperative work amounted to 3,392 days of service.

Property.—An inventory of nonexpendable property in Washington was submitted to the department at the close of the calendar year 1911.

Express and freight.—During the year 4,013 pieces of freight and express were handled, of which 1,155 were outgoing and 2,858 were incoming. There were 541 transportation acounts checked, an increase of about 20 per cent.

Purchase of supplies.—The purchase of supplies, which includes the work of procuring bids, issuing orders, and preparing vouchers covering all purchases made directly by the Survey in Washington, required the services of two persons. The number of requisitions handled was 2,010, a decrease of about 7 per cent. The number of orders drawn, however, was 1,775, a decrease of but 1 per cent.

Stationery, printing, and miscellaneous supplies.—There were 7,355 requisitions filled from stock in the stationery room. The requisitions drawn on the department numbered 319 for miscellaneous supplies, 167 for stationery, and 439 for printing. These figures show an increase of nearly 3 per cent over 1911 in the number of requisitions filled from stock. The decrease in the number of requisitions for stationery and for miscellaneous supplies drawn on the department, slightly over 9 and 3 per cent, respectively, is due to the fact that larger quantities are ordered at one time. In the number of requisitions for printing there was an increase over the previous year of about 2 per cent.

DIVISION OF DISBURSEMENTS AND ACCOUNTS.

A condensed statement covering the financial transactions of the fiscal year is given below:

Amounts appropriated for and expended by the United States Geological Survey pertaining to the fiscal year ended June 30, 1912.

Title of appropriation.	Appropriation.	Repayments.	Available.	Disbursements.	Balance.
Salaries, office of the Director	$35,340	.....	$35,340.00	$35,271.98	$68.02
Salaries, scientific assistants	29,900	.....	29,900.00	29,899.92	.08
Skilled laborers, etc	20,000	.....	20,000.00	19,999.85	.15
Topographic surveys	350,000	$3,134.29	353,134.29	350,050.46	3,083.83
Geologic surveys	300,000	56,493.63	356,493.63	349,846.47	6,647.16
Mineral resources of Alaska	100,000	19.50	100,019.50	96,718.13	3,301.37
Chemical and physical researches	40,000	335.35	40,335.35	37,572.23	2,763.12
Preparation of illustrations	18,280	.....	18,280.00	18,217.66	62.34
Mineral resources of the United States	75,000	13.36	75,013.36	74,133.06	880.30
Gaging streams, etc	150,000	20,986.34	170,986.34	166,465.71	4,520.63
Books for the library	2,000	.....	2,000.00	1,025.76	974.24
Geologic maps of the United States	110,000	71,884.34	181,884.34	150,525.61	31,358.73
Surveying national forests	75,000	2,838.90	77,838.90	77,121.72	717.18
	1,305,520	155,705.71	1,461,225.71	1,406,848.56	54,377.15

The following table gives the classified net expenditures by the Survey for the fiscal year, the repayments shown in the preceding table having been deducted:

Classification of expenditures by the United States Geological Survey pertaining to the fiscal year ended June 30, 1912.

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	$35,271.98	$35,271.98										
Salaries, scientific assistants	29,899.92	29,899.92										
Skilled laborers, etc	19,999.85	19,999.85										
Topographic surveys	346,916.17	229,399.56	$27,357.68	$5,797.35	$32,708.04	$10,613.95	$568.85	$5,780.45		$5,268.19	$1,190.59	$941.96
Geologic surveys	293,352.84	224,985.08	19,796.16	1,992.44	14,312.63	4,442.92	416.33	5,285.20	$103.70	2,787.58	264.43	1,471.09
Mineral resources of Alaska	96,698.63	58,542.18	12,779.35	5,498.85	5,031.69	871.65	148.75	1,024.28		776.42	227.07	175.87
Chemical and physical researches	37,236.88	22,167.11	1,398.58	1,672.90	698.60	183.67	47.26	125.37	268.59	462.42	444.25	859.31
Preparation of illustrations	18,217.66	16,188.75		17.10			13.63	1,700.75			2.58	71.75
Mineral resources of the United States	74,119.70	62,271.19	3,260.64	333.16	2,341.13	7.65	908.48	182.23	1.75	439.84	15.05	469.25
Gaging streams, etc	145,479.37	109,910.13	12,517.91	951.61	6,819.84	342.02	603.01	2,227.06		852.61	651.62	893.28
Books for the library	1,025.76			7.90			.74					
Geologic maps of the United States	78,641.27	61,134.06	68.45	79.46	68.95		52.71	2,403.35	1,108.26	561.97	1,529.63	9,086.73
Surveying national forests	74,282.82	45,881.15	2,618.23	1,899.35	3,159.58	5,852.93	39.98	305.18		272.34	317.43	104.02
	1,251,142.85	915,650.96	79,797.00	18,250.12	65,140.46	22,314.79	2,799.74	19,033.87	1,482.30	11,421.37	4,642.65	14,073.26

Appropriation.	Fuel.	Mechanic's, engineer's, etc., supplies.	Cleaning and toilet supplies.	Wearing apparel.	Forage and other supplies for animals.	Provisions.	Ammunition and explosives.	Special and miscellaneous supplies.	Equipment (including live stock).	Structures (bench marks).	Rent of buildings.	Fees for licenses, permits, etc.
Salaries, office of the Director												
Salaries, scientific assistants												
Skilled laborers, etc												
Topographic surveys	$315.43	$50.44	$45.50	$61.40	$5,758.58	$9,705.03		$306.18	$6,742.15	$4,245.24	$32.85	$26.75
Geologic surveys	147.88	96.95	74.93	60.65	2,377.40	5,621.52	$33.35	206.63	8,824.00		47.25	4.72
Mineral resources of Alaska	68.62	23.12	67.72	360.28	1,203.59	2,775.94	70.73	83.59	6,950.93		18.00	
Chemical and physical researches	418.62	85.42	6.77	9.00	119.59	608.28	6.65	116.98	7,485.18		51.33	1.00
Preparation of illustrations									223.10			
Mineral resources of the United States	.90		10.80					6.17	3,037.96		833.00	.50
Gaging streams, etc	21.20	130.52	28.45	201.80	174.36	325.13	2.95	54.99	6,014.07		2,755.31	1.50
Books for the library									1,017.12			
Geologic maps of the United States	83.16	442.54	27.56	17.64					1,976.80			
Surveying national forests	86.88	5.25	75.62	3.00	1,479.58	5,838.59	11.30	35.67	4,885.29	1,335.95	75.50	
	1,142.69	834.24	337.35	713.77	11,113.10	24,874.49	124.98	810.21	47,156.60	5,581.19	3,813.24	34.47

LIBRARY.

During the year the library has received by purchase and exchange 12,886 books and pamphlets and 1,124 maps, some of which are of temporary value only and will not be recorded as accessions to the permanent collection. A careful estimate shows that the library now contains 87,000 books, 100,000 pamphlets, and about 100,000 maps. Accessions are restricted as closely as possible to publications that consider subjects within the scope of the Survey's work and that will probably be of permanent value. Publications on other scientific subjects are transferred to the Library of Congress. Notwithstanding the efforts to confine the increase to the narrowest limits consistent with usefulness, the need of additional shelf room is now urgent.

The number of persons consulting the library during the year was 11,077, and 11,126 books and 317 maps were loaned for use outside.

The cataloguing of current accessions by full title entries in the author and subject catalogues was kept up to date. During the year 3,481 volumes and maps were catalogued.

Additions to the card catalogue during the year numbered 7,522. The Survey continues to furnish to the Library of Congress, for printing on its cards, the catalogue entries of geologic publications; of these entries 542 were supplied during the year.

The correspondence consisted of 4,587 letters received and 3,132 letters written and, as in other years, related largely to the exchange of publications. The list of institutions to which full sets of Survey publications are distributed now numbers 311 in the United States and 564 in foreign countries, a total of 875. Publications that are of value to the library are received in exchange from most of the institutions on this list. To an additional list of 523 persons and institutions, domestic and foreign, selected publications are furnished in return for certain of their own publications supplied to the library. The geologic folios are furnished to 380 libraries, in addition to the depository libraries supplied by the superintendent of documents, Government Printing Office.

The bibliography of North American geology for 1910 was completed and issued as Bulletin 495. It contained 1,410 author entries, an increase of 105 over the volume for 1909. The bibliography for 1911, containing 1,266 author entries, will be ready for the printer in July and will be published as Bulletin 524.

The personnel of the library consisted of the librarian, the assistant librarian, two cataloguers, and three other persons.

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