DEPARTMENT OF THE INTERIOR

FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, Director

FORTIETH ANNUAL REPORT

OF THE

DIRECTOR OF THE UNITED STATES GEOLOGICAL SURVEY

TO THE

SECRETARY OF THE INTERIOR

FOR THE FISCAL YEAR

ENDED JUNE 30

1919

WASHINGTON

GOVERNMENT PRINTING OFFICE

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FORTIETH ANNUAL REPORT OF THE DIRECTOR OF THE UNITED STATES GEOLOGICAL SURVEY.

GEORGE OTIS SMITH, *Director.*

INTRODUCTION.

The fortieth annual report of the United States Geological Survey is an appropriate place in which to compare the present scope of the work with that of the work done during the first year of this organization. The growth of the Survey is suggested by a comparison of the appropriations for 1918–19, which comprise items amounting to $1,437,745, with the total appropriation of $106,000 for the first year, 1879–80. During the 40 years the personnel has been increased from 39 to 967. The corresponding growth in public functions of the organization, which is one of the oldest of the Federal scientific bureaus, can be inferred from the detailed report of activities which makes up the greater part of this volume. The past year has been the most notable in the Survey's history, as it marked the completion of the period of its largest national contribution, and the later half of the year was largely a time of readjustment of program. It seems opportune, therefore, that the special topics discussed in the pages immediately following should be forward-looking and suggestive of the larger usefulness planned for the Geological Survey in the future.

SPECIAL TOPICS.

READJUSTMENT OF ACTIVITIES.

The special war activities outlined in the Thirty-ninth Annual Report continued until the signing of the armistice, when return to the regular program of scientific work began. The policy that had been adopted—not to change the Survey organization, but simply to adapt it to the emergency needs of the war period—made readjustment easier. No special appropriations had been asked during the war, but the appropriations made for activities that would contribute to the needs of the country in time of peace had been diverted to similar activities that would contribute to its needs in time of war. The geologist limited his field studies to the search for the raw mate-

rials most needed by the war industries, the topographer mapped the areas selected by the General Staff; the hydraulic engineer cooperated with the Fuel Administration in power conservation; the statistician met the country's need for weekly and monthly figures of mineral production under the emergency demand; and the engraver and printer reproduced for both Army and Navy the maps required for their operations.

The changes in personnel incident to 243 separations after July 1, 1918, for Army and Navy service, together with the similar loss of 234 workers during the preceding year, made the administration of the Survey work more difficult, and indeed without the increased efforts of those who remained some of the Survey's contributions to the war program could not have been made. It should be added that the Survey's honor roll of 477 would have been longer had not "deferred classification" been officially asked for some of the more essential members of the organization, against their personal preferences.

With so universal a spirit of full service, only brief record should be made of individual honors. Yet it has been a satisfaction to the whole organization that four Survey members attained the rank of lieutenant-colonel in the Engineer Corps and Coast Artillery. These officers brought to their military duties the special training in geologic and topographic engineering that could have been obtained only in the Geological Survey.

The Chief of Coast Artillery, in expressing his appreciation of the assistance rendered by the Geological Survey, mentioned especially the preparation and publication of the "Manual for the artillery orientation officer," stating that this publication was in great demand during the war, as is shown by the fact that over 40,000 copies were printed and distributed. Other contributions of similar type have since been made by a Survey engineer, Lieut. Col. Birdseye, who has prepared pamphlets entitled "Meridian determination" and "Circumpolar ephemeris" for the Coast Artillery Training Center, Fort Monroe, Va.

Personal letters from Gen. Pershing were received by Lieut. Col. Alfred H. Brooks and Lieut. Col. Glenn S. Smith. The letter to Col. Brooks expressed appreciation of his "loyal and energetic work as a member of the American Expeditionary Forces" and stated that his services as chief geologist were "of a constructive character in a field new to the military service" and that the results of his efforts "were becoming manifest to all." Col. Smith was commended for the "energy and technical knowledge which aided most materially in securing suitable personnel and equipment for the Topographic Service, in training and organization, and in the making of topographic surveys in France."

Citations by the commander in chief of the American Expeditionary Forces have also been received "for exceptionally meritorious and conspicuous services" by

Lieut. Col. Glenn S. Smith, "as director of base printing plants."
Maj. J. H. Wheat, "as instructor, Army Intelligence School."
Maj. William O. Tufts, "in topographical surveying with First Army."
Maj. Herbert H. Hodgeson, "in charge of triangulation work at the front."
First Lieut. James B. Leavitt, "as topographic officer for Sixth American Corps."
Mr. Louis H. Gott, "in drafting section, Topographical Division, Second Section, G. S., G. H. Q."
Maj. Luria L. Lee, "as adjutant, First Battalion, 29th Engineers."
Capt. Albert O. Burkland, "as topographic officer, First Division."
First Lieut. Charles H. Davey, "as instructor, Intelligence School."
First Lieut. Reuben A. Kiger, "as topographical officer," V Corps.
Capt. Oliver G. Taylor, "as topographic officer, First Corps."

Maj. Lee was also awarded the French Croix de Guerre for exceptional service rendered as captain in the 29th Engineers during the Chateau Thierry offensive. A copy of his citation is given below.

GENERAL HEADQUARTERS
of the
French Armies of the East.

STAFF

Personnel Bureau (Decorations)

Order No. 18094 "D" (extract).

With the approbation of the Commander in Chief of the American Expeditionary Forces in France, the Marshal of France, Commander in Chief of the French Armies of the East, cites in the order of the division:

* * * * * * *

Capt. Luria Lyons Lee, 29th Regiment, American Engineers:

Rendered exceptional services to the Geographic Branch of the Army during the battles of July, 1918, in the execution of surveys in the region northwest of Chateau Thierry, giving proof under particularly difficult circumstances of very great competency and untiring energy.

* * * * * * *

At General Headquarters, May 28, 1919.

The Marshal of France,
Commander of the French Armies of the East.
PETAIN.

For original extract:
The Lieutenant Colonel,
Chief of Personnel Bureau.

Capt. A. T. Fowler likewise received the French Croix de Guerre for notable services under the fire of the enemy. A copy of his citation is given below.

GENERAL HEADQUARTERS
of the
French Armies of the East.

STAFF

Personal Bureau (Decorations).

Order No. 18094 "D" (extract).

With the approbation of the Commander in Chief of the American Expeditionary Forces in France, the Marshal of France, Commander in Chief of the French Armies of the East, cites in the order of the division:

* * * * * * *

Capt. Alvah Tennant Fowler, 29th Regiment, American Engineers.

During the period from May to July, 1918, has displayed unusual ability and remarkable energy in the conduct of surveys undertaken for the Service Geographique of the Army, in the region of Tartigny, Folleville, Picardy, pushing the work under fire of the enemy and assuring the rapid execution of the work in bombarded villages.

* * * * * * *

At General Headquarters, May 28, 1919.

The Marshal of France,
Commander of the French Armies of the East.
PETAIN.

For original extract:
The Lieutenant Colonel,
Chief of Personnel Bureau.

A copy of the citation for Lieut. Kostka Mudd, who also received the Croix de Guerre, may be found in the Thirty-ninth Annual Report, on page 10.

INADEQUATE COMPENSATION.

In a highly specialized scientific bureau quality of public service must depend largely upon training and experience. The compensation offered must be such as to attract the best graduates of the universities and to hold those who prove their aptitude for scientific work. The fact that there have been 77 resignations from the scientific force of the Geological Survey during the last year—17 per cent of the force—suggests inadequacy of compensation, and the percentage of resignations in the clerical and nonscientific force was even larger. This statement of course does not include separations to enter military service. In the previous year, however, the resignations of the scientific members were only about a third as many, owing to a patriotic unwillingness to leave the Government service during the war. Yet the separation was only delayed, and this may

be supposed to have caused the 17 per cent loss in the year just closed to be excessive, but this optimistic view is not supported by the number of resignations since July 1, 1919.

The fact that there has been a 19 per cent total (scientific and clerical) "turn over" in the Geological Survey in each of the last two years, not including separations for military service, plainly indicates that the Survey salaries are lower than those paid elsewhere. The criticism that has been aimed at the Survey policy of making its scientific investigations useful undoubtedly finds support in the present commercial demand for geologists who have received the Survey training, yet the universities also continue to look to the Government service for trained specialists. The largest inroad upon the Survey efficiency comes from the oil companies: the final result of the pioneer work of the Federal geologists in applying geologic

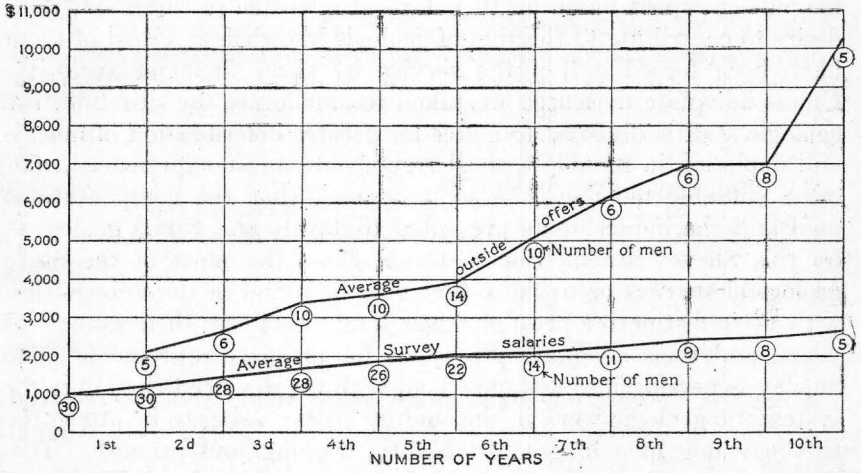


FIGURE 1.—Diagram showing average salaries received by certain Survey geologists compared with the salaries offered to them by outside employers.

methods to the search for oil and gas is that a large proportion of the leading oil geologists the world over are United States Geological Survey graduates. Indeed, the future decline in popularity of the Survey as a recruiting station for oil-company personnel will be due simply to the fact that the experienced oil geologists who remain in the Government service are from personal preference immune to outside offers. How much more attractive is the compensation offered in the commercial practice of geology is shown by figure 1. The curves show the relation between the average outside offers and the average Government salaries paid to oil geologists at the same periods. Of the group of thirty oil geologists of 10 years' experience only two now remain in the Survey. The gap between the curves widens rapidly as the length of experience increases and shows a difference in compensation ranging from $1,000 to $7,000.

The relation between Government salaries and outside salaries of geologists has been definitely determined in a compilation of the records of 29 geologists who left Government service after receiving an average salary of $2,271. The average initial salary of these men in private employ was $5,121, and after about two years of average service this compensation averaged $7,804, and eight of these geologists receive $10,000 or more. The disparity is even greater if consideration is given to the large financial returns from investments made by the private geologists in connection with their professional work, a privilege properly denied by statute to the official geologist.

That the value of these men as specialists and consulting geologists is far greater to the country at large than to private corporations is undeniable. Furthermore, it is important to note that most of these geologists had persisted to the limit of endurance with a magnificent spirit based on their love of scientific research and their desire to contribute to the sum of geologic knowledge. Most of them have been forced out of the service by sheer financial necessity. Unless adequate measures are taken to ameliorate the situation, the geologic staff is destined to suffer far greater deterioration of morale and depletion in its ablest, most responsible, most experienced, and most valuable members. Also it appears that the compensations paid and the inducements presented to-day to the young geologists by this Survey are inferior to those offered by most of the State geological surveys or to those that may be found in the universities, with their distinctive prestige, their long vacations, their sabbatical years, and their adequate provisions for ultimate retirement. The Survey is passing into a stage when, with greater need than ever for systematic geologic work in the country, it is ceasing to be attractive to the young men of greatest ability, training, and promise. This situation deserves prompt and effective remedy, for it threatens most seriously to cripple this branch of the public service.

Increase in Government compensation is not the sole remedy for the present condition. The Government employee is hedged about with restrictions that are especially grievous to one who wishes to make the public service his life work. Some of these are bureaucratic, in part essential to the conduct of work for the benefit of the whole public, but also possibly in part unnecessary hold-overs from past conditions and therefore removable with enlightened administration. Many of the restrictions, however, are of legislative origin, especially those which are fiscal in nature. Not only is the public servant apparently not regarded worthy of his hire, as measured by commercial standards, but he is obliged to conduct his work under conditions of intended economy that do not make for efficiency. A per diem allowance whose limit has not changed with the advancing

cost of living forces the choice of a second-rate hotel, where the Government engineer traveling on official business, for instance, is not likely to meet the professional men with whom to be in touch is a part of his official duty. The only recourse is expenditure of private funds for official expenses, a procedure which aggravates the discrepancy between Government and outside salaries. Other restrictions in Government accounting are so obviously based upon the assumption that the public servant is potentially dishonest as to be a constant irritation to the self-respect of some men who hold the highest ideals of public service. The more confident a man is of his personal integrity the less he likes to be treated as a grafter. Even though such restrictions are necessary in the public service the fact remains that they predispose some of the best men in the scientific bureaus to accept employment under more liberal auspices.

LOSS OF EFFICIENCY THROUGH CROWDING.

The latest restriction put upon efficiency in the scientific service of the Government has been the enforcement of a retrenchment measure whereby scientist and clerk alike are allowed only 75 square feet of floor space each. The inadequacy of this allotment becomes evident when the tools of a working geologist are enumerated—several large cases of rock specimens, map cases, book cases, file cases, as well as his desk and drawing table or bench for simple laboratory tests. The practical arguments against putting two or more highly paid workers in the same room were set forth on pages 7–14 of the Thirty-third Annual Report, and such considerations presented to the congressional committee at that time led to the authorization of the new building, in which the Survey now finds its personnel more crowded than in its old rented quarters. Moreover, many of the special features of the new building designed to facilitate the best work of the scientists lose their highest value under the present conditions. Men who need what are essentially laboratory facilities can not be crowded into the same space as clerical workers and render the service for which they are paid. The loss in efficiency which can not appear on the books of the Treasury will surely several times exceed the apparent saving in rentals; and even worse than that, this crowding now adds to the unattractiveness of Government employment to those who are most needed in the public service.

MAPPING THE COUNTRY.

Several factors have combined to put added emphasis on the country's need of an adequate map of its whole territory. The industrial development of the Nation and the consequent variety of engineering projects of land reclamation, of power generation,

and most recently of highway construction have created a demand for the topographic data that are best displayed by a topographic map based upon accurate surveys; and the war not only called attention to the defenseless condition of much of the country's border area, where the Army had no maps upon which to base its campaigns, but their military experience overseas taught hundreds of thousands of citizen-soldiers how to read and use topographic maps, of the existence of which in their home country they were generally unaware. Thus the engineers, both civil and military, have added their weight of influence to the demand of the educators for faster progress in adequate representation of this part of the geography of our country, and more and more the average citizen is making use of the maps already issued.

With nearly 60 per cent of the area of the country totally unmapped and much that has been mapped in need of resurveys, and with the largest mapping organization in the country surveying only about 40 per cent of the area in 40 years, the logical demand is for more speed. If these maps are to serve their full purpose in promoting national development the whole country must be mapped within this generation, or, even better, within the next decade. The estimated cost of this mapping program is $40,000,000, including the cost of revising the older surveys. To accomplish this work within the period desired would, however, involve more than the appropriation of this amount of money by the Federal and State governments. An organization of specially trained engineers must be built up by means of gradually increased appropriations, beginning with $700,000 for the field season of 1919 and reaching a maximum of $4,500,000 in 1928. It is believed that on such a scale of expenditure the field surveys could be both economically and effectively executed, and the work could be completed in 1932.

The active cooperation of the States in such a program is expected by reason of the increased interest in topographic mapping throughout the country, for counties as well as States are now planning for dollar-for-dollar cooperation with the Federal Government in financing these necessary surveys. In 1917–18 State cooperation reached its lowest ebb, because of the necessary restriction of topographic surveys to areas of military importance selected by the War Department. With this restriction now removed the State funds available for the fiscal year 1919–20 will approach $200,000, and this is the largest amount that has ever been available from that source. Thus with the Geological Survey's appropriation for topographic surveys and the special funds for military mapping contributed by the War Department, approximately $700,000 becomes available for the year beginning July 1, 1919. The return of the engineer officers who made

topographic surveys at the front in France and the increase in the number of assistants to whom had been given special training by the Survey for military service of this type make the trained personnel for the time being more than sufficient to provide for this expansion in mapping, but fortunately this surplus of topographic engineers can be utilized this year in the West Indian surveys mentioned on page 16.

At an engineering conference in Chicago April 25, 1919, the following resolution was adopted:

The Engineers, Architects, and Constructors Conference on National Public Works, composed of the representatives appointed by 74 national, State and local organizations, with an aggregate membership of over 100,000 men, realizes the great importance of adequate maps for the economical planning and construction of a large proportion of engineering works.

With much wisdom the Federal and State governments are now entering upon a program of highway construction which constitutes the greatest engineering project ever undertaken by our Government and which will result in the expenditure of many billions of dollars of public funds in the next decade. This highway construction, as well as many other important public and private engineering undertakings, such as drainage and reclamation projects and others—in the aggregate of tremendous magnitude—demand for economical accomplishment the best type of information such as is afforded by the topographic maps issued by the Federal Government in cooperation with many of the States. These maps are completed for only about 40 per cent of the area of the country. The past rate of progress, if continued, will require between 80 and 100 years to complete the maps for the whole United States.

It is apparent to this conference that by having such maps the saving in the cost of engineering works to be constructed during a very small portion of this time will more than pay for the making of these maps. Therefore, it will be greatly to the public advantage if the completion of these maps can be hastened as rapidly as men can be trained to do the accurate work required.

In view of the foregoing statements, which express the sense of this conference,

Be it resolved: That the facts be presented to the President and to the Congress, and that they be urged to make adequate provision for the entire work of completing the topographic map of the United States in the shortest possible time, compatible with requisite accuracy; and

Be it further resolved, That inasmuch as Engineering Council has already taken up this matter with Federal Government departments, their efforts to hasten the completion of the topographic map be indorsed by this conference and that this resolution be intrusted to them to present to the President, the Secretary of the Interior, the members of the Congress, and to make such other disposition of it as will, in their judgment, further the end desired.

This indorsement of the topographic maps by the engineering profession was a well-considered expression of a general demand for something needed by the members of the engineering organizations represented at the conference. These practical men realize that every dollar of Federal and State funds appropriated for these surveys, if spent in the next ten years, will save many dollars that otherwise must be expended by corporations and individuals in fragmentary surveys made for special purposes, and the worst feature of such an uneconomic procedure would be that it would provide no maps for

the use of the general public. It is therefore an underestimate of the national economy involved to say that the dollar spent in time for this purpose will save nine. The program of mapping the whole country for the use of this generation appears warranted as an essential item in the larger plans for the best use of the Nation's resources.

WEST INDIAN SURVEYS.

An increased appreciation of the value of scientific investigation in planning the wise utilization of natural resources has led several of the West Indian republics to seek the assistance of the United States Geological Survey and to make cooperative agreements with it, whereby topographic and geologic surveys of the islands are to be made at the expense of their governments and the technical supervision of the work is to be assumed by the Survey. The officials of these republics welcome this method of assuring the same quality of mapping for their areas as is obtained in surveys of the United States, and this appreciation of the aid thus given should lead to a larger American participation in the industrial and commercial development that ought to follow this inventory of mineral and land resources.

At the end of the fiscal year a general geologic reconnaissance had been made in the Dominican Republic, and arrangements had been completed for organizing the topographic surveys, field work to begin early in September. In the Republic of Haiti plans were perfected for similar work.

In a special message to the Cuban Congress the President of Cuba has urged an appropriation for the topographic and geologic survey of the island. The cooperative assistance of the Geological Survey has been promised by the Secretary of the Interior to a representative of the Cuban Government as well as in official correspondence, and it is expected that this largest of the West Indian projects will be begun within a year.

A geologic reconnaissance of the Virgin Islands of the United States and a part of Porto Rico with particular reference to groundwater resources was made in May and June. In Porto Rico a topographic survey also is desired by the local government.

A POWER PROGRAM.

Under the war demand for fuel conservation the hydraulic engineers of the Geological Survey served the Fuel Administration in a field study of power problems. The cooperative contribution was both statistical and engineering, and its results showed the fuel requirements of the electrical utilities of the country and indicated where a surplus of power was available, where inadequate power supply could be remedied, and where fuel economies were possible either through interconnection with more efficient plants or substitution of

water power for steam. Thus a power survey of the United States was begun, and with the termination of this cooperation with the Fuel Administration at the end of the war the Secretary of the Interior asked of Congress two appropriations, one of $50,000, for continuing this power survey over the whole United States, and the other of $200,000, for an intensive survey of the industrial zone of the East, where power requirements are most congested.

It appropriately comes within the province of the Geological Survey to plan this power investigation, both because this is the original Federal agency in making the earlier irrigation surveys and because for the last 25 years the Geological Survey has been given annual authorization for "determining the water supply of the United States" and for reporting "upon the best methods of utilizing the water resources." At present in the central power plants of the country water power carries only about 40 per cent of the load, while the total fuel requirement for steam-generated power, including that of the railroads, is not less than 800,000 tons daily. A power program that calls for the immediate and full development of every available and feasible water power, moreover, means saving both in coal and in man power, and with this purpose of securing the double conservation, the investigation has been proposed. The first step is to get the facts for the country as a whole and particularly for the North Atlantic industrial district.

This "super-power" project, which engineers agree seems wholly practicable but which can be regarded as now only in the vision stage, is to pool the power supply for the whole industrial area between Boston and Washington, in which is concentrated one-fourth of the power-generating capacity of the country. Such a unified power system would tie together properly located steam-electric and hydro-electric plants—old plants that are efficient as well as new plants—in a great power main from which would flow the energy to serve a score of railroads, hundreds of public-service companies, thousands of mills and factories, and millions of homes.

The subject is necessarily one for interstate investigation and is linked with the national problem of providing adequate transportation facilities. Electrification of our railroads would effect fuel economies of more than 50 per cent in coal consumed, not to mention the greater efficiency of electric traction through increasing road capacity. Equally important, moreover, is the relation of cheaper power to American industry. As stated in a letter transmitting the estimate for this appropriation, "Only by increased economy in the production and distribution of power will it be possible for our manufacturers to decrease their production expenses and compete successfully in the world's markets, maintaining at the same time the American standard of wages and living."

COMMERCIAL GEOLOGY.

The study of foreign mineral deposits and supplies by members of the Survey staff had for years been incidental to the continued inventory of the mineral production and resources of the United States. During the war, however, this study took on new importance and received special attention; in January, 1918, a preliminary statement of the mineral production of the world had been prepared in atlas form at the request of the Secretary of State, the Bureau of Mines cooperating. Work was then begun on the study of the distribution of the world's reserves of the essential minerals, with the specific intention of furnishing the American representatives at the Peace Conference with the economic data needed for their use. Two general purposes were served—first, that of obtaining a clear understanding of the relations between our own war needs and the foreign sources of supply from which these needs must or could be met; second, that of obtaining an understanding of the bearing of mineral resources upon the origin and conduct of the war and upon the political and commercial readjustment that would follow the end of hostilities. Extensive use was made of the results of the first class by the Government departments that had to do with our foreign trade in its bearing upon domestic industries, notably the War Trade Board, the Shipping Board, and the War Industries Board. The results of the second class were put to immediate use by the Army authorities, by the Department of State, and by the "Inquiry" charged by presidential order with the preparation of economic data for use at the Peace Conference.

The appreciation by the "Inquiry" of the importance of the investigations of foreign mineral resources led to a cooperative agreement between that organization and the Survey and to a small allotment ($7,700) in June, 1918, to permit the employment of additional technical assistance for a period of one year. As the result of this cooperative work a world atlas showing the production of the more important mineral commodities was completed, together with atlases showing the mineral reserves of Europe and of South America, and a large amount of information was compiled in regard to other continents. Most of this information on foreign mineral deposits was compiled from published sources, but the material was enriched by important contributions of unpublished material from the private files of American mining engineers and geologists, and the cooperative relations thus established between the mining public and the Survey have been extended and strengthened as the work progressed.

Formal cooperation with the "Inquiry" terminated on January 1, 1919, and the work was reorganized on a new basis, with only six geologists devoting their time to foreign mineral deposits. At the

same time general instructions were issued to the Survey specialists assigned to work on domestic resources to devote attention to foreign deposits in connection with the domestic investigations, stress being laid upon those foreign deposits which contributed to domestic supplies. At present the working staff of six has been reduced to four, owing to resignations and leaves of absence.

The larger share which the United States must take in international affairs makes it imperative that the public be better informed on these economic subjects, and therefore after the data thus compiled had served the immediate needs of the Government itself and there was no longer any necessity of maintaining the confidential status of most of the information the Secretary of the Interior warmly indorsed the proposal to prepare the material for publication, so as to make it useful to the general public.

The "Atlas of commercial geology," the first part of which is now in press, will exhibit graphically the distribution of mineral production and of mineral reserves. An effort is made to give the necessary world view by means of mineral maps of every continent. The basic importance of the raw-material resources to the country makes it a prime public duty of citizens generally to know the facts regarding the mineral industry, and to ascertain these facts the intensive study of our own resources is not enough; we must also acquire a comprehension of what minerals other countries contain to supplement what we have at home.

If it were possible to construct a composite diagram showing either the current output or the future reserves of the essential minerals in all the countries of the world the graphic exhibit would show so large a centralization in North America as to suggest that here is a group of nature-favored nations. Yet the present industrial demands for fuels, metals, and other mineral raw materials force the American business man to look beyond the present decade and beyond the borders of the United States. Commercial geology is simply the science of geology applied to the problems of industry in terms of trade. The "Atlas of commercial geology" will present the basal facts for use by the business man and thus show the relation of geology to national life.

In connection with the compilation of mineral data for this atlas the Survey geologists have collected detailed information that is of practical use to the mining geologist or engineer in private employ. This material is of various quality, and from its very nature the record can never be regarded as completed and thus ready for publication, but to attain somewhat the same end of publicity an "open file" of mineral information has been established in the Geological Survey. On the cards of this file are recorded in abstract the salient features in regard to foreign mineral deposits—the location and size

of the productive area, the production, the estimated reserves, the grade of the ores, and the nature of the commercial or political control. In addition to this a large amount of information is being compiled as to the recent production, imports, exports, and consumption of mineral commodities in foreign countries and as to recent developments that are of significance to Americans. The mining profession has been notified that this information has been compiled and filed in orderly fashion and is available for the use of American interests. Some of the largest American concerns engaged in the development of foreign mineral deposits have made extensive use of this file and have in turn contributed to it by transmitting material from their own files. The willingness to pool information that has cost many thousands of dollars may be taken as indicative of the get-together spirit of American industry, a type of public service in which it is eminently fitting for the Federal scientific bureau to cooperate.

PUBLICATION POLICY.

The "increase and diffusion of knowledge among men" is an appropriate expression of the object of the Smithsonian Institution, but it expresses no less the most important function of every other scientific bureau. To reach the public with the facts is an essential part of research. The measure of the Survey's success is not simply the number of pages of its official reports or even the quality of these publications, but also the promptness with which these results of scientific work are made public and the degree of publicity given to the useful product of the scientific investigations. To this end, a publication policy has been developed that includes securing newspaper notices of Survey publications, a type of publicity often criticized yet well warranted if the effort is made to advertise not the bureau or its personnel but its product; utilizing mediums of publication other than the official reports, such as the technical journals, transactions of scientific societies, and the reports of State surveys; and answering every inquiry not only by sending carefully selected publications on the subject but by writing more specific information that is not included in Survey reports or referring to the State surveys as sources of further information. Evidence of the success attending this publicity policy is found in the increasing frequency of telegraphic requests for publications or unpublished data.

The Survey's own reports, as described on pages 22–38, must continue to constitute the record of the results of its activities, but that this is not the only record can be seen in the fact that during the year Survey geologists, chemists, and engineers contributed 69 papers for publication outside the Survey, and 15 reports were turned over to the cooperative State surveys for publication. The guiding

test in choosing the place of publication is where can promptest issue and widest circulation be given to the results of the Federal scientific work: publicity under the best auspices is the sole aim.

The wide distribution of the topographic maps has been recognized as absolutely necessary if the public is to receive the benefit of the topographic surveys, but the sale of these maps was interfered with by the war, and at one time, indeed, for military reasons, some of the maps were withdrawn from general sale. There has been an increase, however, during the last year, so that as many maps were sold in June, 1919, as in June, 1915. With the purpose of promoting a larger use of these Government maps in the schools, a set of 25 carefully selected maps showing the various types of country in the United States has been distributed by Members of Congress from their legal quotas. Thus far 3,000 schools have been supplied with this set, and its use in teaching will be facilitated by a brief description of the set by Prof. W. M. Davis, which is sent to these schools. To promote the educational use of the current issues of topographic maps, similar brief descriptions of the maps published during the year appear on pages 38–58 of this report, and these descriptive notes are now included in the monthly list of publications. This innovation in publicity was made in response to the expressed needs of teachers who desire to use the maps best adapted to their classes.

GEORGE FERDINAND BECKER.

Dr. George Ferdinand Becker, the well-known geologist, died in Washington April 20 at the age of 72. He was born in New York City and was the son of Alexander Christian Becker, of Denmark, and Sarah Cary Tuckerman Becker, the daughter of Rev. Joseph Tuckerman, of Boston. Dr. Becker was the last member of the group of distinguished geologists who in 1879 were associated with Clarence King at the time of the organization of the United States Geological Survey. He was a leader in mining geology and geophysics and for many years had been the chief of the division of chemical and physical research in the Geological Survey, and the investigations made under his direction led to the establishment of the Geophysical Laboratory of the Carnegie Institution of Washington.

Dr. Becker was a graduate of Harvard, received the degree of doctor of philosophy at Heidelberg, and later graduated from the Royal School of Mines in Berlin. He was for four years an instructor of mining and metallurgy in the University of California, from which he came to the United States Geological Survey.

Dr. Becker was one of the pioneers in governmental efforts to guide and encourage the development of the mineral resources of the West. In 1880, when essentially the entire technical staff of the Geological Survey was utilized by the Bureau of the Census in taking the census

of mineral production, the statistical work west of Mississippi River was placed in Dr. Becker's charge. A little later his personal solicitation before a committee of Congress was largely responsible for the permanent establishment, under the auspices of the Geological Survey, of the annual statistical canvass of the mineral industry of the country now carried on by the division of mineral resources of the Survey.

In 1880, also, Dr. Becker began the study of the geology of the famous Comstock silver lode, which even at that time had yielded $325,000,000 in bullion and which is imperishably associated with some of the most romantic episodes in American mining. The results of this work were published in monographic form in 1882. He spent the summers of 1883 to 1885 in the study of the quicksilver deposits of California and in connection with these studies made a visit to the famous old Almaden mine in Spain. He was one of the pioneers in the geologic work in the gold fields of southern Alaska, which he visited in 1895.

Dr. Becker's geologic observations and studies were not confined to the United States, however, for in 1896, under the auspices of an English company, he visited the Rand gold fields, South Africa, and some of his observations there were later published by the Geological Survey.

In 1898 he reported to the military governor of the Philippines as geologist, and he spent 14 months in the islands. Although prevented from accomplishing much in the way of active field work because of the hostile attitude of the natives, he was able, during that period, to compile a very useful review of the geology of the islands as known at that time. In connection with this Philippine service Dr. Becker prepared a special report for President Roosevelt on the desirability of scientific explorations in the islands.

Dr. Becker also rendered national service in the Canal Zone as a member of a special committee under the auspices of the National Academy of Sciences, for the purpose of investigating the geologic phases of the engineering problems of the Panama Canal.

Dr. Becker was a member of the National Academy of Sciences, the Washington Academy of Sciences, and the American Institute of Mining Engineers. In 1914 he was elected president of the Geological Society of America. He was the author of more than a hundred scientific papers.

WORK OF THE YEAR.

PUBLICATIONS.

The publications of the year numbered 218 and consisted of 1 annual report, 8 professional papers, 6 separates from 1 professional paper, 21 bulletins, 33 separates from 5 bulletins, 14 water-supply papers, 2 separates from 1 water-supply paper, 61 separates from

3 annual reports on mineral resources, 1 new geologic folio, 1 supplemental list of publications, 1 book entitled "Fiscal regulations of the U. S. Geological Survey," 1 book entitled "Topographic instructions," 1 advance statement on copper in 1918, 3 index-map circulars, 10 texts for back of maps of camps, 42 press bulletins, and 12 monthly lists of new publications. The total number of pages in these publications was 11,644. Brief notices of the publications in the regular series, also of 181 new topographic maps and several reprinted maps showing camps, are given below.

THIRTY-NINTH ANNUAL REPORT of the Director of the United States Geological Survey to the Secretary of the Interior, for the fiscal year ended June 30, 1918. 1918. 163 pages, 4 plates.

A detailed account of the work of the Geological Survey during the fiscal year 1918, including reports from each branch, division, and section, abstracts of the publications of the year, and charts showing contributions to war service by the Survey and its three principal branches. Under the heading "Special war activities" the Director discusses the way in which the personnel, records, and methods that represent the products of many years of scientific activity were being utilized in the prosecution of the war, past experience being thus translated into present service. The number of Survey men in the Army increased during the year from 61 to 332. The special investigations of the year fell into two broad groups relating to war materials and to military surveys. In the search for supplies of war minerals the Survey geologists visited mining districts not only in the United States but in Central and South America and the West Indies. Cooperation with the war boards and other departments was continuous and gradually increased in scope. The Survey took the initiative in organizing a joint information board on mineral products. The spirit of the whole organization is expressed in the sentence "The war has given science a larger opportunity to be useful." The same thought is expressed in the closing words of an obituary notice of one of the original members of the Survey who had rendered continuous service for 39 years: "Pure science as given to the world by Grove Karl Gilbert was useful science."

PROFESSIONAL PAPER 99 (Extract). A description of the quantitative classification of igneous rocks, with tables for the calculation of the norm, by H. S. Washington. 37 pages.

Reprint of the five appendixes to Professional Paper 99, which contain matter of general use to petrographers and mineralogists and in this form will be more readily accessible and more easily handled than in the original bulky volume. A list of errors that have been discovered in that volume is given, and eleven analyses are added.

PROFESSIONAL PAPER 104. The genesis of the ores at Tonopah, Nev., by E. S. Bastin and F. B. Laney. 1918. 50 pages, 16 plates, 22 text figures.

Presents the results of an investigation conducted in informal cooperation between the Geological Survey and the Bureau of Mines. This investigation was intended to supplement the work of Spurr and Burgess, whose reports on the geology of the Tonopah district were published in 1905 and 1909, by applying to the ores methods of microscopic study which were not in general use by economic geologists at the time they wrote but which in other districts have proved of material assistance in the interpretation of ore genesis. Ore was discovered at Tonopah in 1900. In 1915 the district was exceeded in silver output in the United States only by Butte. The total value of the gold, silver, copper, and lead produced in the district to the end of 1917 was over $92,000,000. The authors believe that the ores from which these metals have been derived were in

the main of hypogene origin, having been deposited by solutions that exuded from cooling, buried bodies of igneous rock or magma. The hypogene ore bodies were subsequently subjected to processes of oxidation and enrichment, but these processes, referred to collectively as supergene, were quantitatively much less important than the hypogene mineralization. The paper is illustrated by numerous photomicrographs and other views of the ores.

PROFESSIONAL PAPER 106. The Quaternary geology of southeastern Wisconsin, with a chapter on the older rock formations, by W. C. Alden. 1918. 356 pages, 39 plates, 21 text figures.

Southeastern Wisconsin, now one of the most beautiful of the inhabited parts of the continent, was once an ice field as repellent and featureless as the ice cap of Greenland. The movement of the glaciers in this region in late Pleistocene time gave rise to conspicuous topographic forms and thus left a record of striking individuality. A large ice lobe that advanced through the Green Bay valley and a still greater lobe that crept down the valley of Lake Michigan crowded against each other and pushed the terminal moraines that accumulated on their adjacent sides into one rough, bunchy, gigantic ridge. This joint moraine is the master feature of the region in both scientific and popular interest. Its immense hummocks and hollows suggested to the pioneers the great caldrons they used for boiling down ash lye into potash, and they called it the Potash Kettle Range. Some of the kettles seemed to be set in place, and others to be turned upside down. About 40 years ago this range and other glacial features of eastern Wisconsin were mapped and interpreted by the State Geological Survey. The field work was done at the rate of about 4,000 square miles a year, and thus the survey perforce had something of the nature of a bird's-eye view. The present paper is a work of another order, representing more deliberate methods of investigation and greater attention to detail. The two reports, however, fall into as gratifying accord as is wholesome to the progress of inquiry. This region is particularly interesting to students of glacial phenomena because the topographic conditions, in an area of comparatively small relief, were favorable for the development of nearly all the features that are typical of continental glaciation as contrasted with mountain glaciation. These features are set forth in detail with numerous maps and illustrations. The paper contains an introduction by Dr. T. C. Chamberlin, now of the University of Chicago, under whose direction the studies of the author were carried on. No evidence has been found in the glacial deposits to indicate that man occupied this region before or during the great ice age, and so the study of the effigy mounds and other relics of prehistoric man in the region is outside the province of the geologist.

PROFESSIONAL PAPER 107. Geology and ore deposits of the Tintic mining district, Utah, by Waldemar Lindgren and G. F. Loughlin, with a historical review by V. C. Heikes. 1919. 282 pages, 39 plates, 49 text figures.

The Tintic district, named after a noted Ute chief, is about 60 miles south of Salt Lake City, in the East Tintic Mountains. It is one of the three principal silver-lead districts of Utah and has recently entered the ranks of the great copper camps. The value of the metals produced here from 1869 to the end of 1917 was over $180,000,000. This district was investigated in 1897 by G. W. Tower and George Otis Smith, of the Geological Survey, and their report was published in 1898. The results were also summarized in a folio of the Geologic Atlas of the United States. Since the first report was published the annual production has doubled, the development work has increased enormously, and an entirely new line of ore deposits has been opened. A resurvey was therefore assigned to the authors of the present report, who did most of the field work in 1911, 1913, and 1914. The 14 years between 1897 and 1911 were years of progress in geologic science, and though no great changes in theory or notable discoveries were made

there was a steady improvement in method—a constant trend toward exactness in map delineation and quantitative accuracy in results. This progress is reflected in the new Tintic report. The general geography and geology and some of the mines are discussed by Mr. Loughlin, and the ore deposits by Mr. Lindgren. Mr. Heikes contributes a chapter on the history of mining and metallurgy in the district. The book is abundantly illustrated with maps, sections, and halftone views.

PROFESSIONAL PAPER 108. Shorter contributions to general geology, 1917; David White, chief geologist. 1918. 247 pages, 66 plates, 31 text figures.

Contains 13 papers by 14 authors. These papers were published separately in advance and were noticed in the Thirty-seventh and Thirty-eighth annual reports.

PROFESSIONAL PAPER 109. The Canning River region, northern Alaska, by E. de K. Leffingwell. 1919. 251 pages, 35 plates, 33 text figures.

Prior to the explorations whose results are here set forth the Canning River region of Arctic Alaska was practically unknown except as to its larger geographic features. The region as a whole presented an almost complete hiatus in the scientific knowledge of Alaska, and Mr. Leffingwell has performed a valuable service in mapping and describing its geography and geology. During the 10 years between the organization of his first expedition, in 1906, and the completion of this report his whole attention was given to the work. Capt. Ejnar Mikkelsen was joint commander of the first expedition, but after 1907 the work was done with few companions and no scientific assistants, and on some of his trips the author was entirely alone. The explorations were made at Mr. Leffingwell's own initiative and expense, and the results are in every sense of the word entirely his own contributions to science and to a better understanding of Arctic Alaska. He spent nine summers and six winters on the north shore, pitched camp about 380 times, and traveled 7,000 miles, in addition to the 20,000 miles covered by three round trips between Puget Sound and Point Barrow. The report contains an interesting description of Arctic equipment, sections on meteorology, animal life, history of exploration, and geographic nomenclature, and full discussions of the geography and geology. The results of a detailed study of "ground ice"—bodies of more or less clear ice in permanently frozen ground—form the closing section of the report. The book is elaborately illustrated.

PROFESSIONAL PAPER 110. A geologic reconnaissance of the Inyo Range and the eastern slope of the southern Sierra Nevada, Calif., by Adolph Knopf, with a section on the stratigraphy of the Inyo Range, by Edwin Kirk. 1918. 130 pages, 23 plates, 8 text figures.

The geology and mineral resources of the Inyo Range were investigated by Mr. Knopf in 1912, with the assistance of Mr. Kirk in the study of the stratigraphy. A report on the economic geology of the region was published in 1913, and the work might have stopped there, but in view of the unusual geologic interest of the region further examinations were made in 1913 and the work was extended westward across Owens Valley to include parts of the steep eastern front and the crest of the Sierra Nevada. This region includes a section of the fault zone that divides the Sierra Nevada from the Great Basin, along which movement has taken place up to very recent time. The sedimentary rocks of the Inyo Mountains are more than 36,000 feet thick and range in age from pre-Cambrian to Triassic. In post-Triassic time these beds were faulted and folded, and the region was then invaded by great masses of quartz monzonite and allied rocks. The escarpment of the Sierra Nevada is composed dominantly of intrusive granitic rocks, which are exposed through a vertical range of 8,000 feet. The region has been glaciated at two widely separated periods. The report describes the geologic features in detail and is well illustrated. It includes a sketch of the mineral resources, which comprise lead, zinc, gold, copper, and marble.

PROFESSIONAL PAPER 114. Geology and ore deposits of the Yerington district, Nev., by Adolph Knopf. 1918. 68 pages, 5 plates, 12 text figures.

Yerington is one of the smaller copper districts of the West, its entire output from the beginning of mining operations being less than a third of the annual output of the mines at Bisbee, Ariz. It is, however, next to Ely, the most productive copper district in Nevada and yielded to the end of 1917 more than 61,000,000 pounds. The deposits of this district are exceptionally interesting to the student of ore deposition and differ from those of the more productive western districts in being of contact-metamorphic origin and only slightly modified by enrichment. Mr. Knopf presents a suggestive discussion of the relation of ore deposition to contact metamorphism. The report contains geologic maps and sections and views of fossils and rock specimens.

PROFESSIONAL PAPER 120–B. Geology of northeastern Montana, by A. J. Collier. 1918. Pp. 17–39, Pls. I–VI, figs. 2–6.

Report on a large region in northeastern Montana that has never been thoroughly explored by geologists, owing to the fact that it is a part of the Great Plains and the belief that it is too monotonous and uninteresting to tempt anyone to turn aside from the pronounced geologic features a little farther west. This region has been visited in several reconnaissances by parties from the Geological Survey examining its lignite resources, and the geologic information obtained during these visits is summarized in this paper. Contains a geologic map of the region and views of some of its geologic features.

PROFESSIONAL PAPER 120–D. The structure and stratigraphy of Gravina and Revillagigedo islands, Alaska, by Theodore Chapin. 1918. Pp. 83–100, Pl. VIII, figs. 10–12.

A short report on an area in the southern part of southeastern Alaska that is of geologic interest on account of its fossils.

PROFESSIONAL PAPER 120–F. Relations of late Paleozoic and early Mesozoic formations of southwestern Montana and adjacent parts of Wyoming, by D. D. Condit. 1918. Pp. 111–121, Pls. IX–XIII, fig. 14.

Presents evidence found in southwestern Montana concerning the great Jurassic base-leveling and its bearing on the solution of certain problems involving late Paleozoic, Triassic, and Jurassic formations and sets forth the relations of those formations to beds in western Wyoming.

PROFESSIONAL PAPER 120–G. New graphic method for determining the depth and thickness of strata and the projection of dip, by H. S. Palmer. 1918. Pp. 123–128, Pls. XIV–XVI, figs. 15–19.

Explains a new method of solving trigonometric problems in geologic work by the use of alinement diagrams, which are said to be simpler than logarithmic tables and to give more accurate results.

PROFESSIONAL PAPER 120–H. A contribution to the geology of northeastern Texas and southern Oklahoma, by L. W. Stephenson. 1918. Pp. 129–163, Pls. XVII–XXX.

The region comprising the Black and Grand prairies, in Texas and Oklahoma, abounds in features of physiographic, geologic, and paleontologic interest and has been investigated at different times since 1860. The writer of this paper made studies in the region at intervals between 1911 and 1917, and his purpose is to set forth the present state of geologic knowledge regarding it. The paper contains a geologic map and several halftone illustrations.

PROFESSIONAL PAPER 120–I. Some American Cretaceous fish scales, with notes on classification and distribution of Cretaceous fishes, by T. D. A. Cockerell. 1919. Pp. 165–202, Pls. XXXI–XXXVII.

Fish remains are very abundant in several Cretaceous formations of the Rocky Mountains and Great Plains, but except in the Niobrara formation of Kansas a

fish skeleton well enough preserved for description or identification is the greatest rarity. Most of the fish remains that have been found consist of separate scales, many of which are well preserved. It has been hoped that these scales might prove to be of value in stratigraphic identification and correlation. The scales collected by the Geological Survey in the Western States have recently been studied systematically by Prof. Cockerell, of the University of Colorado, and the results of the study are set forth in this paper. The author discusses the inherent limitations in such a study but states that, as the Cretaceous period saw the rise and development of the higher fishes, with numerous types clearly pointing toward the modern fauna, it is especially desirable to note every fact that will throw light upon the Cretaceous history. The detailed descriptions of the scales are illustrated by heliotype plates.

This pamphlet contains a title-page, table of contents, and index for the use of those who may wish to bind the separate chapters of Professional Paper 120.

BULLETIN 660. Contributions to economic geology, 1917, Part I, Metals and nonmetals except fuels; F. L. Ransome, E. F. Burchard, and H. S. Gale, geologists in charge. 1918. 311 pages, 11 plates, 33 text figures.

BULLETIN 661. Contributions to economic geology, 1917, Part II, Mineral fuels; David White, geologist in charge. 1918. 336 pages, 29 plates, 33 text figures.

Bulletin 660 contains 11 papers by 14 authors; Bulletin 661, 10 papers by 7 authors. These papers, which had previously been published separately, have been noticed in the Thirty-eighth and Thirty-ninth annual reports.

BULLETIN 662. Mineral resources of Alaska, report on progress of investigations in 1916, by A. H. Brooks and others. 1918. 438 pages, 18 plates, 8 text figures.

Contains 15 papers by 11 authors. These papers were published separately during the fiscal year 1917–18 and were noticed in the Thirty-ninth Annual Report.

BULLETIN 664. The Nenana coal field, Alaska, by G. C. Martin. 1919. 54 pages, 12 plates.

The Nenana coal field lies in the rugged northern foothills of the Alaska Range, but most of the coal areas are in lowland tracts between the foothill ridges. Nenana River is followed by the Government railroad now under construction, and one of the principal coal areas of the field has been wholly surveyed and is easily accessible from the railroad, at a point about 360 miles from the coast. The coal lands in this field that are most accessible and contain the most immediately minable coal have been offered for leasing. This report contains a detailed description and map of each township in the field, with classification lists showing coal land and noncoal land.

BULLETIN 666–FF. Our mineral supplies: Quicksilver, by F. L. Ransome. 1919. 9 pages.

Quicksilver is the last mineral to be covered by the series prepared to meet the war need for information on the country's mineral supplies. It was delayed by the pressure of other war work of the author to whom it was originally assigned, but the essential facts were made available to the war boards in other ways.

BULLETIN 666–GG. Our mineral supplies: Bibliography, compiled under the direction of G. M. Wood. 1919. 58 pages.

The final chapter of Bulletin 666. Most of the chapters of this bulletin were published in the spring and summer of 1917. This chapter contains a list of Survey publications concerning deposits of the minerals considered in the other chapters.

BULLETIN 668. The Nelchina-Susitna region, Alaska, by Theodore Chapin. 1918. 64 pages, 10 plates, 4 text figures.

The region described in this bulletin, lying mainly west of Copper River and north of Matanuska River, had before 1913 been visited only by occasional exploration parties and a few trappers and prospectors. In 1913 reports of the discovery

of gold, with the usual exaggeration as to richness and extent of the deposits, attracted several hundred men to the region, but most of them left after they learned the actual conditions. The geology of the region, however, indicates the possibility that gold lodes may be found there and that some of the preglacial gravels that may have survived erosion contain workable placers. The region is now isolated and operating costs would be high, but it will be readily accessible when the Government railroad is completed to the Matanuska coal field, and systematic prospecting may then be justified. This report summarizes the available information concerning the region, the geology and mineral resources of which were investigated by the author in 1914. It contains topographic and geologic maps and views of features of geologic interest. The area discussed covers about 10,000 square miles.

BULLETIN 669. Salt resources of the United States, by W. C. Phalen. 1919. 284 pages, 17 plates, 16 text figures.

In the search for potash carried on by the Geological Survey under specific authority of Congress a great deal of information on the salt resources of the United States has been collected. So much of this information as relates to the geology of the deposits, theories of saline deposition, chemical composition of saline materials, and statistics of production of salt is set forth in this bulletin. The work included chemical examination of hundreds of samples of brines, bitterns, rock salt, and calcium chloride; investigations of the geology of the deposits of rock salt and of the brines; and study of the records of deep wells and of samples of the rocks through which the wells had been drilled. Visits were made to a large number of operating plants in all parts of the country, and the report gives a mass of information that will be of service to everyone interested in the salt industry, which in 1917 produced nearly 50,000,000 barrels of 280 pounds each. The author states that the deposition of salt has probably been taking place during all geologic ages since the early Cambrian, and the deposits of rock salt now found have been formed by the gradual evaporation of bodies of sea water cut off from the main ocean—just such a process as is now going on in Great Salt Lake and the Dead Sea. The report contains a map of the United States showing salt-producing localities, also larger-scale maps of some of the principal localities, geologic maps and sections, and views taken at some of the deposits.

BULLETIN 671. Spirit leveling in New York, 1896 to 1905 and 1912 to 1916, inclusive; R. B. Marshall, chief geographer. 1918. 213 pages, 1 plate.

BULLETIN 672. Spirit leveling in Illinois, 1914 to 1917, inclusive; R. B. Marshall, chief geographer. 108 pages, 1 plate.

BULLETIN 673. Spirit leveling in Kentucky, 1903 to 1914, inclusive; R. B. Marshall, chief geographer. 100 pages, 1 plate.

BULLETIN 674. Spirit leveling in the State of Washington, 1896 to 1917, inclusive; R. B. Marshall, chief geographer. 204 pages, 1 plate.

These bulletins give the results of spirit leveling done by the Geological Survey in the States and during the years named in the titles. Bulletin 674 covers all the leveling done by the Survey in Washington to the end of 1917; the other bulletins are supplementary to bulletins previously published. Most of the altitudes are given to three decimal places.

BULLETIN 676. Some Pliocene and Miocene Foraminifera of the Coastal Plain of the United States, by J. A. Cushman. 1918. 100 pages, 31 plates.

Describes and figures species of Pliocene Foraminifera from five localities in North Carolina, South Carolina, and Florida and all recorded species of later Miocene Foraminifera from the Atlantic and Gulf Coastal Plain between Alabama and New Jersey.

BULLETIN 677. Geology and mineral deposits of the Colville Indian Reservation, Wash., by J. T. Pardee. 1918. 186 pages, 12 plates, 1 text figure.

The Colville Indian Reservation, which is a little larger than the State of Delaware, lies in northeastern Washington, occupying the southern parts of Ferry and Okanogan counties. It is 50 miles northwest of Spokane. This report describes practically all the prominent or promising mines and prospects known in the reservation up to 1913. The detailed descriptions of the four principal mining districts are preceded by a broadly generalized discussion of the geography and geology of the reservation as a whole. The area is bordered on the south by the trenchlike valley of Columbia River, a chasm sunk 1,600 to 2,000 feet below the bordering plains, with somber colonnades, massive dull-gray terraces, rugged promontories, and a great swirling stream below. The east half of the reservation is occupied by steep mountains, but the west half is less rugged. The highest altitudes attained are 6,000 to 6,500 feet. The first metalliferous deposits discovered in this region were gold placers, but most of the mineral production has been in silver. The value of the total output up to 1912 was about $25,000. The mineral deposits of present economic importance are predominantly metal-bearing lodes. This report contains several geologic maps and halftone views.

BULLETIN 680. A geologic reconnaissance for phosphate and coal in southeastern Idaho and western Wyoming, by A. R. Schultz. 1918. 84 pages, 2 plates, 8 text figures.

Report on a brief reconnaissance of an area of about 2,000 square miles in Idaho and Wyoming for the purpose of collecting data for the elimination of lands from existing phosphate reserves if it was found that they contained no valuable deposits of phosphate. As a result of this examination some lands were restored to agricultural entry and some were included in new withdrawals. The net result was a reduction of about 57,000 acres in the outstanding phosphate reserve. A geologic and topographic examination of this area was made in 1872 and another in 1877, by the Hayden Survey. Recent work has disclosed some errors in the geologic maps of the earlier surveys and has brought to light information on previously unvisited parts of the area. Beds of coal have also been found at several localities in this area, and some of them are now being mined. The coal is bituminous and of fair quality. It is used mostly by settlers who live within hauling distance of the mines.

BULLETIN 681. The oxidized zinc ores of Leadville, Colo., by G. F. Loughlin. 1918. 91 pages, 8 plates, 7 text figures.

The Geological Survey early investigated the ore deposits of the Leadville region and in 1886 published an elaborate monographic report on it. This was supplemented in 1907 by a bulletin on the Downtown district of Leadville. The oxidized zinc ores of the region were not exploited until after the Survey's field study of the other ores had been completed. In 1913 Mr. Loughlin was detailed to study these ores, and the present paper gives the results of his examination. It was planned to include this paper as a chapter in a new Leadville monograph, but owing to inevitable delay in the completion of the larger work it was decided to publish this report separately. The shipments of oxidized ores began late in 1910 and by the end of 1916 had amounted to over 650,000 tons, containing from 21 to 31 per cent of zinc. The author discusses the mineralogy, varieties, metal content, distribution, mode of occurrence, and genesis of these ores and gives suggestions for prospecting for them. The book contains photomicrographs of the ores, diagrams, plans, and sections.

BULLETIN 683. The Anvik-Andreafski region (including the Marshall district), Alaska, by G. L. Harrington. 1918. 70 pages, 7 plates.

The coast of Alaska was explored by early Russian and English navigators, but the interior was long wholly unknown, even after a considerable trade in furs had

been established along the coast. The region along the Yukon between Anvik and Andreafski rivers was first visited by white men in 1834, and the earliest geologic work in this part of Alaska was done in 1867. The investigations of the Geological Survey in this region began in 1889, though little detailed work was done until 1896. Since then the region has been visited at intervals, and in the summer of 1916 a topographic and geologic party spent about three months in this part of the Yukon Valley. The information obtained in these explorations is set forth in Bulletin 683, which contains four large maps and several views of the geologic features of the region. Placer gold amounting to $15,000 was obtained here in 1914; in 1916 the output was nearly $700,000.

BULLETIN 684. Bibliography of North American geology for 1917, with subject index, by J. M. Nickles. 1918. 154 pages.

A list, arranged alphabetically by authors' names, of publications on the geology of the continent of North America and adjacent islands, also Panama and the Hawaiian Islands, issued in 1917. The book is indexed and contains lists of chemical analyses reported and of minerals, rocks, and geologic formations described.

BULLETIN 685. Relation of landslides and glacial deposits to reservoir sites in the San Juan Mountains, Colo., by W. W. Atwood. 1918. 38 pages, 8 plates, 17 text figures.

The urgent demand for water to be used for irrigation on the lowlands adjacent to the San Juan Mountains has led to the construction of a number of reservoirs and the planning of others to store water from melting snows and heavy rain and release it later as needed. Most of the reservoir sites are in the great glaciated canyons of the range, and the selection of some of them has apparently been determined by the occurrence of a narrow gorge or constricted portion in the canyon downstream from a broad, open portion. In some of these canyons, however, the narrow portions have been formed by the deposition of large masses of loose materials of landslide or glacial origin, and such materials have not proved to be water-tight. On many projects perfectly good water-tight dams have been constructed, but serious leakages have occurred underneath or around one end or even both ends of the dam. Some of the projects have therefore been abandoned, and others are kept up with heavy expenses for repairs. Nevertheless other reservoirs were being planned in places where just such loose materials border the dam sites. This paper sets forth the geologic conditions in the canyons and lake basins in the endeavor to preclude expensive errors in selecting future reservoir sites. It is well illustrated and should be of great practical value.

BULLETIN 686. Structure and oil and gas resources of the Osage Reservation, Okla. Advance chapters as follows:

A. Introduction, by David White. 1918. Pp. i–xii, Pl. I, fig. 1.

B. T. 23 N., R. 11 E., Tps. 22 and 23 N., R. 12 E., by W. B. Emery. 1918. Pp. 1–9, Pls. II–III, figs. 1–2.

C. T. 27 N., R. 9 E., by D. E. Winchester. 1918. Pp. 11–15, Pl. IV, figs. 1c, 3–4.

D. T. 24 N., R. 10 E., by C. F. Bowen. 1918. Pp. 17–26, Pls. V–VI, figs. 1d, 5.

E. T. 25 N., R. 9 E., by K. C. Heald. 1918. Pp. 27–41, Pl. VII, figs. 1e, 6–10.

F. T. 28 N., Rs. 9 and 10 E., and T. 29 N., R. 10 E., by C. F. Bowen. 1918. Pp. 43–58, Pls. VIII–IX, figs. 1f, 11.

G. T. 25 N., R. 10 E., by D. E. Winchester, K. C. Heald, and others. 1918. Pp. 59–73, Pl. X, figs. 1g, 12–17.

H. T. 25 N., Rs. 11 and 12 E., by O. B. Hopkins. 1918. Pp. 75–90, Pls. XI–XII, figs. 1h, 18–19.

I. T. 26 N., Rs. 9, 10, and 11 E., by F. R. Clark. 1918. Pp. 91–118, Pls. XIII–XVII, figs. 1i, 20–22.

J. T. 20 N., R. 11 E., by E. R. Lloyd and K. F. Mather. 1918. Pp. 119–127, Pls. XVIII–XIX, figs. 1j, 23.

K. T. 27 N., R. 7 E., by K. C. Heald. 1918. Pp. 129–135, Pl. XX, figs. 1k, 24–25.

L. Tps. 24, 25, and 26 N., Rs. 6 and 7 E.; Tps. 25 and 26 N., R. 5 E.; and T. 26 N., R. 4 E., by C. F. Bowen. 1918. Pp. 137–148, Pls. XXI–XXIII, fig. 1l.

M. Tps. 24 and 25 N., R. 8 E., by K. C. Heald and K. F. Mather. 1919. Pp. 149–170, Pls. XXIV–XXVI, figs. 1m, 26–27.

N. Tps. 20 and 21 N., R. 12 E., by C. S. Ross. 1919. Pp. 171–177, Pls. XXVII–XXVIII, figs. 1n, 28–29.

O. Tps. 21 and 22 N., R. 11 E., by C. S. Ross. 1919. Pp. 179–191, Pls. XXIX–XXXI, figs. 1o, 30.

P. T. 24 N., R. 9 E., by K. C. Heald, C. F. Bowen, and others. 1919. Pp. 193–211, Pls. XXXII–XXXIII, figs. 1p, 31–33.

Q. T. 27 N., R. 8 E., by K. C. Heald. 1919. Pp. 213–222, Pls. XXXIV–XXXV, figs. 1q, 34–38.

R. T. 26 N., R. 8 E., by K. C. Heald and K. F. Mather. 1919. Pp. 223–236, Pl. XXXVI, fig. 1r, 39–40.

The Osage Reservation is of particular interest in connection with the search for an increased supply of petroleum, because it contains a great area of unleased oil lands; the productivity of the developed fields is high and well sustained; the reservation contains many anticlines and domes, and the development and tests indicate that most of the structurally favorable folds will yield oil; the oil is of high grade; pipe lines and refineries are at hand; and the lands are being offered for lease. A review of the bonuses already paid shows a regrettable lack of information as to the relative values of the tracts sold and indicates that many of the bidders had little or no geologic guidance. These papers have been prepared to supply the evident need for geologic information regarding the Osage lands. They are brief and practical and are intended for the immediate use of the oil men. Each paper contains a map showing the geologic structure of the area described.

BULLETIN 687. The Kantishna region, Alaska, by S. R. Capps. 1919. 114 pages, 17 plates, 6 text figures.

The area of 4,500 square miles described in this bulletin as the Kantishna region lies north of the crest of the Alaska Range, between Nenana and Kantishna rivers, just west of the line of the Government railroad now under construction. It includes the northeastern part of the Mount McKinley National Park, set apart in 1917, and is a short distance north of Mount McKinley, the highest mountain in North America, reaching 20,300 feet. This region was not visited, so far as is known, until 1902, when a Geological Survey party traversed the northwest slope of the Alaska Range and followed Nenana River to its mouth. Several mountaineering parties organized to scale Mount McKinley from the north obtained valuable geographic information on this region, and in 1916, realizing that interest in the region would increase greatly when it became accessible by the new railroad, the Geological Survey sent two field parties there to make topographic and geologic surveys and study the mineral deposits. These parties spent over two months in the region, and the results of their work are here set forth. The report contains topographic and geologic maps on a scale of about 4 miles to the inch (1:250,000) and numerous views showing the topography and natural resources. Probably no other part of North America is so well supplied with wild game, including mountain sheep, caribou, moose, black bear, and many fur-bearing animals. The principal mineral resource of the region is placer gold,

of which about $380,000 worth had been recovered by the end of 1916. Gold and antimony lodes have been worked to a small extent, and the region contains some deposits of lignite.

BULLETIN 688. The oil fields of Allen County, Ky., with notes on the oil geology of adjoining counties, by E. W. Shaw and K. F. Mather. 1919. 125 pages, 10 plates, 10 text figures.

Oil was first found in Allen County, Ky., at about the time of the Civil War, and prospecting was carried on actively in many parts of the county for two or three years after the war, but nothing more was done for 20 years. In 1887 interest was reawakened by the remarkable development of oil and gas in Ohio and Indiana. No great success was attained, and little more was done till 1913, when the high price of oil stimulated renewed search. The results were encouraging, and drilling has continued at an increasing rate. In March, 1917, there were 102 producing wells in Allen County, yielding about 1,400 barrels of oil daily, and by May practically the entire county was under lease. The county contains five well-defined fields, separated by barren strips. Of the 511 wells drilled to the end of 1918, 334 have been successful. The total production is estimated at 100,000 barrels. No pipe line is available, and most of the oil marketed is shipped by rail to refiners at Nashville and Louisville. With better marketing facilities the capacity of the fields would be about 500,000 barrels a year. The total original supply of oil in the three main pools was probably over 3,500,000 barrels, of which only a small fraction has been extracted. This report presents the geology of the county in detail, discusses the economic features of the oil fields, together with notes on adjoining counties, and gives suggestions for prospecting. It is illustrated by several geologic maps, views of geologic features that have a bearing on the occurrence of oil, and a number of well sections.

BULLETIN 690–D. Quicksilver deposits of the Phoenix Mountains, Ariz., by F. C. Schrader. 1918. Pp. 95–109, figs. 8–11.

In 1916 quicksilver was discovered in the Phoenix Mountains, an outlying desert range of the Great Basin type in Maricopa County, south-central Arizona. Other deposits were found later in the year in the same vicinity. This paper sketches the general geology of the area and describes the deposits. The ore averages 3 per cent or more of quicksilver.

BULLETIN 690–F. Some manganese deposits in Madison County, Mont., by J. T. Pardee. 1918. Pp. 131–143.

The deposits of manganese in Madison County, Mont., are primarily of sedimentary origin and therefore differ from most of the other manganese deposits in this general region, which are related to metalliferous quartz veins. Because of their composition these ores are desirable for mixing with the siliceous ores found at many other places in Montana, especially at Butte, where the ores contain less iron than is needed in making high-grade ferromanganese. The author of this paper suggests that because of their sedimentary origin it is worth while to prospect the same beds elsewhere in this general region for manganiferous ores.

BULLETIN 690. Contributions to economic geology (short papers and preliminary reports), 1918, Part I, Metals and nonmetals except fuels; F. L. Ransome, E. F. Burchard, and H. S. Gale, geologists in charge. 1919. 149 pages, 5 plates, 11 text figures.

Contains 6 papers by 6 authors. These papers were published separately in advance. Two of them are noticed above; the others were noticed in the Thirty-ninth Annual Report.

BULLETIN 691–D. Geology and oil and gas prospects of the Lake Basin field, Mont., by E. T. Hancock. 1918. Pp. 101–147, Pls. XVI–XXIII, fig. 31.

The Lake Basin field is an area of about 1,000 square miles in south-central Montana. The town of Billings is at its southeast corner, and it is accessible

from four railways. This paper gives the results of an investigation made for the purpose of studying the stratigraphy of the field in detail and discovering such structural features as have elsewhere been found to bear a definite relation to accumulations of oil and gas. Four deep wells have been drilled in this field, and the author recommends one locality for further tests.

BULLETIN 691-E. Oil and gas geology of the Birch Creek-Sun River area, northwestern Montana, by Eugene Stebinger. 1918. Pp. 149–184, Pl. XXIV, figs. 32–34.

The area described in this paper lies adjacent to the front range of the Rocky Mountains in northwestern Montana and is part of a large region in the northern Great Plains that seems to deserve consideration as prospective territory for oil and gas development. Beds of the same age as those that have yielded most of the oil produced in Wyoming and Colorado and large quantities of gas in Alberta underlie much of this region, in many places at depths that can be reached by the drill. This paper presents the field evidence that bears on the prospects of finding oil and gas in the area, including a description of the broader features of the geology and more detailed accounts of local structural features that seem to be possible sources of oil and gas.

BULLETIN 691-F. Anticlines in a part of the Musselshell Valley, Musselshell, Meagher, and Sweetgrass counties, Mont., by C. F. Bowen. 1918. Pp. 185–209, Pl. XXV.

Sets forth the results of an investigation made to determine the nature and extent of the rock folds in the Musselshell Valley, Mont., and the possible occurrence of oil and gas in these folds. Several well-developed anticlines and domes were found, and sandstones that would serve as suitable reservoirs for the accumulation of oil were noted at a number of horizons. The report discusses the geology of the region as a whole and suggests the most favorable places for future development. The area described covers about 1,200 square miles and lies on the western border of the Great Plains, its east edge being 10 miles west of Roundup. It is crossed by two railways and is well provided with roads.

BULLETIN 691-G. The Nesson anticline, Williams County, N. Dak., by A. J. Collier. 1918. Pp. 211–217, Pl. XXVI.

Describes a fairly well marked anticline that is of interest because it is in an area in which the rocks in general lie nearly flat. A small flow of gas has been obtained in an artesian well a few miles from the crest of this fold, and the author suggests the drilling of one or more additional wells nearer the crest, in search of a larger gas flow.

BULLETIN 691-I. The Santo Tomas cannel coal, Webb County, Tex., by G. H. Ashley. 1918. Pp. 251–270, Pls. XXIX–XXXII, figs. 37–41.

The deposit of cannel coal at Santo Tomas, Tex., is the largest body of cannel coal of bituminous rank in the United States, if not in the world. The coal is a low-moisture coal almost as hard as anthracite and is sold on Government contracts under a guaranty of 12,500 British thermal units on "dry coal." It is used on eight railroads in this region. Cannel coal yields oil and gas on distillation, and the amount of coal already in sight in this district warrants its investigation by those interested in chemical industries. The large amount of clay that has to be removed in the mining operations is available for the manufacture of clay products, such as vitrified ware, sewer pipe, draintile, and possibly paving brick. This paper describes the physical features of the region and discusses the coal in detail, with chemical analyses and geologic sections.

BULLETIN 691-J. Asphalt deposits and oil conditions in southwestern Arkansas, by H. D. Miser and A. H. Purdue. 1918. Pp. 271–292, Pl. XXXIII.

Describes seven asphalt deposits in Pike and Sevier counties, Ark., one of which is developed by a mine from which asphalt has been shipped in commercial

quantity. As the asphalt is doubtless a residue of crude petroleum, wells have been sunk in this region in the hope of finding oil, but no commercial pools have yet been discovered. The paper contains several detailed logs of deep wells in this region, with geologic interpretations.

BULLETIN 691–K. Coal south of Mancos, Montezuma County, Colo., by A. J. Collier. 1919. Pp. 293–310, Pls. XXXIV–XXXIX, figs. 42–43.

The coal found south of Mancos, Colo., is a relatively pure bituminous coal that is much esteemed as a fuel. Chemical analyses show that its heating value ranges from 10,270 to 14,650 British thermal units. The transportation facilities of the region are poor, but the coal is worked by two mines that supply the local demand. This paper describes the coal beds and gives numerous sections of them.

BULLETIN 691–L. Geology of the Lost Creek coal field, Morgan County, Utah, by F. R. Clark. 1918. Pp. 311–322, Pl. XL, fig. 44.

The Lost Creek coal field is on the main line of the Union Pacific Railroad, about 10 miles northeast of Devils Slide, Utah. Coal has been mined in a small way at several places in this field to supply ranchers, and the deposits were examined by the Survey to determine the possibility of a commercial field in this area and to obtain data for classifying the public land in it. The author of this report concludes that the coal can not be developed profitably except, as in the past, for local use.

BULLETIN 691–M. Structure and oil resources of the Simi Valley, southern California, by W. S. W. Kew. 1919. Pp. 323–355, i-viii, Pls. XLI–XLIV, fig. 45.

Within the last few years considerable activity has been manifested in the development of a small oil field in the Simi Valley, Calif., about 35 miles northwest of Los Angeles and 2½ miles north of Santa Susana, a town on the Coast Line of the Southern Pacific Co. A number of successful wells have been drilled in this field, but comparatively little information has been published on its geology. This paper gives the results of a geologic survey of the field made in 1917 to determine its future possibilities and discover other localities where the structure is favorable for the occurrence of oil. The author makes recommendations as to sites for future test drilling.

This pamphlet contains an index, title-page, table of contents, and introduction for the use of those who may wish to bind the separate chapters of Bulletin 691.

BULLETIN 692–A. The Alaskan mining industry in 1917, by G. C. Martin. 1919. Pp. 1–42, i-xiv.

The first chapter of the fourteenth annual bulletin on the progress of investigations of the mineral resources of Alaska. Contains a preface, an administrative report, a sketch of the Alaskan mining industry in 1917, and a list of recent Survey publications on Alaska. The mineral production of Alaska in 1917 was valued at $40,700,000 and had been exceeded only in 1916, when it was valued at $48,600,000. The decrease was mainly in copper and gold.

BULLETIN 692–C. Mining in Chistochina basin, Prince William Sound region, and Kenai Peninsula, Alaska, papers by Theodore Chapin and B. L. Johnson. 1919. Pp. 137–176, Pl. III, figs. 1–2.

A chapter of the annual progress report on investigations of the mineral resources of Alaska. Contains four papers on the areas indicated in the title.

BULLETIN 693. The evaporation and concentration of waters associated with petroleum and natural gas, by R. V. A. Mills and R. C. Wells. 1919. 104 pages, 4 plates, 5 text figures.

The association of saline waters with petroleum and natural gas has been widely observed, but the origin or mode of formation of these waters has been a perplexing problem. The investigation whose results are presented in this bulletin seems to show that the relatively simple concepts that have prevailed

must give way to the conclusion that the brines are the result of a complex and long-continued evolution in which deep-seated waters from many sources have undergone evaporation and concentration accompanied by noteworthy chemical changes. The field investigations were made during three summers in the Appalachian oil and gas region, but the conclusions are of wide application. Many of the principles set forth by the authors are capable of practical use, and the bulletin is of economic value to oil and gas operators, as well as of scientific interest. It contains numerous chemical analyses, geologic sections, and views of specimens collected from wells. The need of further investigations of this sort is emphasized.

WATER-SUPPLY PAPER 409. Surface water supply of the United States, 1915, Part IX, Colorado River basin; N. C. Grover, chief hydraulic engineer; Robert Follansbee, E. A. Porter, and C. C. Jacob, district engineers. 1918. 236+xxxiv pages, 2 plates.

WATER-SUPPLY PAPER 410. Surface water supply of the United States, 1915, Part X, The Great Basin; N. C. Grover, chief hydraulic engineer; E. A. Porter, H. D. McGlashan, F. F. Henshaw, and G. C. Baldwin, district engineers. 1918. 255+xl pages, 2 plates.

WATER-SUPPLY PAPER 411. Surface water supply of the United States, 1915, Part XI, Pacific slope basins in California; N. C. Grover, chief hydraulic engineer; H. D. McGlashan and F. F. Henshaw, district engineers. 1918. 345+xxxvi pages, 8 plates.

WATER-SUPPLY PAPER 412. Surface water supply of the United States, 1915, Part XII, A, Pacific slope basins in Washington and upper Columbia River basin; N. C. Grover, chief hydraulic engineer; G. L. Parker and W. A. Lamb, district engineers. 1918. 258+xlix pages, 2 plates.

WATER-SUPPLY PAPER 413. Surface water supply of the United States, 1915, Part XII, North Pacific drainage basins, B, Snake River basin; N. C. Grover, chie hydraulic engineer; G. C. Baldwin and F. F. Henshaw, district engineersf 1918. 215+xlix pages, 2 plates.

WATER-SUPPLYP PAPER 414. Surface water supply of the United States, 1915, Part. XII, North Pacific drainage basins, C, Lower Columbia River and Pacific drainage basins in Oregon; N. C. Grover, chief hydraulic engineer; F. F. Henshaw and G. L. Parker, district engineers. 1918. 182+xlix pages, 2 plates.

These papers present in condensed form the results of measurements of stream flow in the basins named in the titles during the calendar year 1915. Data for gaging stations are given under the following heads: Location, Drainage area, Records available, Gage, Discharge measurements, Channel and control, Extremes of discharge, Winter flow, Diversions, Regulation, Accuracy, and Cooperation. The books contain tables giving gage heights and daily and monthly discharges at each station and halftone plates showing typical gaging stations, current meters, and automatic water-stage recorders. Water-Supply Paper 411 contains also views showing measuring apparatus of various types on streams in California. At the end of each book is a list of gaging stations maintained now or in the past in the drainage basins covered and an annotated list of publications by the United States Geological Survey relating specifically to the region, as well as a similar list of reports that are of general interest in connection with hydrology and brief references to reports published by State and other organizations.

WATER-SUPPLY PAPER 422. Ground water in the Animas, Playas, Hachita, and San Luis basins, N. Mex., by A. T. Schwennesen, with analyses of water and soil, by R. F. Hare. 1918. 152 pages, 9 plates, 17 text figures.

The great irrigation works for the storage and distribution of surface water undertaken by the United States Reclamation Service in the arid Southwest—projects that involve the expenditure of millions of dollars, require years for their

execution, and could hardly have been financed by private capital—appeal to the imagination by their very magnitude and have made possible thousands of new homes in a region that was formerly an almost barren desert. But even after developments of this kind have been carried to their utmost limit there will still remain immense areas of unreclaimed arable land. Parts of these remaining areas can be made productive by other means, one of the most promising of which is irrigation with water pumped from wells. Even the most forbidding desert wastes may be underlain by water-bearing deposits, and where the quantity and quality of the water are suitable and the depth to the water table not too great, these supplies may be utilized. The development of such supplies is largely a matter of individual enterprise. Each landowner may own his irrigation system, and the units may be as small as is desired. This feature makes it possible to reclaim with ground water many small, isolated areas in which irrigation with surface water is not practicable. Ground water is being successfully used in this way in the vicinity of Deming, N. Mex., and this paper describes an area of about 3,600 square miles in Grant County, west of Deming, where in several areas the ground water lies at shallow depths. The field work on which the report is based was done in cooperation between the Geological Survey and the New Mexico Agricultural Experiment Station. The report gives definite information in regard to the quantity and quality of the ground water, its depth beneath the surface, and its economic availability for irrigation. The illustrations include maps and diagrams, together with views showing typical features of the area.

WATER-SUPPLY PAPER 425–D. Ground water in Reese River basin and adjacent parts of Humboldt River basin, Nev., by G. A. Waring. 1918. Pp. 95–129, Pls. VII-XII, fig. 4.

Nevada contains a large number of nearly parallel mountain ranges, and the intervening valleys are deeply underlain by gravel, sand, and clay brought down by flood water from the mountain slopes. This unconsolidated valley fill serves as a great reservoir in which much of the water that falls as rain or snow becomes stored, and in some of the valleys this water can be pumped to the surface for use in irrigation. At some places, however, the ground water is too alkaline or too scanty or it lies too deep to make its use successful. It is therefore important that a careful study of the ground-water conditions in any area be made before development is attempted. This report sets forth the results of such a study in a belt about 150 miles long and 12 to 30 miles wide in the central part of the State. It discusses the geology of the belt, with especial reference to the water-bearing formation, gives data on both surface and ground water, and offers practical suggestions for development.

WATER-SUPPLY PAPER 425–E. Ground water in Quincy Valley, Wash., by A. T. Schwennesen and O. E. Meinzer. 1918. Pp. 131–161, i–iv, Pls. XIII–XIV, figs. 5–7.

Reports the results of an investigation made at the request of residents of Quincy Valley, an area of about 600 square miles in Grant County, Wash., to determine whether the area contains an adequate supply of ground water that could be used in irrigation. Discusses the topography and geology of the area and gives data on climate, soil, depth to water, water-bearing formations, quality of water, pumping plants, and irrigation. Concludes that irrigation projects planned to serve more than 15,000 acres are not justified by the facts now available.

This pamphlet contains an index, title-page, and table of contents for the use of those who may wish to bind the separate chapters of Water-Supply Paper 425.

WATER-SUPPLY PAPER 427. Bibliography and index of the publications of the United States Geological Survey relating to ground water, by O. E. Meinzer. 1918. 171 pages, 1 plate.

An annotated list including all publications prepared wholly or in part by the Geological Survey that treat any phase of the subject of ground water or any subject directly connected with ground water. The list comprises 454 volumes, all but 12 of which were published by the Geological Survey. The book contains a full subject index to these publications and a map of the United States showing areas covered by them.

WATER-SUPPLY PAPER 428. Artesian waters in the vicinity of the Black Hills, S. Dak., by N. H. Darton. 1918. 64 pages, 13 plates, 11 text figures.

The foothills and plains adjoining the Black Hills in western South Dakota are semiarid, and their development has been retarded by the scarcity of water. Surface waters are meager and at most places are considerably mineralized. Springs are rare, and as much of the area is underlain by clay or shale the water from most shallow wells is scanty and poor. Fortunately the area is underlain at greater depth by sandstones that receive water at their outcrops in the Black Hills and will yield it when tapped by wells. To make the best use of these water-bearing beds a knowledge of the general geology of the region is necessary. This report gives a description of the geology, with cross sections, a map, and halftone views, and sets forth in detail the conditions bearing on the occurrence and recovery of underground water. The few deep wells that have been put down in this area have been so satisfactory that they offer great encouragement for further drilling.

WATER-SUPPLY PAPER 432. Surface water supply of the United States, 1916, Part II, South Atlantic and eastern Gulf of Mexico basins; N. C. Grover, chief hydraulic engineer; G. C. Stevens and W. E. Hall, district engineers. 1918. 58+xxvi pages, 2 plates.

WATER-SUPPLY PAPER 433. Surface water supply of the United States, 1916, Part III, Ohio River basin; N. C. Grover, chief hydraulic engineer; A. H. Horton and W. E. Hall, district engineers. 1918. 205+xxxii pages, 2 plates.

WATER-SUPPLY PAPER 435. Surface water supply of the United States, 1916, Part V, Hudson Bay and upper Mississippi River basins; N. C. Grover, chief hydraulic engineer; W. G. Hoyt and A. H. Horton, district engineers. 1918. 207+xxix pages, 2 plates.

WATER-SUPPLY PAPER 441. Surface water supply of the United States, 1916, Part XI, Pacific slope basins in California; N. C. Grover, chief hydraulic engineer; H. D. McGlashan and F. F. Henshaw, district engineers. 1918. 330+xxxvi pages, 2 plates.

WATER-SUPPLY PAPER 465. Surface water supply of Hawaii, July 1, 1916, to June 30, 1917; N. C. Grover, chief hydraulic engineer; G. K. Larrison, district engineer. 1918. 191 pages.

Similar in scope to Water-Supply Papers 409 to 414, noticed on page 35.

MINERAL RESOURCES OF THE UNITED STATES, 1916. Eight advance chapters.

MINERAL RESOURCES OF THE UNITED STATES, 1917. Fifty advance chapters.

MINERAL RESOURCES OF THE UNITED STATES, 1918. Three advance chapters.

GEOLOGIC FOLIO 208. Colchester-Macomb, Ill., by Henry Hinds. 1919. 14 folio pages of text, 4 maps, 14 text figures.

The Colchester and Macomb quadrangles cover about 455 square miles in McDonough and adjoining counties, western Illinois. They form a part of the Glaciated Plains province, whose surface consists largely of unconsolidated glacial drift left by the great ice sheets that invaded the region in Pleistocene time. The drift deposits cover by far the greater part of these quadrangles to a depth of 50 feet or more, but older, consolidated rocks crop out in many of the valleys, and still older formations have been reached by the drill. The principal mineral

resources of the quadrangles are clay, shale, and coal. The annual output of clay products is now valued at more than half a million dollars, and the area contains deposits of material that would be suitable for other clay products which are not now manufactured. Coal mining was formerly the chief industry of the area, and 50 years ago the annual shipments from Colchester alone amounted to 500,000 short tons. The coal compares favorably in quality with that of other fields in Illinois and adjacent States. The production is now comparatively insignificant. The soils of this area are exceptionally fertile, and most of the inhabitants are engaged in farming. Several railroads traverse the region, and no part of it is more than 15 miles from a shipping point. This folio gives an outline of the geography and geology of the Glaciated Plains province and describes the two quadrangles in detail. It is illustrated with halftone views and geologic sections and contains topographic and geologic maps.

TOPOGRAPHIC AND OTHER MAPS as follows:

Alabama.

Camp McClellan. Scale, 1 inch=2 miles; contour interval, 50 feet.

Map of the Anniston quadrangle showing by red overprint the location of Camp McClellan. A text prepared by F. E. Matthes, printed on the back of the map, gives an account of the more conspicuous natural features of the region.

Alaska.

Juneau and vicinity. Scale, 1 inch=$\frac{3}{8}$ mile; contour interval, 50 feet.

Map, in great detail, showing Juneau, the capital of Alaska, on Gastineau Channel, and the neighboring mountains, in which have been found valuable deposits of gold that have made the region famous throughout the world. The positions of all the mines are shown on the map, together with the surface developments, such as mills, ditches, power lines, and, by no means of least interest, the positions of several of the underground adits, some of which are more than a mile long. The hills rise steeply from sea level and carry numerous glaciers near their summits.

Arizona.

Chiricahua. Scale 1 inch;=1 mile; contour interval, 50 feet.

Map of part of the north-south Chiricahua and Peloncillo mountain ranges, which are separated by a lowland, San Simon Valley, in which the streams wither away without forming a main stream. This lowland affords a good route which has been utilized by the El Paso & Southwestern Railroad, and the Borderland Highway. (Partly in New Mexico.)

Perilla. Scale 1 inch=2 miles; contour interval, 100 feet.

Map of a strip of country about 12 miles north of the Mexican boundary, characterized by more or less isolated mountain groups separated by wide lowlands in which are some irregularly distributed low hills that look as if they were partly submerged in outwash from the mountains in a region so arid that practically none of the streams are perennial. (Partly in New Mexico.)

Ray and vicinity. Scale, 1 inch=$\frac{1}{2}$ mile; contour interval, 25 feet. (Resurvey.)

Map, on a very large scale, of the celebrated copper camp of Ray, which is in the south-central part of the State. The map shows a great number of mine shafts and prospects and the many settlements that have sprung up in connection with the mining industry.

Arkansas.

Camp Pike. Scale, 1 inch=2 miles; contour interval, 50 feet.

Map of the Little Rock quadrangle showing by red overprint the location of Camp Pike and Fort Logan H. Roots. A text prepared by L. W. Stephenson and H. D. Miser, printed on the back of the map, gives an account of the more conspicuous natural features of the region.

California.

Berenda. Scale, 1 inch=½ mile; contour interval, 5 feet.

Large-scale map of part of the Great Valley of California southeast of Merced and east of San Joaquin River. The straight course of the Southern Pacific Railroad indicates the slight amount of relief.

Bliss Ranch. Scale, 1 inch=½ mile; contour interval, 5 feet.

Large-scale map of part of the nearly flat plain east of San Joaquin River, in which there are no through-flowing perennial streams, no villages, few roads, and only 16 houses.

Bradley. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of part of the hilly region traversed by Salinas River and its tributaries Nacimiento and San Antonio rivers. The highest points are about 1,500 feet above the main stream, whose surface is about 500 feet above the sea.

Bryson. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of the hilly country rising to a maximum elevation of 3,025 feet, parallel to the general trend of which flow Nacimiento and San Antonio rivers—the former in a narrow valley whose floor the stream nearly completely fills, the latter in a valley whose floor is many times the width of the stream.

Chowchilla. Scale, 1 inch=½ mile; contour interval, 5 feet.

Map, on large scale, of part of the nearly flat southwestward-sloping plain of the Great Valley of California, on which a boom town, laid out extensively and with mathematical precision far in advance of settlement, was the starting point of an unsuccessful railroad project.

Collinsville. Scale, 1 inch=½ mile; contour interval, 5 and 10 feet.

Map, on large scale, of junction of Sacramento and San Joaquin rivers and the dissected upland to the north known as the Montezuma Hills. Both rivers have built natural levees along their courses so that the flood plain is higher near them than it is farther away. Much of Sherman Island, which lies between the two rivers, is therefore below sea level, some of it as much as 8 feet.

Denverton. Scale, 1 inch=½ mile; contour interval, 5 and 10 feet.

Map of a small part of Suisun Bay, the marshy flats adjacent to it, through which meander tortuous sloughs, and several groups of rugged hills, like the Potrero and Kirby hills, which rise as islands above the swampy lowland.

Fairview. Scale, 1 inch=½ mile; contour interval, 5 feet. (Part of quadrangle.)

Map of an area of strongly marked, narrow north-south ridges, probably due to the structure of the rocks, separated by narrow lowlands, together forming the western boundary of the gently sloping plain of the Great Valley of California. There are no perennial streams in the area.

Goodsprings. See Nevada.

Haystack Mountain. Scale, 1 inch=½ mile; contour interval, 5 feet.

Map, on large scale, of dissected hilly country, from 300 to 1,000 feet high, east of the Great Valley of California. Numerous knobs, like Haystack Mountain, rise abruptly several hundred feet above the more level lower country in a region practically devoid of perennial streams.

Honker Bay. Scale, 1 inch=½ mile; contour interval, 5 and 10 feet.

Map of part of Suisun Bay and the mouth of Sacramento River. To the north of the bay are extensive salt-water marshes, some of which have been inclosed by artificial levees; to the south of the bay are narrow marshes above which rise the outwash slopes and foothills of the Diablo Range.

Ingomar. Scale, 1 inch=½ mile; contour interval, 5 feet.

Map of part of the broad flood plain of San Joaquin River, much of which is occupied by temporary lakes. Throughout the area are numerous irrigation ditches, some of which are parts of large systems that bring water from considerable distances, but most of which distribute water to areas here under cultivation.

Le Grand. Scale, 1 inch=½ mile; contour interval, 5 feet.

Map of part of the considerably dissected westward-sloping plain of the Great Valley of California near its junction with the hills. No perennial streams occur in the area, but several well-opened valleys, such as that of Chowchilla River, show the course followed by the run-off of torrential rains.

Lingard. Scale, 1 inch=½ mile; contour interval, 5 feet.

Map of part of the practically undiversified westward-sloping plain of the Great Valley of California south of Merced. All the streams in the area are intermittent.

Little Table Mountain. Scale, 1 inch=½ mile; contour interval, 5 feet. (Part of quadrangle.)

Large-scale map of area a short distance east of the Great Valley of California, cut up into innumerable small knolls and a few higher knobs, such as Little Table Mountain, which rises abruptly 500 feet above the adjacent country.

Mount Whitney. Scale, 1 inch=2 miles; contour interval, 100 feet.

Map of a part of the Sierra Nevada, showing its glaciated aspect, troughlike valleys, abundant lakes, steep slopes, and sharp peaks, the highest of which, Mount Whitney, rises to 14,501 feet; also its abrupt descent toward the east to the gently sloping, nearly flat Owens Valley, which is bounded on the east by the rugged Inyo Mountains, which rise to elevations of over 10,000 feet.

New Almaden. Scale, 1 inch=1 mile; contour interval, 25 feet.

Map of part of the Santa Cruz Mountains, whose peaks rise to elevations of 3,000 feet and whose rocks contain some of the richest quicksilver deposits in this country. The crookedness of many of the roads that lead up the mountain slopes indicates the steepness of the ridges, whose crests, however, are followed for considerable distances by the secondary roads and trails.

Orestimba Creek. Scale, 1 inch=½ mile; contour interval, 5 feet. (Part of quadrangle.)

Map of a much cut-up hilly region forming part of the western boundary of the Great Valley of California. A fairly large valley trends eastward across the mapped area, but neither the stream in it nor the streams in any of the other valleys shown are perennial.

Owens Creek. Scale, 1 inch=½ mile; contour interval, 5 feet. (Part of quadrangle.)

Map of part of the hilly country east of Merced, showing its passage into the dissected plain which forms the eastern margin of the Great Valley of California. No perennial streams occur in the area, though well-marked valleys, spaced at intervals of 5 or 6 miles, trend southwestward from the hills.

Piedras Blancas. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of a small part of the coast region of California, whose shore line is irregular, with numerous rocky stacks lying just offshore. Back from the shore the country rises to a well-marked terrace at an elevation of about 500 feet, to the east of which rise hills whose summits are more than 2,500 feet above the sea.

Plainsberg. Scale, 1 inch=½ mile; contour interval, 5 feet.

Map of part of a nearly featureless plain that slopes in general westward at the rate of less than 4 feet to the mile toward San Joaquin River in the southern part of the Great Valley of California. The absence of obstruction to travel on this plain is indicated by the course of the Southern Pacific Railroad, which runs in a perfectly straight line diagonally across the area.

Point Reyes. Scale, 1 inch=1 mile; contour interval, 25 feet.

Map of part of the coast of California north of the entrance to San Francisco Bay. The area shows a great diversity of coast and mountain forms, which makes the map of the region almost indispensable to teachers. The contrast between the rugged shore of Point Reyes and the smooth, eroded shore fronting the Pacific north of that point, the drowned valleys north of Drake Bay, and the sand beaches

and nipped headlands affords graphic illustrations of some of the various products of marine action. Tomales Bay, a peculiar fiord whose position is probably determined by a line of earth movement, or fault, illustrates lesser erosion due to a smaller body of water.

Point Sur. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of part of the coast of California south of Monterey. The mountains of the Santa Lucia Range rise abruptly from the sea in rocky cliffs, and innumerable rocks and islets in the ocean fringe the shore, which is ragged and irregular, showing few beaches or bay-head fillings except in the immediate vicinity of Point Sur, which is apparently a land-tied island.

Powell Slough. Scale, 1 inch=½ mile; contour interval, 5 feet.

Map of the city of Colusa, on Sacramento River, and the practically flat and undiversified plain to the west. Except Sacramento River, there are no continuous streams in the region, but the four or five bodies of water forming Powell and Hopkins sloughs, which apparently occupy an old line of drainage, are noteworthy features.

San Benito. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of the mountainous country 35 to 50 miles east of Monterey, whose highest peaks rise to nearly 4,000 feet but whose topography does not show any decided trend due to marked differences in the characters of the underlying rocks. Throughout the area practically all the streams are intermittent.

San Luis Ranch. Scale, 1 inch=½ mile; contour interval, 5 feet.

Map, on large scale, of part of the Great Valley of California where it is traversed by San Joaquin River and its network of sloughs, in which are numerous artificial embankments, some carrying irrigation ditches.

San Miguel. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of a part of Salinas River and the dissected plateau region to the north and east of it, which rises to elevations of about 2,700 feet in the Cholame Hills and Middle Mountain. The map indicates that no perennial streams except the main river occur in the area.

Sandy Mush. Scale, 1 inch=½ mile; contour interval, 5 feet.

Large-scale map of an exceptionally flat part of the plain of the Great Valley of California, east of San Joaquin River, with well-marked natural levees indicated along the streams.

Snelling. Scale, 1 inch=½ mile; contour interval, 5 feet.

Map of part of Merced River that flows on a broad-floored valley, the topography of which indicates several abandoned courses of this stream, and the rolling hills north of the river. The broad floor of part of Dry Creek valley is a noteworthy feature of the area, as are also the three short stretches of this stream, which are the only parts that carry water throughout the year.

Spring Valley. Scale, 1 inch=½ mile; contour interval, 5 feet. (Part of quadrangle.)

Map of part of plain sloping gently northeastward from the hills west of Clear Lake. Notable features are the present eastward course of Cortina Creek, its old nearly northerly course, and a probably still older course toward the northeast, which is now marked only by its abandoned natural levees.

Suisun. Scale, 1 inch=½ mile; contour interval, 5 and 10 feet.

Map, on large scale, of the marshy area adjacent to Montezuma Creek and its numerous sloughs, a broad plain sloping gently southward, from the northern margin of which rise, like islands, Vaca Mountain and two isolated highlands, one rising above the marshy lowland and the other above the southern margin of the plain.

Turner Ranch. Scale, 1 inch=½ mile; contour interval, 5 feet.

Map of part of San Joaquin River and the nearly flat plain to the north through which it flows. The country for 3 or 4 miles south of the main channel of the river is a practically untraversable network of sloughs. Several good examples of interrupted streams may be seen in the area north of the river.

Colorado.

Rocky Mountain National Park. Scale, 1 inch=2 miles; contour interval, 100 feet.

Map of part of the Rocky Mountains, here forming the Continental Divide, the highest of whose peaks is Long Peak, 14,255 feet, though many others rise to elevations of more than 13,000 feet; the whole showing the topography usual in lofty mountains, such as glaciers, glaciated valleys, lakes, precipitous slopes, and great relative relief.

Delaware.

Cape Henlopen. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of Delaware Bay, the Atlantic Ocean, and the coastal region in the vicinity of Cape Henlopen, the highest point in the area being the sandy ridge, 70 feet high, on which Cape Henlopen light is built. The depth of water is indicated by blue contours for 5, 10, and 20 feet.

Cedar Creek. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of Delaware Bay and the gently sloping plain west of it, whose highest parts rise to elevations of only about 50 feet, and whose coastal part, except the narrow sandy strip along the bay, is a marsh.

Harrington. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of nearly level plain adjacent to the Delaware-Maryland boundary, most of which stands only about 60 feet above the sea but nearly all of which is flat, so that roads traverse it in all directions. (Partly in Maryland.)

Rehoboth. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the coast of Delaware, the conspicuous topographic features of which are the long sand reefs, which have cut off Rehoboth and Indian River bays from the ocean, except at very narrow inlet. The country back from the coast is a low plain, and the lower parts of the courses of the rivers appear to have been submerged.

Florida.

Boulogne. See Georgia.

Cambon. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the Atlantic Coastal Plain in Florida, with numerous swamps and practically no definite streams, showing in the eastern part a plain whose upland stands at an elevation of about 20 feet, which is separated by a fairly distinct low escarpment from a higher plain, whose upland rises in places to an elevation of 100 feet.

Fernandina. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the coast of Florida and Georgia, showing sandy reefs, inland from which are salt-water marshes traversed by a network of sloughs and rivers, the largest of which, St. Marys River, has been made accessible to vessels drawing as much as 20 feet of water, by jetties 2 and 3 miles long built out into the ocean.

Folkston. See Georgia.

Hilliard. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of the low swampy plain in the extreme northern part of Florida, none of which is as much as 100 feet above the sea and all of the eastern part of which is below 50 feet. In the region there are almost no surface streams, but swamps occupy every swale and are abundant even on the uplands.

Jacksonville. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of Jacksonville, which has been built on the plain adjacent to St. Johns River and is the center from which many railroads radiate. The country around the city is a low plain, in few places as much as 50 feet above the sea. A noteworthy exception is a small area between Cedar Creek and Turner Ponds, where there are knobs that rise to heights above 100 feet.

Kingsland. See Georgia.

Mayport. Scale, 1 inch=1 mile; contour interval, 5 feet.

Map of part of the coast in northern Florida, at the mouth of St. Johns River, with projecting jetties, seaside settlements that dot the coast, and the swamp and low plains traversed by an intricate network of sloughs and channels.

Middleburg. Scale, 1 inch=1 mile; contour interval, 10 feet. (Photolithograph.)

Map of part of the Coastal Plain in northern Florida, which throughout much of its area is about 80 feet high but whose highest points stand at elevations of about 150 feet. In the northern part of the area mapped swamps are numerous, but in the southern and southwestern parts the uplands are well drained.

Moniac. See Georgia.

Orange Park. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of estuary-like part of St. Johns River and the swampy plain through which it flows, none of which is as much as 80 feet in elevation and most of which is under 25 feet. The depths in the ocean are shown by contours for 5, 10, and 20 feet below mean low water.

Palm Valley. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the coast of Florida, with nearly straight shore, well-marked beach ridge, marshy plain, and a few uplands that are as much as 60 feet above the sea. The courses of Guano River, parallel to the shore and not more than half a mile distant, and of North River, about 1½ miles from the shore, are noteworthy.

St. Marys. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of Nassau and St. Marys rivers and the low plain between them. The rivers flow in broad, swampy lowlands, in which they straggle in irregular bends and curves and above which the highest part of the flats, forming most of the uplands, rises only 20 to 30 feet. (Partly in Georgia.)

Georgia.

Boulogne. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the low plain traversed by Satilla and St. Marys rivers, mostly swamp with intervening higher areas, the highest uplands apparently forming a dissected plain that stands at an elevation of 70 to 100 feet and a lower plain at 20 to 30 feet. (Partly in Florida.)

Camp Gordon. Scale, 1 inch=2 miles; contour interval, 5 feet.

Map formed by combining on one sheet the Atlanta map and part of the Marietta map. Shows the country around Camp Gordon. A text prepared by F. E. Matthes, printed on the back of the map, gives, in popular style, a description of the more conspicuous natural features of the region.

Cumberland Island. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of a part of the coast of Georgia, showing an offshore sandy reef, behind which are salt-water marshes, traversed by a network of channels and sloughs. Sand dunes dot the reef at irregular intervals. The depth of the water off the coast is indicated by under-water contours for 5, 10, and 20 feet.

Everett City. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the low plain, much of it swampy, through which Altamaha River flows in a broad-floored valley. The surface of the plain in the eastern part of the area stands at an elevation of less than 20 feet, but the upland in the western part is about 50 feet in elevation and is separated from the lower plain by an easily recognized escarpment.

Folkston. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of Okefenokee Swamp and its eastern boundary, Trail Ridge, whose crest, about half a mile wide, rises 20 to 30 feet above the swamp and whose eastern slope descends rather steeply until it joins a plain whose surface stands 50 to 60 feet below the crest of the ridge. (Partly in Florida.)

Gough. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the rolling dissected plateau near the western margin of the Coastal Plain province, whose upland surface stands at an elevation of somewhat less than 400 feet above the sea and whose streams are in rather narrow-floored valleys, few of which are utilized for roads.

Hinesville. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of swampy lowland 25 to 40 miles west of Savannah, through the northern part of which flows Canoochee River. Plains at two distinct elevations, 20 feet and 85 feet, separated by a well-marked escarpment, are clearly recognizable.

Hortense. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the swampy plain of southern Georgia, 15 to 25 miles west of the ocean. Satilla River flows through the southern part of the area, but elsewhere the plentiful rainfall is absorbed by the swamps and from them fed to the larger rivers without forming distinct surface streams.

Jesup. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of Altamaha River, the broad swamps through which it flows, and the dissected plain which lies southwest of it and which, through much of the area, is separated from the flood plain of the river by a steep cliff 50 to 75 feet high. Flat uplands stand at different elevations and in places are separated by moderately steep escarpments.

Kingsland. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the low swampy plain of Georgia a few miles west of the ocean, most of it less than 25 feet above the sea and a large part of it a marsh, practically at sea level, through which sloughs and the drowned lower courses of some of the rivers form an untraversable network. (Partly in Florida.)

Moniac. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of the eastern part of Okefenokee Swamp and its eastern boundary, Trail Ridge, whose crest rises 20 to 40 feet above the swamp and descends rather steeply eastward to a lower plain. The continuation of these features to the north is shown in the Folkston quadrangle. St. Marys River, which marks the boundary between Georgia and Florida, traverses the lower plain in a rather wide-floored trench. (Partly in Florida.)

Nahunta. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the plain of eastern Georgia traversed by Satilla River, which flows in a winding course through a broad, swampy lowland that is practically untraversable by roads. East and west of the lowland rather steep slopes lead to the upland, whose nearly flat surface stands about 50 feet above the level of the river.

Pineland. See South Carolina.

St. Marys. See Florida.

Shirley. See South Carolina.

Idaho.

Paradise Valley. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of part of the Blackfoot Mountains, southwest of which is Paradise Valley, a level lowland about 2 miles wide, which stands 600 feet above the main stream, Blackfoot River, one of whose tributaries, Brush Creek, has eroded a deep canyon and thus appears to have diverted the drainage of the valley. Numerous terraces occur along Blackfoot River.

Preston. Scale, 1 inch=2 miles; contour interval, 10 feet.

Map of part of the Bear River and Wasatch ranges, whose highest peaks rise to elevations of more than 9,000 feet and whose dissected western foothills fall away westward to Cache Valley. In its northern part Bear River, the main stream of the area, flows in a well-opened valley, but farther south it traverses the foothills in the canyon, the narrowest part of which is called Oneida Canyon, from which it flows through the open lowland of Cache Valley in a fairly broad-floored trench. (Partly in Utah.)

Illinois.

Altenburg. Scale, 1 inch=1 mile; contour interval, 20 feet. (Part of quadrangle.)

Map of part of Mississippi River, its flood plain to the north, and the rocky point, Fountain Bluff, against which the river impinges.

Campbell Hill. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of a part of Mississippi River and its flood plain, whose surface is marked by former channels of the river, now filled with silt, and of rather thoroughly dissected uplands whose tops stand about 700 feet above sea level or 350 feet above the river. (Partly in Missouri.)

Camp Grant. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map formed by combining maps of parts of the Kings, Kirkland, Rockford, and Belvidere quadrangles to show the region around Camp Grant. A text written in popular style, printed on the back of the map, gives an account of the origin and appearance of the more conspicuous natural features.

Dixon. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of dissected plains of central Illinois west of Chicago, traversed by Rock River, which has cut the floor of its valley about 100 feet below the summit of the adjacent upland and has formed, in parts of its course, flood plains that are half a mile wide. In the stream are many islands, so that in places it has a distinctly "braided" appearance. Abandoned courses of the river are distinctly seen southwest and northwest of Grand Detour.

Good Hope. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of the eastward-sloping dissected plains or low plateaus of west-central Illinois. In places the plain has been cut rather deeply by streams, such as Crooked Creek and its tributaries and Swan Creek and its tributaries.

La Harpe. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of the plain of west-central Illinois, which is dissected by numerous westward-flowing streams, between which is the nearly flat plain of the uplands. The map furnishes an especially good example of the youthful stage in the dissection of a nearly featureless plain.

Morris. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of Illinois River and the nearly smooth plain through which it flows in east-central Illinois. The greatest relief, which is about 180 feet, is between Illinois River 4 miles west of Morris and a point north of Lisbon, in the extreme northwestern part of the area.

Vermont. Scale, 1 inch=1 mile; contour interval, 20 feet. (Part of quadrangle.)

Map of a strip of country, about 3 miles wide east and west and 15 miles long north and south, in the west-central part of Illinois, which is mostly a plain, slightly cut in the southern part by a small stream, Sugar Creek, and its tributaries.

Vienna. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of the extreme southern part of Illinois, which is a dissected plateau with irregularly arranged valleys, the most notable of which is the lowland, 2 or 3 miles wide, that is followed in part by Cache River and the New Columbia, Bear Creek, and San Beck ditches—a lowland which marks the abandoned course of a large river.

Wilmington. Scale, 1 inch=1 mile; contour interval, 20 feet. (Resurvey.)

Map of part of the plain southwest of Chicago, which is traversed by Kankakee and Des Plaines rivers. The maximum relative relief is less than 200 feet, and much of the area is less than half this height above the main streams.

Indiana.

Winchester. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of the little-dissected plain of west-central Ohio and east-central Indiana, the relief of whose surface is so slight that settlements, railroads, and roads are located with no hindrance from the topographic features. (Partly in Ohio.)

Iowa.

Camp Dodge. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map formed by printing on one sheet parts of the maps of the Madrid, Slater, Waukee, and Des Moines quadrangles to show the region around Camp Dodge. A text prepared by J. H. Lees and W. C. Alden, printed on the back of the map, gives an account of the origin and appearance of the more conspicuous natural features of the region.

Chariton. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of the dissected plateau or plain of south-central Iowa, whose former flat upland surface has been largely destroyed by numerous streams, which have cut rather steep-sided, narrow-floored valleys, though the largest stream, White Breast Creek, flows in irregular small bends on a floor that is much wider than the belt of country between the bends.

Kansas.

Columbus. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the plains in the extreme southeast corner of Kansas, not far from the well-known lead and zinc districts of Missouri and Oklahoma. Several isolated knobs, such as Blue Mound, rise to elevations between 950 and 1,000 feet and suggest that they are remnants of a once much more extensive surface which stood at that elevation.

Kentucky.

Camp Taylor. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map formed by combining and printing on one sheet maps of the Prospect, Kosmosdale, and Louisville quadrangles to show the region around Camp Taylor. A text prepared by Charles Butts, printed on the back of the map, gives an account of the origin and appearance of the more conspicuous natural features of the region.

Harlan. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of part of a much-dissected northwestward-sloping plateau formed of southeastward-dipping rocks. Pine Mountain, trending eastward, traverses the central part of the area and is an unsymmetrical ridge, bounded on the north by a fault that together with a belt of soluble rocks has determined the position of the lowland occupied by Straight Creek, the head of Beach Fork, and the headwater branches of Laurel Fork.

Hyden. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of part of the dissected plateau of southeastern Kentucky, which is characterized by highlands that rise to approximately the same elevation and in which there is very little flat land, either along the streams or on the tops of the ridges. By a misapplication of names the largest branch of the Middle Fork of Kentucky River above the forks is called Greasy Creek, whereas a much smaller branch carries the name "Middle Fork."

Williamson. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of the dissected plateau in the eastern part of Kentucky, where the largest stream is Tug Fork, which forms the boundary between Kentucky and West Virginia. The roads and trails follow the streams or pass from one valley to another through gaps at the heads of stream basins that lie on opposite sides of the ridges. (Partly in West Virginia.)

Maine.

Cutler. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map showing part of the coast of Maine and a few islands, such as Machias Seal Island and North Rock, that lie 10 miles offshore. The depth of water up to and including 20 feet is indicated by contours drawn 5, 10, and 20 feet below sea level. The coast line is irregular but not deeply fiorded, and the country back from the coast is hilly and includes a poorly drained swampy area, the whole owing much of its appearance to glaciation.

Machias. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of the coast of Maine. The outline of the shore is irregular, as it is cut by numerous bays. A great number of islands lie offshore, and irregularly distributed knobby hills and low tracts form the inland region.

Maryland.

Harrington. See Delaware.

Massachusetts.

Camp Devens. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map formed by combining parts of maps of the Groton, Fitchburg, Lowell, Worcester, Marlboro, and Framingham quadrangles to show the region adjacent to Camp Devens. A text prepared by W. W. Atwood, printed on the back of the map, gives an account of the origin and appearance of the more conspicuous natural features of the region.

Michigan.

Bay City. Scale, 1 inch=1 mile; contour interval, 5 feet.

Map of part of Saginaw Bay and the country southwest of it, a plain only 15 to 20 feet above the lake, which is traversed by Saginaw River, on both sides of which Bay City has been built. Parallel to the shore are several linear ridges whose form and position suggest that they are old beach ridges and moraines. The highest and most continuous of these ridges is followed for a long distance by the Ausable State road.

Camp Custer. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map formed by combining parts of the maps of the Galesburg and Battle Creek quadrangles to show the region adjacent to Camp Custer. A text prepared by Frank Leverett, printed on the back of the map, gives an account of the origin and appearance of the more conspicuous natural features of the region.

Cedar Springs. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of the glaciated plains north of Grand Rapids, in the southern part of which Grand River flows on a valley floor that appears too wide for the present stream. The upland is dotted with small knobs and depressions that mark deposits or sculpturing produced by the glaciers that once occupied the region.

Elsie. Scale, 1 inch=1 mile; contour interval 5 feet.

Map of part of the plain of central Michigan which was overridden by the ice of the continental glacier that covered the northern part of the United States in the distant past and left evidence of its occupation in the form of the hills and valleys and the material that covers them and in the courses of the streams.

Ionia. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of the nearly flat plain of south-central Michigan, traversed by Grand River, which flows in a sinuous course on the flat floor of a trench, three-quarters of a mile wide, sunk 100 to 150 feet below the surface of the upland. The great width of the valley indicates that it was once occupied by a much larger stream.

Kalamazoo. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of the plains country of southern Michigan, whose surface is much diversified by small knobs and depressions formed by the irregular deposition of material through the action of great glaciers that once occupied the region.

Lowell. Scale, 1 inch=1 mile; contour interval, 20 feet..

Map of part of the glaciated plain of west-central Michigan, which is traversed by Grand River and its tributaries. Grand River flows on the floor of a trench cut below the general level of the uplands. The floor of the trench is nearly flat and about half a mile wide, and the course of the trench is much less sinuous and irregular than the course of the river.

Mount Pleasant. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of the typical portion of the central part of the Lower Peninsula of Michigan, which is characterized by irregularly distributed knobs, ridges, and depressions that owe their present aspect largely to the continental glacier that covered the region in the past.

Perrinton. Scale, 1 inch=1 mile; contour interval, 5 feet.

Map of part of the glaciated plain of central Michigan, whose topography shows numerous features, such as moraines and disorganized drainage, that are the results of the former occupation of the region by great glaciers. The abrupt change of the course of Hayworth Creek, whereby that stream abandons a well-marked valley that lies directly in line with its general course, indicates the complexity of the history of the events that produced the present features.

Saginaw. Scale, 1 inch=1 mile; contour interval, 5 feet.

Map of the plain at the head of Saginaw Bay on which the city of Saginaw has been built. Although this plain is somewhat cut by numerous small streams and Saginaw River, roads and railroads traverse it in all directions without encountering topographic obstructions.

Minnesota.

Beardsley. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of portion of Lake Traverse which is in a depression marking an old glacial drainage line through the adjacent glaciated plains, whose otherwise nearly flat surface is interrupted by numerous hollows, some of which contain lakes that differ from one another in size and shape. (Partly in South Dakota.)

Peever. See South Dakota.

Pillager. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of a region of innumerable lakes of divers shapes and sizes, interspersed with small isolated hills and here and there an area of somewhat higher country formed of a confused jumble of knobs and depressions. Some of the lakes are so large that such shore features as spits, land-tied islands, and cliffs have been formed around their margins. The aspect of the region is in large measure attributable to glaciation in the past.

Missouri.

Campbell Hill. See Illinois.

Halltown. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the dissected upland which forms the divide between the drainage basins of Missouri, Arkansas, and White rivers. In the eastern part of the region depressions, probably sink holes, are numerous on the upland.

Montana.

Heart Butte. Scale, 1 inch=1 mile; contour interval, 100 feet.

Map of part of the mountains that form the Continental Divide, which abruptly drop off toward the east, so that within 10 miles they merge into plains that slope gently northeastward. On the plain near the foot of the mountains are innumerable small lakes.

Porcupine Valley. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of dissected plateau north of Missouri River in northeastern Montana, whose general upland elevation is about 2,700 feet. Porcupine Creek and its tributaries have cut valleys 400 to 500 feet below the level of the upland. A noteworthy feature of the area is the valley of East Fork, which can be traced for at least 10 miles and is practically as deep and as large as the valley of the main stream, though no perennial stream flows in it.

Nevada.

Goodsprings. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of Spring Mountain and adjacent ridges, in several of which are valuable mineral deposits, which are now being mined. The mountains rise to elevations of 5,000 to 8,000 feet. Their higher parts are steep and rugged, but their lower slopes are gently inclined plains of outwash material. (Partly in California.)

Highland. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of the Highland Range and adjacent country in east-central Nevada. The mountains, whose highest peak has an elevation of nearly 9,400 feet, trend nearly north and south, and from their bases, starting at elevations of about 6,000 feet, plains slope east and west. The minuteness of the dissection of these plains near the mountains is noteworthy. The few intermittent streams in the area wither away on the sloping plains.

New Hampshire.

Alton. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of rolling country above the general level of which stand higher hills, such as the Blue Hill Range and Birch Ridge, and which is diversified by a number of lakes and swampy areas that probably mark filled-in lakes, the whole region having been subjected to glaciation.

New Jersey.

Camp Dix. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of the region adjacent to Camp Dix, which lies some 15 miles southeast of Trenton, N. J., on the Coastal Plain, which at the camp is about 120 to 175 feet above the sea, but whose relatively smooth surface is interrupted at several places outside the camp by higher knobs and tracts, such as the Stony Hills, which rise to elevations of more than 300 feet. (Partly in Pennsylvania.)

New Mexico.

Antelope Wells. Scale, 1 inch=1 mile; contour interval, 25 feet.

Map of part of an area immediately north of the Mexican border. In the easternmost part is the flat plain of Playas Valley, west of which are broken mountains and rolling dissected hills that trend in general northwest.

Big Hatchet Peak. Scale, 1 inch=1 mile; contour interval, 25 feet.

Map of the Big Hatchet Mountains, whose highest peak has an elevation of about 8,366 feet and whose rugged slopes give way at an elevation of about 4,700 feet to gentler ones, which on the southwest extend to Playas Valley and on the northeast abut on a plain of similar origin and form, sloping southwestward from the Sierra Rica.

Chiricahua. See Arizona.

Cienega Springs. Scale, 1 inch=1 mile; contour interval, 25 feet.

Map of a strip of country lying about 12 miles north of the Mexican boundary, the most prominent feature of which is Animas Valley, a lowland 8 to 10 miles wide from east to west, which lies between the Animas and San Luis mountains on the east and the Guadalupe and Peloncillo mountains on the west, a large part of these four ranges being shown on the map.

Dog Mountains. Scale, 1 inch=1 mile; contour interval, 25 feet.

Map of the Alamo Hueco Mountains and the near-by groups of isolated hills, like the Dog Mountains, which rise abruptly from the outward-sloping plains that encircle the highlands and have probably been formed in large part by outwash from the mountains.

Hachita. Scale, 1 inch=1 mile; contour interval, 25 feet.

Map of part of Hachita Valley, a broad, open north-south lowland formed of gently sloping outwash plains from the mountains to the east and west. The mountains to the west, the Little Hatchet Mountains, fall largely within the area mapped, but only isolated spurs of the mountains to the east, such as the Apache Hills and Sierra Rica, lie within the area.

Pelona. Scale, 1 inch=2 miles; contour interval, 100 feet.

Map of the mountains forming part of the Continental Divide in west-central New Mexico and the plains of San Agustin, an intermontane lowland whose surface is exceptionally flat and undissected, an area of more than 65 square miles having no relief sufficient to be shown on the map by a contour line.

Perilla. See Arizona.

Playas. Scale, 1 inch=1 mile; contour interval, 25 feet.

A splendid representation of a part of the desert country in which two mountain groups, trending north and south, whose crests are about 15 miles apart, are separated by a lowland formed by plains that slope eastward and westward from each group. The depression where these two gentle slopes meet is occupied during rainy seasons by Playas Lake, a body of water more than 12 miles long and in most places less than a mile wide.

Victorio. Scale, 1 inch=1 mile; contour interval, 25 feet.

Map of the rugged Cedar Mountain Range, in the southwestern part of New Mexico, the highest peaks of which stand over 6,000 feet above the sea and whose less steep lower slopes gradually merge into the sloping plain that, with a similar but northward-sloping plain from the mountain to the south and west, forms the lowland traversed by the El Paso & Southwestern Railroad.

Walnut Wells. Scale, 1 inch=1 mile; contour interval 25 feet. (Photolithograph.)

Map of part of the Animas Range and the plain that slopes eastward from its base, which forms the western part of Playas Valley, No perennial streams occur in the region. The map shows a splendid example of a dissected mountain range in a dry climate.

New York.

Camp Mills. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map formed by combining parts of the maps of the Oyster Bay and Hempstead quadrangles to show the region adjacent to Camp Mills. A text prepared by W. C. Alden, printed on the back of the map, gives an account of the origin and appearance of the more conspicuous natural features of the region.

Hornell. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of a rolling upland whose slopes have been in large measure smoothed by glaciation but whose most conspicuous physiographic feature is the disarranged drainage, whereby the broad lowland in part occupied by Canisteo River has been abandoned by a former stream and the extreme northern part of the area has been cut into by Canaseraga Creek, which drains northward, its continuation being shown on the map of the Wayland quadrangle.

Oswegatchie. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of the rolling hilly country west of the highest part of the Adirondack Mountains, which is studded with a number of lakes and whose streams, tributary to the St. Lawrence, flow in irregular courses, here through marshy tracts, there through narrow gorges, and still elsewhere in moderately opened-out valleys, these features all being due in large measure to the former glacial occupation of the region.

Unadilla. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of the highland region in south-central New York, through which flows Susquehanna River and its good-sized tributary from the north, Unadilla River. The smoothness of the uplands and the modification of the form of some of the valleys are due to glaciation.

Ohio.

Camp Sherman. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of the region adjacent to Camp Sherman, a description of whose geographic features, by M. R. Campbell, illustrated by pictures and diagrams, is printed on the reverse side.

College Corner. Scale, 1 inch=1 mile; contour interval, 20 feet. (Part of quadrangle.)

Map of part of the slightly dissected low plateau or plain of west-central Ohio, large areas of which are flat uplands that stand at an elevation of about 1,000 feet above sea level, or about 100 feet above the larger streams.

Felicity. Scale, 1 inch=1 mile; contour interval, 20 feet. (Part of quadrangle.)

Map of part of Ohio River, the narrow strip of flood plain and terrace that borders its course, and the dissected plain or plateau whose surface stands at an elevation of about 900 feet, in which the river has cut down its bed in a steep-sided trench.

Fort Recovery. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of a strip of country about 3 miles wide, immediately east of the Indiana boundary, in west-central Ohio. The area seems to show plains at several different elevations, the highest at about 1,120 feet and the lowest at about 900 feet. The relief, however, is nowhere great.

Kelleys Island. Scale, 1 inch=1 mile; contour interval, 10 feet.

The larger part of the map represents Lake Erie, in which Kelleys Island, a tract only 3 miles long from east to west and less than 3 miles wide from north to south, rises to a height of 40 feet. The island, like the adjacent mainland, is important commercially because of its lime industry.

Lawrenceburg. Scale, 1 inch=1 mile; contour interval, 20 feet. (Part of quadrangle.)

Map of a small strip of Hamilton County about 10 miles long north and south by 4 miles wide, 15 miles west of Cincinnati, in the extreme southwestern part part of Ohio. In this area is the junction of Miami and Ohio rivers, the Miami and its tributary, Whitewater River, flowing in broad-floored valleys, although the Ohio, the larger stream, flows in a valley that has a narrow floor.

Maysville. See Springdale.

New Paris. Scale, 1 inch=1 mile; contour interval, 20 feet. (Part of quadrangle.)

Map of a strip about 3½ miles wide, immediately adjacent to Indiana in west-central Ohio. The area is a plain or plateau somewhat dissected by East Fork, Whitewater River, and the other creeks tributary to streams flowing into Ohio River.

Peebles. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of a dissected plateau of south-central Ohio, which has been so thoroughly intersected by streams that only here and there is the upland flat-topped, but

instead it is generally rolling and the slopes from it to the streams are steep. The largest streams in the region are Ohio Brush Creek, which flows directly southward to the Ohio, and South Scioto Creek, which flows eastward to Scioto River.

Seaman. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of the dissected plain or plateau just north of Ohio River in the southwestern part of the State. In the southern part of the area the great amount of dissection has left but little of the original flat-topped upland, but farther north these flats become more continuous and larger.

Springdale and Maysville. Scale, 1 inch=1 mile; contour interval, 20 feet. (Parts of the quadrangles.)

Map of part of the dissected plateau in southern Ohio just north of Ohio River, which is bordered by a steep slope that rises from the narrow flood plain to a height of about 400 feet above the river. Some of the terraces, which stand 20 to 60 feet above the river, have been selected as sites for settlements. Manchester, the largest town in the area mapped, has been built on two of these terraces.

Vanceburg. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of Ohio River and of the dissected plateau to the north. The floor of the valley of the river is here and there opened out so as to form flats, a mile or less wide. From these flats steep slopes lead to the summit of the plateau, which, though much cut up by streams, includes small areas that are relatively flat.

Winchester. See Indiana.

Oregon.

Kerby. Scale, 1 inch=1 mile; contour interval, 100 feet.

Map of part of southwestern Oregon just north of the California boundary, showing a dissected mountain mass, some of whose crests rise to elevations of 5,000 feet. In its upper or southeastern part Illinois River, the main stream in the area, flows through a broad-floored valley, but farther north and west it flows in a canyon that is too narrow to afford space even for a trail.

Troutdale. Scale, 1 inch=1 mile; contour interval, 25 feet. (Part of quadrangle.)

Map of part of Columbia River at its junction with Sandy River, about 25 miles east of Portland, and the country to the south. Flat areas at different elevations indicate terraces formed at earlier stages in the topographic development of the region.

Pennsylvania.

Camp Dix. See New Jersey.

Newville. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of South Mountain, the Blue Ridge, and the broad rolling lowland between them, the whole presenting a diversified topography, which has been developed by erosion acting for different lengths of time and on rocks of diverse hardness.

South Carolina.

Allendale. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of a portion of the dissected plain whose upland surface stands about 250 feet above the sea and whose streams flow through marshy-floored valleys so swampy that few roads follow them, most of the roads running along the crest of the upland.

Bulls Island. Scale, 1 inch=$\frac{1}{2}$ mile; contour interval, 5 feet.

One of a group of maps (Bulls Island, Capers Island, James Island, Kiawah Island, Ladson, Legareville, Melgrove, Sewee Bay, and Wando) on a large scale (1: 21,120), which show some of the coastal country adjacent to Charleston. Little of the region is as much as 40 feet above the sea, and much of it is swampy land practically at sea level, sparsely inhabited except in the

immediate neighborhood of Charleston, which owes its position to the good harbor afforded by the drowned lower courses of Cooper, Wando, and Ashley rivers.

Capers Island. See Bulls Island.

Cottageville. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the Coastal Plain more than half of whose surface is a swamp. A good-sized stream, Edisto River, crosses the center of the quadrangle from north to south, but it receives practically no tributaries in this entire distance, though probably much water is fed into it by seepage from the bordering swamps.

Cummings. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of a part of the Atlantic Coastal Plain whose highest point is only 100 feet above the sea. Salkehatchie River, which with its tributaries flows through the central part of the area, is the main stream in a marshy wide-floored valley that is avoided by roads. Much of the area is poorly drained and swampy.

Edisto Island. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the smooth coast line, the entrance to South Edisto River, and the swampy lowland country adjacent to that stream. No point in the southern two-thirds of the area mapped is as much as 20 feet above the sea, and no place shown on the map reaches 50 feet.

Green Pond. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of an area in southeastern South Carolina near the coast. In the southern part of the area are Coosaw River and its innumerable sloughs, tributaries, and marshes. The region farther north is a marshy plain, in few places more than 30 feet high, through which Combahee, Chehaw, and Ashepoo rivers flow in meandering courses.

James Island. See Bulls Island.

Kiawah Island. See Bulls Island.

Ladson. See Bulls Island.

Legareville. See Bulls Island.

Melgrove. See Bulls Island.

Olar. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the plain whose rather slightly dissected upland rises to an elevation of about 160 feet above the sea and whose largest stream flows in a trench about 50 feet below the upland, the floor of which is much wider than the stream and is so swampy that no roads follow it.

Pineland. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of a part of the plain northeast of Savannah River, which contains numerous swamps, from some of which streams issue, and nearly flat upland areas, on which roads run and most of which rise not more than 100 feet above sea level. (Partly in Georgia.)

Sewee Bay. See Bulls Island.

Shirley. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of a portion of Savannah River which flows in irregular bends through a swampy valley floor about 2 miles wide that is bordered on the east by a low plain and on the west by rather steep bluffs, 50 feet or more high, which lead to an upland plain that stands at an elevation of 120 to 140 feet above the sea, or 90 to 100 feet above the river. (Partly in Georgia.)

Varnville. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of the dissected swampy plain of eastern South Carolina, the highest parts of which stand only 150 feet above the sea and the lower parts about 30 feet. The relative relief throughout most of the area is very much less than the difference between these two amounts. The larger streams flow in wide-floored valleys, which are so swampy that the roads cut across them by routes as short as possible.

Walterboro. Scale, 1 inch=1 mile; contour interval, 10 feet. (Photolithograph.)

Map of part of the dissected swampy plain of eastern South Carolina. In the eastern part of the area few of the summits of the upland are as much as 50 feet above sea level. In the western part, however, many of the summits stand at an elevation of 100 feet. Some of the swamps drain in two or more directions.

Wando. See Bulls Island.

Yemassee. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of plain in the southeastern part of South Carolina, consisting of almost equal areas of low, marshy swamps, through which the rivers flow, and better-drained areas that stand 50 to 100 feet above the swamps and are usually separated from them by abrupt though low slopes.

South Dakota.

Beardsley. See Minnesota.

Peever. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of Lake Traverse, Big Stone Lake, and the narrow lowland between them, which together form a depression, marking an old drainage line, in the adjacent glaciated plains, whose nearly flat surface is interrupted by numerous hollows of irregular shape and of varying sizes. The northeastward continuation of Lake Traverse is shown on the map of the Beardsley quadrangle. (Partly in Minnesota.)

Texas.

Addicks. Scale, 1 inch=½ mile; contour interval, 1 foot.

Map of part of the sloping plain between Houston and Brazos River, which is somewhat dissected and which, because of the small contour interval used, appears to be less smooth than it actually is, for the difference in elevation in the entire area mapped is only about 60 feet.

Bone Spring. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of part of the Rosillos and Santiago mountains and the desert basins that extend from their bases, whose main topographic features are determined by the kind and structure of the underlying rocks and their erosion and the deposition of the eroded material, but whose detailed features—for example, the drainage of Dagger Flat and Persimmon Gap—indicate a complex and interesting history.

Bullis Gap. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of part of the dissected plateau lying north of the Rio Grande, whose surface slopes eastward from an elevation of somewhat more than 3,000 feet in its western part to about 2,500 feet in its eastern part and the dissection of which has produced ridges, mesas, and buttes.

Cypress. Scale, 1 inch=½ mile; contour interval, 1 foot.

Map of plains in the vicinity of Houston, all of whose surface, except the extreme northwestern part, lies between 118 and 155 feet above the sea. Like other parts of this same general region, the area shows a great number of small, shallow depressions, some of which contain ponds.

Deepwater. Scale, 1 inch=½ mile; contour interval, 1 foot.

Map of a plain whose highest part is less than 50 feet above the sea and is trenched across and somewhat dissected by Buffalo Bayou and its tributaries. On the surface of the plain are numerous irregularly distributed small depressions. The small contour interval adopted makes the streams, as mapped, appear to flow in deep canyons, though in reality few of the valleys are as much as 35 feet deep.

Dove Mountain. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of the much-dissected plateau of southwestern Texas, among the noteworthy special topographic features of which are the crescentic range of hills in the northeastern part of the area, cut across at intervals by wind or water gaps,

the westward-sloping mesa of Pine Mountain in the central part, and the small isolated buttes, like Dove Mountain and Black Hills, in the southwestern part, whose forms suggest past volcanic activity.

Dryden Crossing. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of dissected plain or plateau through which the Rio Grande flows just east of that part of its course which trends northeastward. No settlements except individual ranch houses have been made in the region, and all the streams are intermittent except the Rio Grande.

Electra. Scale, 1 inch=½ mile; contour interval, 5 feet.

Detailed map of Electra and part of the oil field near that town, which has built up a great industry near the Oklahoma-Texas boundary. The "tank farms" for the storage of petroleum and its products form a rather unusual feature.

Hillendahl. Scale, 1 inch=½ mile; contour interval, 1 foot.

Map of Harris County, Tex., showing a plain sloping gently southeastward, on whose surface are very many small circular depressions and which is traversed in its southern part by Buffalo Bayou, a small stream that flows in a narrow trench or canyon, the depth of which is much accentuated by the small contour interval adopted for the map.

Hood Spring. Scale, 1 inch=1 mile; contour interval; 50 feet. (Photolithograph.)

Map of a mountainous region in southwestern Texas. The mountains occur in more or less isolated groups, from the base of which spread out great sloping plains of outwash material in which the streams wither or disappear. There are no perennial streams in the area.

Indian Wells. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of part of the Rio Grande and the dissected plains country through which it flows in a rather narrow canyon, in places nearly 1,000 feet deep. The region is practically uninhabited and is traversed by no railroads; less than 10 miles of first-class roads have been built in it, and only seven houses.

Iowa Park. Scale, 1 inch=½ mile; contour interval, 5 feet.

Map of part of the plains in north-central Texas south of Red River, traversed by Wichita River, which flows in irregular loops on a broad flood plain on whose surface are numerous terraces, cut-off lakes, and other forms produced by the river when it followed a different course.

Kelly Fields and Camp Travis. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of the San Antonio quadrangle with red overprint showing the Army camps and aviation fields in the vicinity of San Antonio. A text prepared by L. W. Stephenson, printed on the back of the map, gives an account of the more conspicuous natural features of the region.

Nine Point Mesa. Scale, 1 inch=1 mile; contour interval, 50 feet. (Photolithograph.)

Map of dissected mountainous country north of the Rio Grande in southwestern Texas, one of whose most conspicuous topographic features is the steep escarpment west of Chalk Draw, which trends northwestward and extends not only across the area of this quadrangle but is continued to the north into the Santiago Peak quadrangle. Other noteworthy features are the strong westward-facing escarpment of Nine Point Mesa and the very rugged topography of the Santiago Mountains.

Reagan Canyon. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of part of the Rio Grande and the mountainous country north of it, which closely hems in the river and within 2 miles of the stream rises to elevations of more than 3,300 feet.

Santiago Peak. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of part of the Santiago Mountains, a remarkable linear northward-trending range whose peaks rise to elevations of 4,500 to 5,000 feet and from whose base

plains slope eastward and westward. A short distance west of this range rises Santiago Peak, a conical mountain 6,521 feet high, whose shape and position suggest that it is an ancient volcano.

West Wichita Falls. Scale, 1 inch=½ mile; contour interval, 5 feet.

Map of the dissected plain west of Houston, in which Wichita River flows in rather angular loops through a wide-floored flood plain in which there are numerous topographic indications of cut-off lakes, terraces, cut spurs, and banks of other courses of the stream. The settlement is on the uplands. Within the area are a number of lakes, impounded behind artificial dams.

Utah.

Preston. See Idaho.

Stockton. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of part of the Oquirrh Mountains and the plain that slopes westward from them until it merges into the similar eastward-sloping plain from mountains farther west, forming Rush Valley, in which is a lake and playa. Along the base of the mountains the shore lines of the ancient glacial Lake Bonneville are clearly recognizable, and at the places where the streams leave the mountains they have built symmetrical alluvial cones, some of them now much dissected.

Virginia.

Aylett. Scale, 1 inch=1 mile; contour interval, 10 and 20 feet.

Map of part of the dissected Coastal Plain near its western border in Virginia, through which Mattaponi River flows in irregular angular bends in a lowland above which at many places are terraces that mark the former floors of the valley.

Camp Lee. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map formed by combining parts of maps of the Petersburg and Bermuda Hundred quadrangles to show the region adjacent to Camp Lee. A text prepared by A. W. Giles and published as a separate pamphlet by the Virginia Geological Survey describes the geology and topography of this region.

Carterton. Scale, 1 inch=1 mile; contour interval, 50 feet.

Map of part of Clinch River and the deeply dissected plateau region north of it. Clinch River and some of its tributaries have their courses along belts of weak or soluble rocks, mainly limestone, the depressions about a mile north of the river evidently being sink holes that have been dissolved in limestone rock. The geology of this area, together with that of much of the adjacent region, is mapped and described in Folio 59 of the Geologic Atlas, published by the Geological Survey.

Charles City. Scale, 1 inch=1 mile; contour interval, 10 and 20 feet.

Map of James River and the adjacent dissected plain, all of the upland of which is well drained, so that practically the only swamps indicated are on the flood plain or on the floors of the valleys. The depths of parts of James River are indicated by blue contours for 5, 10, and 20 feet below mean low water.

Disputanta. Scale, 1 inch=1 mile; contour interval, 10 feet. (Photolithograph.)

Map of part of the Coastal Plain of Virginia, whose uplands rise to elevations of less than 150 feet and which has been so much dissected by streams that it has a rolling topography and only small areas on the tops of the hills are flat. Most of the larger streams flow in lowlands so swampy that the roads do not follow them but are on the uplands.

Doswell. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of the area north of Richmond, through which flow Mattaponi and Pamunkey rivers. The uplands show many flat areas that stand at elevations of 200 feet, but the whole region is so much cut up by streams that it is gently rolling.

Langley Field. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of the Hampton quadrangle with red overprint showing the location of Langley Field. A text prepared by L. W. Stephenson, printed on the back of the map, gives an account of the more conspicuous natural features of the region.

Smithfield. Scale, 1 inch=1 mile; contour interval, 10 feet.

Map of part of Nansemond and James rivers and the somewhat dissected series of plains whose flat uplands are locally known as "pocosons" and the highest of which stands about 80 feet above the sea.

Washington.

Connell. Scale, 1 inch=2 miles; contour interval, 50 feet.

Map of part of the rolling plateau in the southeastern part of Washington north of Snake River, a notable feature of which is the line of depressions known as Washtucna and Esquatzel coulées, which afford an excellent, nearly level grade for the tracks of the Northern Pacific Railway.

Mount St. Helens. Scale, 1 inch=2 miles; contour interval, 100 feet.

Map of the country between Cowlitz and Lewis rivers in which Mount St. Helens, a symmetrical volcanic cone on whose flanks are more than half a dozen glaciers, rises to an elevation of 9,671 feet, thus overtopping by 3,000 to 4,000 feet the highest points of the adjacent dissected upland.

Port Angeles. Scale, 1 inch =1 mile; contour interval, 25 feet. (Photolithograph.)

Map of part of Juan de Fuca Strait and of the mountainous region south of it. Some of the mountains shown rise to elevations above 6,000 feet. A striking feature is the flying sand spit known as Ediz Hook, which extends about 3 miles eastward from a headland and forms a good harbor, on the southern shore of which have been established the flourishing settlement of Port Angeles and a United States naval and military reservation.

Samish Lake. Scale, 1 inch=1 mile; contour interval, 25 feet.

Map of part of the mountains and lakes adjacent to the northeastern shore of Puget Sound. The mountains, some of whose peaks are over 3,300 feet high, rise from rather flat lowlands in which the streams in some places flow on the surface and in other places have excavated broad trenches or narrow canyons, the whole representing a region whose features have been produced largely by a complex series of events, one of the most important of which has been relatively recent glaciation.

West Virginia.

Davis. Scale, 1 inch=1 mile; contour interval, 50 feet. (Part of quadrangle.)

Map of part of the plateau west of the Allegheny front, in which is Canaan Valley, a peculiar depression about 12 miles long from northeast to southwest and about 3 miles wide, encircled by steep walls, 500 to 800 feet high, which lead to the upland. This depression is drained westward by Blackwater River through a rather narrow valley.

Richwood. Scale, 1 inch=1 mile; contour interval, 50 feet. (Part of quadrangle.)

Map of part of Nicholas County, showing dissected plateau in the southeastern part of West Virginia, whose summits stand at elevations of about 3,000 feet and in which there are but small areas of flat land.

Williamson. See Kentucky.

Wisconsin.

Ripon. Scale, 1 inch=1 mile; contour interval, 20 feet.

Map of part of the region west of Green Bay, a glaciated plan on which are several lakes, a large number of marshes, streams that do not fit their valleys, and irregularly scattered low rolling hillocks.

Wyoming.

Como Ridge. Scale, 1 inch=1 mile; contour interval, 25 feet.

Map of a region of diverse topography, which is due largely to the structure and the varying resistance to erosion of the rocks, the harder rocks forming the ridges, which rise 500 to 700 feet above lowlands formed of weaker rocks. The main streams in this area, the two forks of Medicine Bow River, which unite to form Rock Creek, flow in exceedingly numerous and irregular small bends.

GEOLOGIC BRANCH.

SCOPE AND ORGANIZATION OF WORK.

The geologic branch is responsible for the work of the Survey in all phases of geology, except for a part of the investigations relating to underground waters. Its researches include stratigraphy, structure, petrology, paleontology, physiography, glaciology, metallography, mineralogy, chemistry, physics, and statistics of mineral production. They embrace field and office investigations, some of which are systematic and continuous but most of which consist of special problems or examinations in economic geology or scientific research and a part of which are special investigations made for other departments of the Government, or for commissions, States, and municipalities. Nearly all these investigations are made the basis of published reports, some of which are, however, printed by cooperating and outside organizations or are covered in unofficial professional or technical serials.

For the efficient accomplishment of its work in the different fields of geology the branch is organized in four divisions, as follows:

1. The division of geology, Sidney Paige, geologist in charge. This division conducts areal geologic surveys and special economic investigations and researches in geology. It is responsible for the preparation of the geologic map of the United States and for the field investigations necessary to classify and appraise the mineral lands in the public domain. It plays a leading part in mineralogic, petrographic, mining, geologic, and physiographic investigations in this country, and its paleontologic examinations include numerous studies for other branches of the Government, for States, for unofficial scientific institutions, and, to a limited extent, for foreign governments. Many of its investigations are carried on in cooperation with State geological surveys or other governmental institutions.

2. The division of Alaskan mineral resources, in charge of G. C. Martin during the absence of Lieut. Col. A. H. Brooks in France, until June, when Col. Brooks resumed charge. This division carries on topographic, hydrologic, and geologic surveys in Alaska. It describes and maps the general geology and mineral resources, makes special investigations of the geology and economic deposits of mineral districts, and reports annually the conditions and progress of the

Alaskan mineral industries and the production of mineral commodities. The division is, in fact, the principal source of knowledge as to the topography, geology, and hydrology of the Territory. To render more efficient assistance to the development of the resources of Alaska, a branch office is maintained the year around at Anchorage.

3. The division of mineral resources, H. D. McCaskey, geologist in charge until January; Edson S. Bastin, geologist in charge since January. This division is responsible for keeping the public informed as to the state of the mineral industries and the rate of production of mineral commodities in the United States. Geologists who have specialized in the different lines of economic geology and most of whom are members of the division of geology as well as of this division prepare the reports on their particular subjects printed in the annual volumes of "Mineral Resources" and such additional statements and reports on the mineral output of States and of districts and on the grades, distribution, prices, markets, etc., as may be needed by different branches of the Government. For certain minerals concerning which it is important that the public should be frequently informed reports are prepared and issued quarterly, monthly, or even weekly. The work of this division also includes the compilation and preparation for publication of information concerning the distribution of foreign mineral deposits, their geology, quality, reserves, state of development, output, and trade distribution. Branch offices of this division are maintained at San Francisco, Salt Lake City, and Denver.

4. The division of chemical and physical research, George Steiger, chief chemist, acting in charge since the death of Dr. George F. Becker, in February. This division is responsible for the chemical and physical investigations essential to the work of the geologic branch. It makes qualitative determinations of specimens sent by correspondents from all parts of the country and qualitative or quantitative determinations of metals, phosphates, potash, and other minerals collected by geologists of the staff or by cooperating organizations. It makes quantitative rock analyses, such as those which have won for the Survey world-wide distinction, and conducts physical and chemical researches bearing upon the geologic problems engaging the Survey.

The scope of the work and the activities of these divisions are more fully described in their respective reports, given below.

DIVISION OF GEOLOGY.

ORGANIZATION AND PERSONNEL.

The scientific force of the division of geology at the beginning of the year consisted of 69 geologists, 30 associate geologists, 21 assistant geologists, 3 junior geologists, and 8 geologic aids. During the year 10 members of the scientific staff resigned to take professional

positions in commercial life at higher salaries, 3 members died, 2 returned from the Army, 7 new members were appointed, and 2 were transferred from another division. The total number of geologists of various grades on the divisional staff at the end of the year was 129, a net loss of 2.

The division is organized in 11 sections, besides which its administration includes the section of geologic map editing, a part of the publication branch. In the following paragraphs are outlined the principal activities of the sections as they have been operating on a war basis; the normal provinces have been disregarded, and members of sections, including some chiefs, have applied themselves with splendid esprit to the assistance of other sections that were more directly concerned with the responsibilities of war geology of different kinds. Outlines of the normal work of the sections are given in the Thirty-eighth Annual Report, pages 43–46.

1. The section of eastern areal geology, Arthur Keith, geologist in charge, has been engaged in the examination of or search for reported deposits of manganese, chromite, tungsten, salt, high-calcium lime, white clays, and other minerals that were important to the successful prosecution of the war. Practically no field work in areal geology has been done. Some of the geologists of this section have assisted the division of mineral resources in compiling statistics of production or in preparing reports showing the distribution, character, production, and trade of the mineral products of foreign countries. The chief of the section has been for the most part occupied in the preparation of a manual of the geography of New England, including the compilation of a base map on the scale of 8 miles to the inch, in which the topography is contoured in 250-foot intervals.

2. The section of western areal geology, Sidney Paige, geologist in charge, has been occupied in the search for chromite, nitrates, potash, and sulphur, in the compilation of military geologic maps, and in the preparation of popular descriptions, for educational use, of regions surrounding a number of military camps and training stations, and these texts have been published on the backs of the corresponding topographic sheets. In these descriptions special attention is given to the explanation of the origin of the physical features of the regions. The chief of the section has had charge of the administration of the division of geology.

3. The section of Coastal Plain investigations, T. Wayland Vaughan, geologist in charge, has devoted its efforts largely to the preparation of information for the military and naval departments of the Government, including special reports on specific areas, such as assembling data for the use of the staff of the Chief of Field Artillery in selecting sites for artillery ranges and cantonments; compiling information on road-building material and on water supplies for use of the Chief of

Engineers in connection with the progressive military map of the country; and answering many inquiries regarding water supply, material for highway construction, and the nature of foundations for different kinds of structures. Special descriptions of the physical features of several cantonments and adjacent areas were prepared for printing on the backs of the topographic maps showing these areas. In the spring of 1919 several members of the section were engaged in the inspection of the salient geologic characters of the Dominican Republic and Haiti and the formulation of preliminary plans for geologic surveys of these republics.

4. The section of glacial geology, W. C. Alden, geologist in charge, has been occupied in preparing descriptive texts, in popular language, covering the physical features and their origin, of areas embracing a number of military and naval training camps; in mapping swamp, cut-over, and agricultural lands in portions of the upper Lake States; in making investigations for other branches of the Government and for States; and in compiling information regarding the mineral deposits and production of several foreign countries.

5. The section of paleontology and stratigraphy, T. W. Stanton, geologist in charge, has made practically no field studies in the States except at the request and expense of cooperating State geological surveys. Office studies of current collections, including many received from State surveys and other branches of the Government or from foreign governments, have proceeded. Two members of the section have carried on paleontologic and stratigraphic studies in Alaska, and one has devoted a part of the year to the structural mapping of several areas of prospective importance as sources of oil and gas, including helium. The geologist in charge is chairman of the committee on geologic names.

6. The section of geology of metalliferous deposits, F. L. Ransome, geologist in charge, has been devoted largely to work on immediate war-mineral needs and to the compilation of statistics and the preparation of reports on different phases of mineral production, under the auspices of the division of mineral resources. Several geologists have been occupied with the work of other sections, notably that of iron and steel alloy metals. During the earlier part of the year the systematic collection and compilation of information as to the mineral reserves and the mineral production of other countries of the world was begun in this section, but later it was transferred to the more appropriate administration of the division of mineral resources. Several chapters for a popular volume entitled "The strategy of minerals" were prepared by members of this section. The geologist in charge completed the examination of the quicksilver deposits of the country and served as a member of the committee of the Depart-

ment of the Interior appointed for the investigation of the decline in gold production.

The subsection of petrology, E. S. Larsen, jr., geologist in charge, is, on account of the intimate association of its work with that of the section of geology of metalliferous deposits, attached to that section. Mr. Larsen has determined 1,600 rock and mineral specimens for persons outside the Survey and has carefully examined about 300 specimens for members of the Survey. The rock-cutting laboratory operated under his supervision has prepared 2,139 thin sections and polished 220 specimens. Most of the regular work of the subsection has given way to the demands for examinations in behalf of other war agencies or for assistance to other geologists engaged in war work in the Survey. Mr. Larsen has submitted for publication a manuscript on the systematic determination of nonopaque minerals by means of the petrographic microscope.

7. The section of geology of iron and steel alloy metals, E. F. Burchard, geologist in charge, is preeminently a "war metal" section and, up to the signing of the armistice, was engaged in special field studies of deposits of chromium, manganese, tungsten, zirconium, molybdenum, and iron, the encouragement of the production from worthy deposits, and the dissemination of information concerning the domestic resources in these ores. The section, which is normally small, was temporarily enlarged by accessions of geologists from other sections of the division and even from other divisions. Twenty-one geologists, besides several assistants, were employed in the field. Deposits were examined in 18 States and in Costa Rica, Panama, the Dominican Republic, and Porto Rico. Systematic loose-leaf notebook schedules covering ownership, exact location, and the essential features of topography, geology, ore tonnage, and developments were mailed to the Washington office by the field geologists upon completion of the examination of each ore deposit, were filed for ready reference, and were used in preparing important summaries. From the manganese schedules was prepared a wall map showing the deposits of manganese ore in the United States, classified as to principal physical types. Cooperation was effected with several States, universities, and councils of defense; special statements and summaries were prepared for the War Industries, Shipping, and War Trade boards; and the information of greatest immediate service to the public was promptly issued through the newspapers and technical magazines. Since the armistice was signed illustrated reports on the economic geology of the many deposits studied have been in preparation or published, and many data have been prepared for the information of the War Minerals Relief Commission.

8. The section of the geology of nonmetalliferous deposits, H. S. Gale, geologist in charge, was, as in preceding years, devoted mainly

to the search for potash and nitrates and the investigation of reported deposits of these salts. In this work assistance was rendered in particular by the section of western areal geology and the divisions of Alaskan mineral resources and of chemical and physical research. Essentially all deposits of nitrates and potash reported to the War, Navy, and Interior departments were investigated in the field, and the more important, like the nitrate deposits in the Amargosa Desert of southeastern California, were very fully examined and tested in cooperation with the Ordnance Department of the War Department. Special investigations were made of a number of deposits of potash-rich silicates, including the leucite rocks of Wyoming and Arkansas, some gray iron ores in Alabama, and the greensands of New Jersey. The New Jersey greensands were examined somewhat comprehensively, with the use of the drill, in cooperation with the State Geological Survey. The work of the section included also the examination of high-grade clay deposits of the Eastern States with the object of locating and defining substitutes for clays previously imported for use in making paper, electrical equipment, and certain types of pottery. A full report on the salt deposits of the United States has been issued as Bulletin 669. The geologist in charge was in March appointed by the Secretary of the Interior a member of a committee to examine and report on the potash resources of Alsace, Spain, and western Germany.

9. The section of the geology of eastern coal fields, G. H. Ashley, geologist in charge, resumed near the end of the year, in cooperation with the State of Virginia, the detailed study and mapping of coal fields, which had been suspended during the war. Cooperation with the fuel sections of the Fuel Administration was continued, and much work was done in reducing commercial coal data to maps and files for ready availability and for use of the Fuel Administration or other branches of the Government. Consideration of questions connected with pooling and zoning of coal led to the study, by the geologist in charge, of the classification of coals in general and the preparation of a detailed and comprehensive scheme of classification. The section has been the source of information supplied to all agencies of the Government respecting the geology of the coals of the eastern United States.

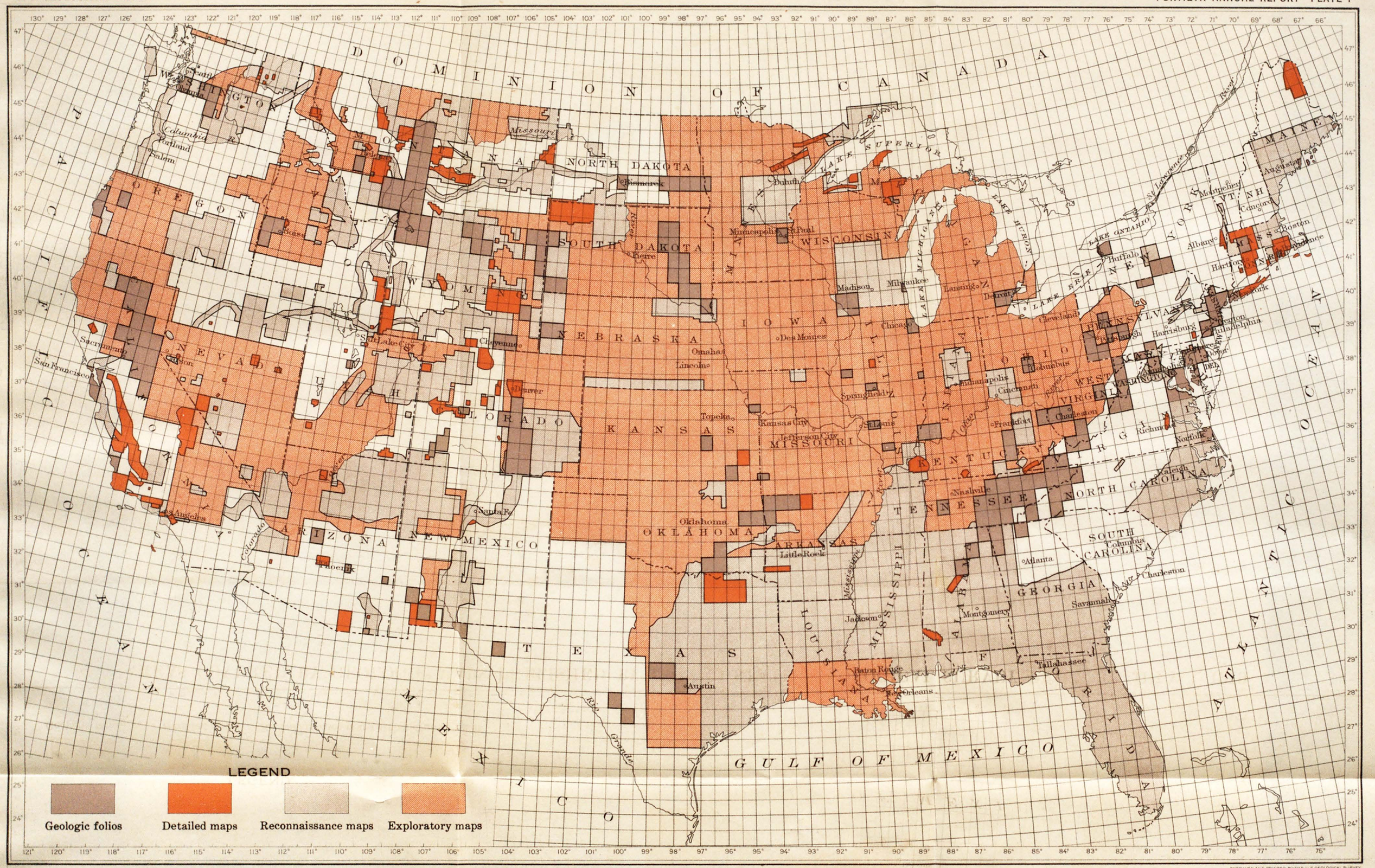
10. The section of the geology of western coal fields, M. R. Campbell, geologist in charge, made special field examinations for the California Fuel Administration or for the advice of the Government in the matter of sales of public lands but was for the most part occupied, under the auspices of other sections, in various investigations relating to war minerals, in the search for new reserves of petroleum, or in the compilation of data regarding foreign mineral

deposits. The greater part of the time of the geologist in charge, who is also chairman of the committee on physiography, was given to the preparation of educational geographic matter, including a description of the Allegheny portions of Virginia, West Virginia, and Maryland for the geographic handbook of the Virginian region, and to the critical review of texts similar in scope by other geologists and of popular geographic descriptions of the regions about the great army camps for publication by State surveys or on the backs of topographic maps covering the regions of the camps.

11. The section of the geology of oil and gas fields, David White, chief geologist, in charge, reinforced by additions from the sections of western coal fields and of stratigraphy and paleontology, has concentrated its work either on structural examinations of the most important of the prospective oil regions, with the object of locating areas most favorable for the occurrence of undiscovered oil reserves, or on special investigations of some of the more complex and important geologic problems concerning the history and structural relations of unconformably buried oil-bearing formations or affecting the mode of occurrence and relations of oil, gas, and water in different regions and under varying geologic conditions. The more important cooperative investigations of the section were made with the Bureau of Mines and the War and Navy departments in a search for helium-rich natural gas; with the Capital Issues Committee of the Treasury Department in examinations and reports on applications for capitalization; and with the Bureau of Internal Revenue in the compilation of the records of production of oil and gas fields, the calculation of rates of depletion, and the formulation of rules to govern the application of income-tax laws to the depletion of oil and gas field properties.

The committee on geologic names, T. W. Stanton, chairman, during the year examined 88 manuscripts comprising 10,702 pages and involving 3,256 geologic names. In addition it did a large amount of work on the stratigraphic catalogue of the United States, preparatory to completing the "stratigraphic lexicon."

The physiographic committee, of which M. R. Campbell is chairman, has given much attention to the scope and matter of the geographic handbooks for the New England States and the Virginian region and to the preparation of popular educational descriptions of the origin of the physical features of the regions surrounding 11 of the large army cantonments and training stations. Considerable progress has been made in collecting definitions of technical physiographic terms, and the card catalogue in preparation by the committee now contains about 6,800 definitions of 2,000 technical words and expressions used in physiographic mapping and description.



AREAS COVERED BY GEOLOGIC MAPS PUBLISHED BY UNITED STATES GEOLOGICAL SURVEY PRIOR TO JULY 1, 1919

Scale $\frac{1}{14000000}$

100 0 100 200 300 400 500 Miles

ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY

PUBLICATIONS.

The publications of the fiscal year 1919 prepared wholly or partly in the division of geology embrace 7 professional papers, 11 bulletins, 1 water-supply paper, 35 chapters of reports to be published later as complete volumes, and 1 geologic folio. Titles and brief abstracts of these publications are given on pages 23–38. Besides the official publications 47 papers were, with the permission of the Director, published by scientific societies or in scientific and technical journals. Seven reports based on work done in cooperation with State geological surveys have been transmitted to the States for publication.

PROGRESS OF GEOLOGIC MAPPING.

The areas in the United States [1] covered by geologic maps published by the Survey and the general nature of the work in each area are shown on Plate I. This map does not, however, indicate areas for which reports prepared by this Survey have been submitted for publication to cooperating State organizations or to other bureaus and departments of the Federal Government.

Owing to the nature of the war work, consisting largely of examinations with estimation and sampling of local deposits scattered through broad regions of the country, of which portions are incidentally reviewed in reconnaissance, the aggregate area covered by detailed surveys and classification of lands during the year is much smaller than usual. Much exploratory mapping has been accomplished in the great "red beds" region of the Southwest in the course of the potash investigations. A detailed statement of the work is given below.

Progress of geologic mapping, fiscal year, 1918–19.

	Square miles.
Detailed mapping	3,150
Reconnaissance mapping	6,350
Exploratory mapping	32,370
	41,870
Lands classified	1,150

FINANCIAL STATEMENT.

The total funds available for the geologic work of the Survey in the United States for the fiscal year 1918–19 were as follows:

Geologic surveys	$347,073.50
Scientific assistants	17,700.00
Search for potash deposits (part of appropriation for chemical and physical researches)	12,019.71
	376,793.21

[1] The progress of geologic surveying in Alaska is described in the section on the division of Alaskan mineral resources (pp. 107–113).

The expenditures classified by subjects were approximately as follows:

Economic geology of metalliferous deposits (mainly war minerals)	$89,124.00
Economic geology of nonmetalliferous deposits (mainly potash, nitrates, and other war minerals)	46,161.71
Economic geology of fuels (oil, gas, coal, and peat)	65,435.00
Special examinations and studies on account of military and naval affairs	18,000.00
Training-camp geography, geographic handbooks, and related educational work	11,250.00
Scientific researches not directly connected with war work (paleontology, etc.)	16,143.00
Supervision, administration, salaries of clerical, technical, and skilled-labor forces, instruments, and supplies	108,171.16
Land-classification board	22,508.34
	376,793.21

Of the amounts allotted to this division $72,260.35 was used directly for field expenses, including the search for potash. Approximately 68 per cent of this amount was expended west of the one hundredth meridian and 32 per cent east of it. With the $22,508.34 for the operations of the land-classification board, very nearly 74 per cent of the total, exclusive of the allotment for supervision, was spent for investigations west of the one hundredth meridian—that is, essentially in the public-land States. The expenditures for supervision, etc., are divisible in about the same proportion between the eastern and western work.

COOPERATION.

As may be inferred from the foregoing outlines of the character of the work performed in the division, there has been cooperation between the sections without reference to permanent administration boundaries, though the administrative organization has been retained intact. Twenty geologists of the division of geology, cooperating with the division of mineral resources, have compiled and submitted for publication annual, monthly, or weekly reports on the production of certain mineral commodities, besides numerous special statements prepared and submitted for the information of other branches of the Government. Ten geologists have taken part in the work on foreign mineral resources. Mutual cooperation has been effective between the division and the other field branches of the Survey, and cooperative assistance has been rendered to other bureaus of the department, notably the General Land Office, the Bureau of Mines, and the Office of Indian Affairs.

As will be noted in other parts of this report, this division has, through the preparation and submission of special reports or through special field investigations, cooperated with the Ordnance, Aviation,

and other departments of the War and Navy departments; also with the War Trade Board, the War Industries Board, the Fuel Administration, the Food Administration, the Capital Issues Committee, the Bureau of Internal Revenue of the Treasury Department, the Tariff Commission, the Bureau of the Census, the Bureau of Standards, the State Department, the Shipping Board, the Railroad Administration, the Federal Trade Commission, the Department of Justice, the Forest Service, and the Office of the Supervising Architect of the Treasury. In its scientific investigations it has cooperated informally with the Smithsonian Institution, the Bureau of Lighthouses, the Bureau of Fisheries, the Coast and Geodetic Survey, and the research laboratories of the Carnegie Institution. Investigations have been undertaken or planned at the request of the governments of the Dominican Republic, Haiti, the Virgin Islands, and Porto Rico. Assistance has been given to the geologic departments of a number of universities and colleges.

In strictly geologic investigations or paleontologic studies the Survey, through the division of geology, has assisted the geological surveys or equivalent agencies in 30 States—Alabama, California, Colorado, Connecticut, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New Jersey, North Carolina, North Dakota, Oklahoma, Oregon, Pennsylvania, Tennessee, Texas, Virginia, West Virginia, and Wisconsin. Informal cooperation exists between the Survey and all the States having geological surveys.

GENERAL FEATURES OF THE WORK OF THE YEAR.

The plans under which the work of the division of geology was in June and July, 1918, organized for the year were based on the necessity for assuring mineral supplies adequate to meet the shipping emergencies and industrial demands of the war. During the first half of the year practically all the available resources of the division, in funds and in geologists, were concentrated on the successful outcome of the struggle. As will later be seen in reviewing the work in detail, organization lines were largely lost sight of in emulative cooperation for the great purpose.

The last half of the year, however, has been a period of transition and genuine reconstruction. The systematic and determined search for new deposits of war materials; the qualitative appraisal and quantitative inventory of reserves in sight; and the monthly, weekly, or daily accounting of the production and distribution of essential war mineral commodities have, with the cessation of hostilities, been followed by the completion of the immediate field projects, the orderly summation and conservation of the economic and military results, and the salvage, so to speak, and methodical organization and record

of the scientific observations and discoveries resulting as by-products of the war work. The search for high-grade or more easily available ores has given place to classified estimates of the reserves in the ground for future use in war or peace; sampling and calculations of tonnage are followed by contributions to our knowledge of the conditions of ore genesis; special inquiries as to underground water supply, road-building materials, drainage, rare minerals, etc., arising from military needs, have shown the way to better methods and new features of geologic mapping and description and to broader conceptions in geography and geology. Geologists have learned much, and geology and geography, both as research and as teaching sciences, have benefited by the war.

Meanwhile, however, as will appear in the report of the division of mineral resources, the necessity for tiding some of our mineral industries over a post-war transitional period of unusual susceptibility to economic accidents and disasters has as yet permitted but partial relaxation in the precautionary task of keeping both the industries and the public informed as to the mineral outputs, stocks in hand, and trade conditions. The continuation of frequent reports showing the rate of production of coal, for example, is essential to the welfare of both the producer and the consumer. Consequently it has not yet been possible for some of the geologists fully to put aside their wartime duties and to return to their pre-war investigations, though this return, which is most desirable, is being brought about as rapidly as circumstances permit.

Among the more important undertakings in which the division of geology has been engaged during the year is a completion of the census of certain war-mineral resources of the country, notably manganese, chromite, and quicksilver. Estimates of petroleum remaining in the ground also were completed. The coal resources of the country had already been computed.

The compilation of data with maps showing the distribution of the mineral deposits in foreign countries, their quality and extent, the output of the districts and regions, and the trade distribution in world commerce, made for the use of the Peace Commission, has proved so valuable and informing to all the agencies that have had the opportunity to use it and evidently will be of so great importance to the American investor, engineer, and economist that it has been decided not only to make public the data in hand but to continue and keep the compilation up to date for the benefit of American industry and commerce. This service should do much to promote the ultimate industrial welfare, foreign trade, and prosperity of the United States. This work, though carried on by geologists of the division of geology, is administered as part of the operation of the division of mineral resources, in the report of which it is more fully described.

The special investigations made at the request of the military and naval authorities and of other agencies responsible for the successful conduct of the war have during the year been not less varied or less numerous than in the preceding year. Among others, they have included the search for smudge-ingredient minerals, for porous rocks to be used in making more buoyant concrete ships, and for underground water supplies for many cantonments and military and naval training stations in different States and in the West Indies; examinations of target ranges, determinations of locations for military storage; examinations and quantitative estimates of natural-gas resources; and investigations of nitrate and potash deposits both at home and abroad.

One of the searches of more than usual interest was that for helium, which, on account of its incombustibility and lightness, is particularly desired for balloon inflation. In the course of this investigation, which was made at the request of the Bureau of Mines for the War and Navy departments, the natural-gas fields of the country were examined, the helium-rich gases were located, the daily helium output of the different fields was computed, their geologic sources were ascertained, and the life of the fields and the supply of helium-rich gas in reserve in the ground were estimated. In addition to the progress reports transmitted to the cooperating agencies, a final report on the sources of helium, its distribution in the earth, its mode of occurrence, and the available reserves has been submitted by G. S. Rogers for publication as a bulletin of the Survey.

The restriction by an allied country of exportation to America of high-grade clays near the end of the war led to an investigation of deposits of high-grade clay in the eastern United States that might be substituted for imported clays in paper making and in the manufacture of porcelain and electrical equipment. The results of this successful search are embodied in a valuable report by Prof. Heinrich Ries, the well-known specialist in the geology of clays.

Another undertaking prompted by war contingencies was a reconnaissance survey of the principal peat deposits of the eastern United States for the purpose of locating and describing peats that in emergencies might be used as fuel in regions remote from the coal fields, and more particularly of promoting at all times a larger and more widespread use of peat for the fertilization of the soil, not only as an ingredient of mixed fertilizers but as itself a valuable fertilizer for certain soils, inasmuch as many of our peats contain more nitrogen than some of the commercial fertilizers sold during the war. A report by Prof. E. K. Soper on the peat resources of the Lake, New England, and Atlantic Coast States, available for use as fuels or fertilizers, is now in preparation.

Among other reports submitted for publication may be mentioned several that are noteworthy though not of military importance, such as the monograph on the geology and ore deposits of the Leadville district, Colo., begun by the late S. F. Emmons and nearly completed by the late Capt. J. D. Irving; a somewhat similar study of the geology of the Ducktown district, Tenn., by W. H. Emmons, F. B. Laney, and Arthur Keith; and a professional paper on the Laramie flora, by F. H. Knowlton. A report on the geology and ore deposits of the Ray and Miami districts, Ariz., by F. L. Ransome, now in press as Professional Paper 115, is a genuine contribution to general geology, as well as an illuminating demonstration of the conditions of occurrence and the relations, genesis, and distribution of the ore deposits. Other reports of unusual interest now in press are two professional papers on the Sunset-Midway oil field, Calif., in one of which (Prof. Paper 116) the geology and oil resources of the field are described in detail by R. W. Pack, and in the other (Prof. Paper 117) the geochemical relations of the oil, gas, and water are discussed by G. S. Rogers. A catalogue of Mesozoic and Cenozoic fossil plants, by F. H. Knowlton, is in press as Bulletin 696; and a bibliography of the platinum group of metals, 1797–1918, by J. L. Howe and H. C. Holtz, as Bulletin 694. A monographic discussion of the Eocene floras of southeastern North America, by Prof. E. W. Berry, is in preparation. "Ore deposits of Utah," by B. S. Butler and others, "Iron-depositing bacteria and their geologic relations," by E. C. Harder, and "Gypsum deposits of the United States," by R. W. Stone, are in press as Professional Papers 111 and 113 and Bulletin 697, respectively. The manuscript of a general paper on Ordovician and early Silurian crinoids is nearly completed by E. O. Ulrich, and a discussion of the oil fields of California, submitted by W. B. Emery, forms the first chapter of a bulletin on the "Oil resources of the public-land States." This report (Bulletin 689) is designed to present succinctly a summary of many of the reports now out of print and no longer obtainable describing withdrawn prospective oil and gas lands in the public-land States, and at the same time to express the best judgment of the writers as to the relative merits and prospects from the oil man's standpoint of different portions of these States. The 1917 edition of the large wall map showing the oil and gas fields of the United States having become exhausted, the data have been compiled in far greater refinement for issue in a new map, which is nearly ready for submission.

Notwithstanding the comparatively slow progress in the publication of scientific reports during the war, a number of volumes have been issued, among which some of more than usual interest or importance are Professional Paper 106, "The Quaternary geology

of southeastern Wisconsin, with a chapter on the older rock formations," by W. C. Alden; Professional Paper 107, "Geology and ore deposits of the Tintic mining district, Utah," by Waldemar Lindgren and G. F. Loughlin, with a historical review by V. C. Heikes; Bulletin 669, "Salt resources of the United States," a comprehensive report by W. C. Phalen; and Bulletin 693, "The evaporation and concentration of waters associated with petroleum and natural gas," by R. V. A. Mills and R. C. Wells. The last-mentioned paper leads into a too long neglected field of oil-field geochemistry and geophysics and is the precursor of investigations of the greatest importance to the oil industry, as well as to theoretical geology.

Two monographs, one on the early Tertiary Bryozoa, the other on the late Tertiary Bryozoa of North America, by F. Canu, of Versailles, France, and Dr. R. S. Bassler, of the United States National Museum, prepared for publication by the Survey, are now being issued by the National Museum on account of congestion of unpublished material in the publication branch of the Survey during the war.

A general account of the work of the geologists of the Survey would not be complete without mention of the important researches conducted by several members of the staff under the direction of T. W. Vaughan through cooperative arrangements with the Smithsonian Institution, the Carnegie Institution, the Panama Canal Commission, and the United States Bureau of Fisheries. A number of the reports based on these investigations in the West Indies and Central America are enumerated in previous reports and on pages 103 and 105 in this report. In addition the following papers by members of the Survey are published as parts of Publication 213 of the Carnegie Institution:

1. Some shoal-water corals from Murray Island (Australia), Cocos-Keeling Islands, and Fanning Islands, by T. W. Vaughan.
2. Some shoal-water bottom samples from Murray Island (Australia), and comparisons of them with samples from Florida and the Bahamas, by T. W. Vaughan.
3. Composition of two Murray Island bottom samples according to source of material, by M. I. Goldman.
4. Salinity of ocean water at Fower Rocks, Florida, by R. B. Dole and A. A. Chambers.
5. The solubility of calcite in contact with the atmosphere and its variation with temperature, by R. C. Wells.
6. The temperature of the Florida coral-reef tract, by T. W. Vaughan.

A paper entitled "Corals and the formation of coral reefs," by T. W. Vaughan, is in press as a part of the annual report of the Smithsonian Institution for 1917.

As a consequence of the exigencies of transoceanic carriage of essential war materials from distant ports during the war, and the resulting investigations of numerous known and reported deposits of manganese, chromite, and other minerals at different points in the West Indian Islands and Central America, there has arisen in several

of the republics an active interest in geologic exploration and mapping, with the object of procuring more complete information as to their natural resources, including the underground water supplies, the mineral deposits, and the building materials. The Government of the Dominican Republic early in the year appropriated funds for the topographic and geologic mapping of the country and requested the United States Geological Survey to take charge of the work. As noted elsewhere (p. 105), a preliminary geologic inspection of the Republic has been made for the purpose of ascertaining the general structural and stratigraphic conditions, and paleontologic collections necessary for use in the classification of the formations have been brought back for examination by the Survey specialists. The Haitian Republic has taken similar action and has allotted the funds for a reconnaissance of the geology and mineral resources of that country also. Plans for both of these surveys, for which the United States Geological Survey is expected to lend the scientific staff and take direction, are already largely formulated. Other calls on the Survey for geologic work in the West Indies are mentioned in other parts of this report.

A most regrettable feature of the year, the gravity of which is accentuated by the extraneous calls just noted, is the resignation of a number of the ablest young geologists of the corps. Greatly increased costs of living, with a lack of corresponding betterment in salaries, has imposed a burden of hardships which after the armistice, when the appeal of patriotism was less strong, could no longer be endured. Six members of the staff have resigned to enter private employment during the last six months of the year. All these are geologists receiving commercial compensations ranging from twice to four times the salary paid by the Government for the same genius, ability, training, and experience.

The geologic work of the division has extended into every State, the Canal Zone, Porto Rico, the Virgin Islands, and the Hawaiian Islands, as well as into the Dominican and Haitian republics, for the development of which this country is under treaty obligations. Through its paleontologic or other investigations the Survey has contributed to the knowledge of the geology of Canada, Mexico, Nicaragua, Costa Rica, Panama, Venezuela, Peru, Argentina, and Cuba and several other islands of the West Indies.

WORK OF THE DIVISION, BY STATES.

ALABAMA.

A popular description of the nature and origin of the physical features in the region around Camp McClellan and Anniston was prepared by F. E. Matthes and printed on the back of the special map covering that region. Information on material available for

the construction of roads within the confines of the camp was transmitted to the military officers, at whose request a geologic map of the Anniston quadrangle, with a typewritten explanatory sheet, was prepared and submitted.

The Upper Cretaceous flora of Alabama is described by Prof. E. W. Berry in Professional Paper 112, issued in August, 1919. Fossil plants from the middle and upper Eocene formations of the State are described by Prof. Berry in a monographic report now awaiting publication by the Survey. Tertiary Foraminifera are described in two manuscripts by J. A. Cushman, one on the genus *Lepidocyclina* and the other on the genus *Orthophragmina*, submitted for publication by the Survey. Mr. Cushman has in preparation a report on the foraminiferal fauna of the Oligocene Byram marl. The older Tertiary Eocene and Oligocene Bryozoa of the State are described by F. Canu and R. S. Bassler in a monographic report prepared for the United States Geological Survey but being published as Bulletin 106 of the United States National Museum. Reports on invertebrate fossils from the Eocene deposits of the State were made by W. H. Dall, and some collections of Tertiary fossils were identified by C. Wythe Cooke.

The deposits of gray iron ore in the vicinity of Talladega were examined by Laurence LaForge, who sampled some of the ores for analysis, in order to determine their capacity to yield potash as a by-product of the blast furnace.

The stratigraphy at several points in the Columbiana, Montevallo, Bessemer, and Vandiver quadrangles was reexamined by Charles Butts. Some of the deposits of high-grade limestone in the Tennessee Valley were examined by Arthur Keith, with the object of advising the War Department as to the sources of high-grade calcium carbonate for use in the manufacture of nitrates.

The Mississippian formations were examined at several localities near Huntsville by Mr. Butts in connection with the correlation of the Mississippian formations of western and central Kentucky and eastern Tennessee.

ARIZONA.

A report on the deposits of manganese ore in Arizona, by E. L. Jones, jr., and F. L. Ransome, has been submitted for publication in "Contributions to economic geology, 1919." The more important results of the search for manganese in the Colorado River desert region and adjacent areas in bordering States were given to the public through the press in October, 1918. Data on the deposits of manganese ore in the State are contained in a review by E. C. Harder and D. F. Hewett of recent studies of domestic manganese deposits, published by the American Institute of Mining and Metallurgical Engineers.

Alleged deposits of platinum in the Grand Canyon were examined and reported on by Mr. Ransome, who completed his description of the Ray quadrangle for publication as a folio. His report on the copper deposits of Ray and Miami is in press as Professional Paper 115.

Deposits near Animas and San Simon, Cochise County, reported to be rich in nitrates, were examined by L. F. Noble.

Collections of invertebrate fossils from the Tertiary were studied by W. H. Dall.

ARKANSAS.

The deposits of leucite rock in the Magnet Cove district of Arkansas were examined and mapped in detail by F. C. Calkins, who sampled them for analysis, with special reference to their possible utilization as a source of potash.

An examination of the stratigraphy, with reference to oil and gas possibilities, near Batesville was made by H. M. Robinson, and a report on the natural-gas resources available to Little Rock was made by E. W. Shaw.

The results of the investigations of the manganese deposits in the vicinity of Batesville are embodied in a report by H. D. Miser now nearly completed. Data on the deposits of manganese ore are contained in a review by E. C. Harder and D. F. Hewett of recent studies of domestic manganese deposits, published by the American Institute of Mining and Metallurgical Engineers.

By request of the Department of Justice, certain sunken lands in the eastern part of the State were examined by Frank Leverett, the results being communicated in the form of testimony for the use of that department.

A popular descriptive text of the major physical features of the Little Rock quadrangle, which includes Camp Pike, was prepared by L. W. Stephenson and H. D. Miser, and an edition of the topographic map, with the text printed on its back, was issued.

Fossil plants from the middle and upper Eocene formations of Arkansas are described by Prof. E. W. Berry in a report submitted for publication. Eocene Bryozoa are described by F. Canu and R. S. Bassler in a monographic report prepared for the Survey, but being published as Bulletin 106 of the United States National Museum.

The study of the fossil fauna of the Morrow formation was continued by G. H. Girty, and a preliminary study of the invertebrate fossils of Silurian age from the St. Clair formation was made by R. D. Mesler.

CALIFORNIA.

In cooperation with the California Bureau of Mines, the State Council of Defense, and the University of California, a detailed examination of the chromite and manganese deposits of the State

was completed in the autumn of 1918. Chromite deposits in Siskiyou, Shasta, Del Norte, Trinity, and Tehama counties were examined by J. S. Diller, who has prepared a report on the chromite deposits in the Klamath Mountain region of southwestern Oregon and northwestern California, for publication in "Contributions to economic geology," and a general report on recent studies of domestic deposits of chrome ore, for publication by the American Institute of Mining and Metallurgical Engineers. Chrome deposits in Amador, Humboldt, Lake, Mariposa, Mendocino, Napa, San Benito, Santa Barbara, Santa Clara, Sonoma, and Stanislaus counties were examined by Prof. G. D. Louderback, who submitted schedules covering the character, quality, development, production, and reserves of a large number of the chrome and manganese deposits of the State.

Manganese deposits in the desert region adjacent to Colorado River in southeastern California were examined by E. L. Jones, jr., and his report on these deposits is now in press as Bulletin 710–E. The results of most immediate war importance were promptly given to the press. Data on the deposits are contained in the review by E. C. Harder and D. F. Hewett, published by the American Institute of Mining and Metallurgical Engineers.

Deposits of tungsten ore at several points in San Diego and Inyo counties were examined by E. S. Larsen, jr., in cooperation with Mr. Means of the Bureau of Mines. A paper on the contact-metamorphic tungsten deposits has been prepared by F. L. Hess and E. S. Larsen for publication by the American Institute of Mining and Metallurgical Engineers.

The quicksilver prospects in Siskiyou County were examined by F. L. Ransome in connection with a general study of the quicksilver resources of the Western States, and the Temescal tin mine near Corona was examined by Adolph Knopf.

After an investigation of the platinum-bearing placers and rocks of northern California and Oregon, a report on the platinum reserves of these States is now in preparation by L. M. Prindle.

The results of an examination of nitrate deposits supposed to be of commercial importance in the region embracing Amargosa Valley, by H. S. Gale, G. R. Mansfield, L. F. Noble, F. C. Calkins, and Theodore Chapin, were transmitted to the Chief of Ordnance, United States Army, and are now in preparation by Mr. Gale and Mr. Noble for publication by the Survey. During the year Mr. Noble has visited and examined nitrate deposits in a number of other areas in southern California. None of the deposits were found to be of commercial importance, though small amounts of reasonably rich salts were present. Office file reports have been submitted by Mr. Noble on the regions examined.

In order to advise the California Fuel Administration as to the coal available for supplying the local market, the coal deposits at Stone Canyon, Monterey County, the Dos Rios coal field, in Mendocino County, and the lignite field at Ione, Amador County, were examined by M. R. Campbell, who submitted reports on them to the State authorities. The lignite at Ione, although a poor fuel compared with standard coal, was found on distillation to yield about 62 gallons of oil to the ton.

Detailed areal mapping of the Corona quadrangle was carried on by W. A. English and W. S. W. Kew. The economic results will be used in a report by Mr. English on the southern California oil fields. Special detailed examinations of the San Jose, Puente Hills, and Whittier-Fullerton areas were made by Mr. English. A number of points in the Camulos quadrangle were inspected by Mr. Kew, who is preparing a report on the geology and oil reserves of the Los Angeles-Ventura region. The results of the detailed studies of the structure and of the oil sands, with reference to oil production and the occurrence of water in the Sunset-Midway field, have been submitted in a full report on the field, in two parts, one by R. W. Pack on the geology and oil resources, in press as Professional Paper 116, and the other by G. S. Rogers, on the geochemical properties of the oil, gas, and water, in press as Professional Paper 117.

In view of the increasing interest of the public in oil possibilities of now undeveloped regions, a report on the oil resources of the public-land States is in preparation as Bulletin 689. The first chapter of this bulletin, discussing the oil prospects of undeveloped areas in California, has been submitted by W. B. Emery and is nearly ready for the printer.

In connection with his study of the Tertiary invertebrate faunas of the Pacific coast, Tertiary and recent mollusks from the vicinity of Point Fermin and La Jolla, near San Diego, were examined by W. H. Dall. A collection of Upper Cretaceous invertebrates from the Los Angeles region was identified by T. W. Stanton. A species of the foraminiferal genus *Orthophragmina* from California is described by J. A. Cushman in a paper submitted for publication. Late Tertiary Bryozoa from the State are described by F. Canu and R. S. Bassler in a monograph prepared for the Geological Survey but being published as a bulletin of the United States National Museum.

COLORADO.

The oil-shale deposits in Battlement Mesa and an area near Grand Valley, Colo., were mapped by D. E. Winchester and will be described in a report on "Oil shale of the Rocky Mountain region."

The results of the examinations of manganese deposits in different parts of the State, studied in the early part of the year, have been compiled by E. L. Jones, jr., for publication in "Contributions to

economic geology." The Federal Survey cooperated with the Colorado Geological Survey in the preparation of a bulletin published by the State.

A description of the oxidized zinc ores in the Leadville district by G. F. Loughlin, has been issued as Bulletin 681. Additional data relating to the geology and ore deposits of the district were gathered by Mr. Loughlin for the completion of a monograph left unfinished by the late Capt. J. D. Irving.

Pitchblende ores in the vicinity of Jamestown were examined by Mr. Loughlin, and the molybdenite deposits near Climax were examined by F. L. Hess.

A reconnaissance somewhat in detail of the Twentymile Park district of the Yampa coal field, in Routt County, embracing about 150 square miles, was made by M. R. Campbell to determine the number and thickness of coal beds underlying Twentymile Park.

Special examinations of coal lands in North Park, Jackson County, and in Tongue Mesa, Ouray County, were made by Mr. Campbell for the purpose of gathering data for the classification and valuation of the coal lands.

A report on the "Geology and mineral resources of the Axial and Monument Butte quadrangles, Moffat County," has been revised for publication by E. T. Hancock, and a report on "Coal south of Mancos, Montezuma County, Colo.," by A. J. Collier, has been issued as Bulletin 691–K.

A report entitled "The Laramie flora of the Denver Basin, with a review of the Laramie problem," has been submitted by F. H. Knowlton for publication as a professional paper. Mr. Knowlton also has in preparation a monograph on the flora of the Denver formation. Small collections of Cretaceous invertebrates, obtained by D. E. Winchester, were reported on by T. W. Stanton.

"Geology and ore deposits of the Creede district, Colo.," is the title of a report by W. H. Emmons and E. S. Larsen, jr., to be issued as a bulletin.

CONNECTICUT.

The lime belt of Connecticut and western Massachusetts has been examined by T. Nelson Dale, whose report is now in preparation.

The peat deposits of the State are described in general in a comprehensive report by Prof. E. K. Soper on the peat resources of the United States available for fuel and fertilizer.

The handbook of the geography of New England, which will include a description of the geographic features of this State, in which the Connecticut Valley region is described by Prof. W. M. Davis, is now approaching completion by Arthur Keith.

Some of the deposits of high-grade clay in Connecticut were examined by Prof. Heinrich Ries in connection with his investigations of white clays of the eastern United States that might be used

in substitution for grades of clay for which this country has long been dependent on foreign importations.

DELAWARE.

Information on well waters between New Castle and Middletown, Del., was furnished to the Construction Division of the United States Quartermaster Corps by T. W. Vaughan.

FLORIDA.

Information was furnished to the Navy Department as to the adequacy of the water supply from wells at Key West, Fla., and data on well waters at Jacksonville and Tampa were furnished to the Railroad Administration by T. W. Vaughan.

The upper Miocene and Pliocene Foraminifera of Florida are described by J. A. Cushman in Bulletin 676, recently issued. Other fossil Foraminifera from the State are described in two papers by him, one on the genus *Lepidocyclina*, the other on the genus *Orthophragmina*, submitted for publication. The same author is preparing a report on the lower Miocene Foraminifera of the State. The Tertiary corals of Florida were further studied by T. W. Vaughan. The fossil Bryozoa are described in two monographs by F. Canu and R. S. Bassler, one on the lower Tertiary, the other on the upper Tertiary Bryozoa of North America, both prepared for the United States Geological Survey but being published as bulletins of the United States National Museum. The Pleistocene invertebrate fossils of the State are under investigation by W. H. Dall.

The gypsum deposits of the State have been described by R. W. Stone in a general report on the gypsum deposits of the United States, now in press as Bulletin 697. In connection with this work Mr. Stone examined the phosphate rocks at a number of localities.

The peat resources of Florida are discussed with reference to their use as fertilizers or as fuel by Prof. E. K. Soper in a general report on the peat deposits of the Lake and Atlantic Coast States.

GEORGIA.

The granite quarries of Georgia were examined by G. F. Loughlin, and the garnet and corundum deposits of Towns County were examined by F. J. Katz and are described in a report submitted for the use of the Bureau of Mines.

A popular description of the nature and origin of the physical features in the country around Camp Gordon, by F. E. Matthes, has been published on the back of the topographic map of the region. This work was done in cooperation with the State Geological Survey.

At the request of the State geologist, the stratigraphy and areal geology of the Cartersville district were examined by Laurence LaForge. A report on the geology and physiography of the district

by Mr. LaForge has been published as Bulletin 35 of the State Geological Survey, a part of a general report on the manganese resources of Georgia. A press notice giving the information of the most immediate importance was issued by the Federal Survey. Data on the deposits of manganese ore are contained in the recent studies of domestic manganese deposits by E. C. Harder and D. F. Hewett, published by the American Institute of Mining and Metallurgical Engineers.

The geology of a part of the Coastal Plain of Georgia is described by C. W. Cooke and H. K. Shearer in Professional Paper 120–C, "Deposits of Claiborne and Jackson age in Georgia." Collections of fossils from the Coastal Plain were examined and identified by Mr. Cooke.

The Upper Cretaceous flora of Georgia is described by Prof. E. W. Berry in Professional Paper 112, issued in August, 1919. An account of the middle and upper Miocene of the State by the same author is awaiting publication. Descriptions of fossil Foraminifera of the genera *Lepidocyclina* and *Orthophragmina* are contained in two reports submitted by J. A. Cushman, who has in preparation other reports on the foraminiferal faunas of the State. A study of the Tertiary corals of Georgia was continued by T. W. Vaughan. The Eocene and lower Oligocene Bryozoa of Georgia are described by F. Canu and R. S. Bassler in Bulletin 106 of the United States National Museum, entitled "North American early Tertiary Bryozoa."

IDAHO.

An area embracing seven quadrangles in southeastern Idaho, previously mapped in detail on a large scale on account of its rich and very extensive phosphate deposits, is covered by a professional paper now in preparation by G. R. Mansfield.

A description by Mr. Mansfield of the geology and mineral resources of the Fort Hall Indian Reservation is now in process of publication.

Mr. Mansfield also submitted a report on a search for coal in eastern Idaho, for publication in "Contributions to economic geology."

Carbonaceous shales in Georgetown Canyon and on Thomas Fork were sampled by D. Dale Condit and Frank Reeves for distillation tests to determine their value as possible sources of oil.

Quicksilver deposits in the Yellow Pine and Black Pine districts and a tungsten deposit near Corral were examined by E. S. Larsen, jr.

"A reconnaissance of the Pine Creek district, Idaho," is the title of a report submitted by E. L. Jones, jr., for publication in "Contributions to economic geology" (Bulletin 710–A).

The results of tests of some of the bituminous shales associated with the phosphate deposits to determine the importance of the shales as possible sources of oil are given by D. Dale Condit in Bulletin 711–B, now in the hands of the printer.

ILLINOIS.

The examination of the areal and economic geology of the Equality and Shawneetown quadrangles, Ill., was continued by Charles Butts, in cooperation with the State Geological Survey. In connection with this work sections at Grand Tower and Thebes were examined for purposes of correlation.

A popular description of the region including Camp Grant, devoted particularly to the explanation of the origin of the physical features of the region, was prepared with the assistance of Prof. R. D. Salisbury and has been published on the back of a topographic map covering this region.

The geology and resources of the Colchester and Macomb quadrangles, examined in cooperation with the State Geological Survey, are described and mapped by Henry Hinds in Folio 208.

INDIANA.

The high-grade clays of Indiana that are usable in substitution for certain foreign clays were examined by Prof. Heinrich Ries during the autumn of 1918 and will be described in a general report by Prof. Ries on the white clays of the eastern United States.

In connection with the cooperative stratigraphic mapping and correlation of the older Carboniferous formations of the Ohio and upper Mississippi valleys inspections of the Mississippian formations exposed near Salem, Bedford, and Crawfordsville were made by Charles Butts.

The peat deposits of the State are discussed in a general report by Prof. E. K. Soper on the peat resources of the United States available for use as fuel or fertilizer.

IOWA.

A popular description of the region about Camp Dodge, with special reference to the origin of its physical features, has been prepared by W. C. Alden, of this Survey, and James H. Lees, of the Geological Survey of Iowa, and has been printed on the back of the topographic map of the region that includes Camp Dodge.

KANSAS.

The investigations of the geologic structure and oil and gas possibilities of the region including Eldorado, Kans., carried on in cooperation with the State Geological Survey, were completed by A. E. Fath, who has prepared a report describing and mapping the region. Some conclusions of immediate importance to the driller were promptly given to the press. A report by Mr. Fath, entitled "Origin of faults and anticlines in the Mid-Continent oil fields," has been submitted for unofficial publication.

In connection with the survey of the sources and the quantitative estimate of the possible supplies of helium-rich natural gas in the United States, structural mapping was done by P. V. Roundy in Chautauqua County. A report by G. S. Rogers on the helium resources of the United States embraces the results of Mr. Roundy's investigations. Mr. Roundy also examined for the information of the Capital Issues Committee of the Treasury Department the geologic structure of a portion of Cowley County.

Invertebrate fossils from certain of the Carboniferous formations of Kansas were given some attention by G. H. Girty.

KENTUCKY.

A report on the results of the investigation of the geologic structure and oil and gas prospects of Allen County, Ky., by E. W. Shaw and Kirtley Mather, was issued in June as Bulletin 688.

In continuation of the cooperative studies of the stratigraphy, with correlations of the Mississippian formations of the Ohio Valley, the older Carboniferous formations in Meade and Bullitt counties were examined by Charles Butts. This work begins a general study of the Mississippian throughout middle and eastern Kentucky, conducted in cooperation with the State Geological Survey.

A popular description of the physical features of the country around Camp Taylor, by Mr. Butts, has been published on the back of the topographic map of the region.

Sections of the Paleozoic formations near Terrill and Lexington were studied by E. O. Ulrich.

LOUISIANA.

In response to the request of the municipal government of Shreveport, La., an examination of the gas reserves in the region tributary to that city was, under cooperative auspices, made by E. W. Shaw. The conclusions were transmitted in a brief informal report to the commissioner of public utilities and thus made public.

Foraminifera found in the cuttings from a number of wells in the State were examined by J. A. Cushman with the object of determining the age and identity of some of the rocks penetrated in the borings.

Information on the ground-water resources in the vicinity of Camp Beauregard was furnished to the officers of that camp by T. W. Vaughan.

The middle and upper Eocene floras of Louisiana are described by Prof. E. W. Berry in a paper now awaiting publication. The upper Oligocene Foraminifera of the genus *Lepidocyclina* are described by J. A. Cushman in a report submitted for publication as a part of Professional Paper 125. The Eocene Bryozoa are described by F.

Canu and R. S. Bassler in the monographic report being published as Bulletin 106 of the United States National Museum.

MAINE.

In connection with the preparation of the handbook of the geography of New England, reconnaissances of the portions of Maine not previously covered by topographic maps were nearly completed by Arthur Keith, with the object of furnishing the material for a topographic map on a scale of 8 miles to the inch, with 250-foot contours. This manual, which is now nearing completion, will be adapted to use in general educational work.

The peat deposits of Maine were reviewed in the autumn of 1918 by Prof. E. K. Soper, for description in a comprehensive report on the peat resources of the United States available for use as fuel or fertilizer. This report is nearly ready for editing.

MARYLAND.

The deposits of chrome ore and the mining developments at Soldier's Delight, near Baltimore, Md., were examined by Miss E. F. Bliss, and these deposits and those near State Line have received attention in a summary of recent studies of domestic deposits of chrome ore, by J. S. Diller, submitted for publication by the American Institute of Mining and Metallurgical Engineers.

The section of the Miocene formation near Chesapeake Beach was examined by W. C. Mansfield, and a report on the fossil invertebrates obtained there was made by W. H. Dall. The Miocene Foraminifera of Maryland are described by J. A. Cushman in Bulletin 676, recently published. The Tertiary Bryozoa of the State are described in a monograph prepared for the Geological Survey by F. Canu and R. S. Bassler but being published by the United States National Museum.

The geography of Maryland is described in a handbook on the geology of the Virginian region, now nearing completion. The Coastal Plain, the Piedmont Belt, the Appalachian Valley, and the Allegheny portions of the State are described by L. W. Stephenson, Laurence LaForge, G. W. Stose, and M. R. Campbell, respectively.

The physiography of the Coastal Plain and Piedmont province of Maryland was the subject of study by T. W. Vaughan.

Information on sources of clay for use at Edgewood Arsenal was furnished to the authorities there by T. W. Vaughan.

MASSACHUSETTS.

The dolomite and calcite limestone deposits and quarries in western Massachusetts were examined and mapped in detail by T. Nelson Dale for description in a report on the limestones and dolomites of Massachusetts and Connecticut.

The country embracing Camp Devens was described in popular terms by Prof. W. W. Atwood in an account of the origin of the physical features which has been printed on the back of the topographic map of the region.

An inspection of the excavation along Cape Cod Canal was made by Prof. J. B. Woodworth, who also examined sets of samples that had been procured in connection with that work. Supplemental work was done by Prof. Woodworth on a manuscript prepared by him which includes accounts of the geology of Cape Cod, Nantucket, and Marthas Vineyard.

The handbook of the geography of New England, in which the geographic features of the Connecticut Valley are described by Prof. W. M. Davis and the remaining regions by Arthur Keith, is nearly ready for submission for publication as a bulletin.

The peat deposits of the State are described and mapped somewhat in detail by Prof. E. K. Soper in a general report, nearly ready for publication, on the peat resources of the Lake and Atlantic coast regions, available for use as fuel or fertilizer.

MICHIGAN.

In cooperation with the Geological Survey of Michigan, the geology of the Battle Creek, Galesburg, Union City, Leonidas, and Kalamazoo quadrangles, which embrace Camp Custer, was examined and mapped by Frank Leverett, whose report thereon has been submitted for publication by the State. Meanwhile a popular description of the geography of the vicinity of the camp, with an explanation of the origin of the surficial features, has been prepared by Mr. Leverett and printed on the back of the topographic map covering the area.

A set of maps showing the surface geology and agricultural conditions of northern Michigan and in the northern counties of the southern peninsula have been prepared by Mr. Leverett on the scale of 1:250,000. Progress has also been made by Mr. Leverett in preparation of his professional paper on "The Quaternary geology of the Lake Superior region."

A report on Silurian invertebrates collected in the State has been made by E. O. Ulrich.

To promote a more extensive use of peat as a fertilizer and to furnish more adequate data as to its availability as a fuel, the peat deposits of the State were examined by Prof. E. K. Soper and are to be described by him in a voluminous report, with maps, covering the peats of the Lake and Atlantic Coast States.

MINNESOTA.

A "Preliminary report on the geology of east-central Minnesota, including the Cuyuna iron ore district," by E. C. Harder and A. W. Johnson, has been issued as Bulletin 15 of the Minnesota Geological

Survey, in cooperation with which the field and office investigations were conducted. About forty representative iron ores from the Mesabi, Vermilion, Cuyuna, Marquette, Menominee, Gogebic, Michipicoten, and Crystal Falls iron-ore districts of the Lake Superior region, besides several fluxing limestones and blast-furnace cokes, were analyzed for potash by the University of Minnesota School of Mines Experiment Station, in a cooperative search for potash in the raw materials utilized in the iron industry.

A monograph on the Quaternary geology of the State is now in preparation by Frank Leverett, whose report on "Surface formations and agricultural conditions of southern Minnesota" is now in process of publication as a bulletin of the State Survey. Maps showing the surficial geology of the northeastern part of the State and of northern Wisconsin and northern Michigan are now being prepared by Mr. Leverett to meet the demand for maps of poorly settled tracts. A general report on the Pleistocene geology of the Lake Superior basin, by Mr. Leverett, is now being written.

The available information as to the peat resources of the State is summarized by Prof. E. K. Soper in a comprehensive report on the peat deposits of the Lake and Atlantic Coast States and their utilization as fuel or fertilizer.

The Cambrian faunas of the State are under revision by E. O. Ulrich.

A cooperative report on the clays and shales of the State, by F. F. Grout and E. K. Soper, is now in press as Bulletin 678.

MISSISSIPPI.

Information was furnished by T. W. Vaughan on the ground-water conditions in the vicinity of Forest, Miss., in connection with making estimates for drilling wells for the Railroad Administration.

A report on the ground waters of Mississippi is in preparation by L. W. Stephenson, who devoted the major part of the year to work on it. In June he returned to Mississippi in order to procure additional information needed for the completion of the report.

The Upper Cretaceous flora of Mississippi is described by Prof. E.W. Berry in Professional Paper 112, now in press. The middle and upper Eocene floras of the State are described by Prof. Berry in a report submitted for publication as a professional paper. Tertiary Foraminifera of the genus *Lepidocyclina* are described by J. A. Cushman in a report awaiting publication, and a report on the foraminiferal fauna of the Oligocene Byram marl is in preparation by the same author. The Eocene and Oligocene Bryozoa of the State are described by F. Canu and R. S. Bassler in Bulletin 106 of the United States National Museum.

MISSOURI.

Deposits of manganese ore in the vicinity of Cornwall and at Ironton, Mo., were examined by H. D. Miser with reference to the quality and quantity of ores that might be produced.

MONTANA.

A study of the manganese ore deposits in the Philipsburg district, Mont., was made by J. T. Pardee, with special reference to the quality of the ore recoverable and the extent of the available reserves. Reports by Mr. Pardee entitled "Manganese at Butte, Mont.," and "Some manganese deposits in Madison County, Mont." have been published as parts E and F, respectively, of Bulletin 690. Data on the manganese deposits are contained in a review by E. C. Harder and D. F. Hewett of recent studies of domestic manganese deposits, published by the American Institute of Mining and Metallurgical Engineers.

Deposits of iron ore near Stanford, Fergus County; of chrome ore in Stillwater and Sweetgrass counties, and of tungsten ore in Deer Lodge County were examined by L. G. Westgate. Reports giving the results of Mr. Westgate's investigations have been submitted for publication in "Contributions to economic geology." Data on the chrome and tungsten deposits have also been incorporated in papers by J. S. Diller and by F. L. Hess and E. S. Larsen that have been submitted for publication by the American Institute of Mining and Metallurgical Engineers.

An inspection of the geology, mining developments, and ore deposits in the New World (Cook City) district was made by Mr. Pardee, who has partly prepared a report thereon.

A summary report on the coal fields of Montana, by A. J. Collier, is near completion, but its publication will probably be delayed in order to issue reports on other more important regions. A report on the Scobey lignite field has been revised by Mr. Collier for publication.

In the course of field investigation, with tests, of the carbonaceous shales associated with phosphates in western Montana and Idaho, with special reference to their capacity to yield oil on distillation, D. Dale Condit sampled deposits of oil shale in the regions of the Bridger Mountains and the Little Belt Mountains and at numerous points near Dillon and southward to the Idaho line. The results of the tests are given in a report on "Oil shale in western Montana, southeastern Idaho, and adjacent parts of Wyoming and Utah," to be issued in the current volume of "Contributions to economic geology" (Bulletin 711-B).

Progress has been made by W. C. Alden in the preparation of a manuscript on the Quaternary geology of the Glacier National Park and northeastern Montana.

A report on the "Geology and oil and gas prospects of the Huntley field, Mont.," by E. T. Hancock, has been submitted for publication in "Contributions to economic geology, 1919" (Bulletin 711–G).

"Gradations from continental to marine conditions of deposition in central Montana during the Eagle and Judith River epochs" is the subject of a paper by C. F. Bowen, based upon his detailed studies of the stratigraphy in the general region. This paper (now in press) will be issued in "Shorter contributions to general geology" (Professional Paper 125–B).

Reports on anticlines in the Musselshell Valley, by C. F. Bowen, and on the structure of the Lake Basin field, by E. T. Hancock, have been issued as parts F and D, respectively, of Bulletin 691.

NEBRASKA.

The alkali-lake district of western Nebraska was examined by W. B. Hicks, with the object of getting information as to the extent and value of the potash resources of the region.

NEVADA.

Several deposits of manganese ore in Nevada were examined by Prof. J. Claude Jones, of the State University, and the manganese deposits near Las Vegas were studied by E. L. Jones, jr. The field examinations were made in cooperation with the State University and the United States Bureau of Mines. A report on the deposits of manganese ore in the State (Bulletin 710–F) has been prepared by Mr. Jones and J. T. Pardee, who made mineralogic studies of the ores, Prof. Jones being unable to continue the work. Press notices, giving the principal facts as to the qualitative and quantitative value of the manganese deposits in White Pine County and in the Colorado River desert region of Nevada and neighboring States, were promptly issued.

Tungsten ores in Nevada were examined by E. S. Larsen in cooperation with Mr. Means, of the Bureau of Mines, and descriptions of these deposits have been included in a paper by F. L. Hess and Mr. Larsen, submitted for publication by the American Institute of Mining and Metallurgical Engineers.

At the end of the year work was resumed by H. G. Ferguson on a report on the geology and ore deposits of the Manhattan district, an investigation that had been laid aside during the war.

Reports on collections of Triassic invertebrate fossils from northwestern Nevada were made by T. W. Stanton, and small lots of Eocene and Carboniferous invertebrates were examined by W. H. Dall and G. H. Girty, respectively.

After his examination of the platinum deposits in the Goodsprings district and of the tin deposits of Majuba Hill, Adolph Knopf prepared a report on the latter locality.

The deposits of oil shale in the vicinity of Elko were examined in detail by J. P. Buwalda, who then visited reported occurrences of oil shale and of coal in other parts of the State. In the course of this work Mr. Buwalda inspected and sampled clay deposits near Beatty, Elko, and Winnemucca and investigated reported potash deposits near Alamo, Blair Junction, Lovelocks, Ely, and the Silver Peak Marsh. A report on the Elko oil shale has been submitted by Mr. Buwalda.

NEW HAMPSHIRE.

The geography of New Hampshire is described by Arthur Keith in a handbook on the geography of New England, which is approaching completion. In this bulletin, which is designed for use as a manual, a topographic map on the scale of 8 inches to the mile, with 250-foot contours, will be used, and much of the topographic information has been furnished by Mr. Keith.

The peat resources of the State are described, with analyses and a discussion of their possible utilization as fuel or fertilizer, in a general report by Prof. E. K. Soper on the peat deposits of the Lake and Atlantic Coast States.

NEW JERSEY.

With the object of procuring adequate qualitative and quantitative data as to the adaptation of the greensand marls of New Jersey to the production of potash, examinations of these deposits, with testing by the drill and sampling throughout a large area, were carried out in cooperation with the State. The work was in charge of G. R. Mansfield, who is now preparing a report on the geologic and chemical results. A preliminary report on the work has been contributed to the State geologist for publication in his annual report.

The peat deposits of the State, which are of great value and have long been used, are described by Prof. E. K. Soper in a general report on the peat resources of the Lake and Atlantic Coast States, with special reference to their availability for use as fuel or fertilizer. This report is nearly ready for submission for publication as a bulletin of the Survey.

The zircon deposits in the northeastern part of the State were, early in the year, examined by W. T. Schaller with reference to the quantity of the mineral available and its adaptability for military purposes.

NEW MEXICO.

Work on the report on the "red beds" region of New Mexico, with special reference to the possibility of the occurrence of potash deposits in association with the thick deposits of salt in this region, was continued by N. H. Darton at the end of the field season. In the course of these investigations Mr. Darton has, during the last three

years, compiled or made the necessary surveys for the preparation of a topographic map of the State on the scale of 12 miles to the inch, with 100-meter contours. This map will serve as the base for a geologic map of the State to accompany the above-mentioned report.

In view of the great demand for information as to regions of anticlinal and domal structure and the possibility of their yielding oil and gas, Mr. Darton has nearly completed a report on the larger structural features of the State.

Anticlinal structure in Alamosa Valley, Socorro County, is described in a report nearly ready for submission by D. E. Winchester.

A reported nitrate deposit in southern Grant County was inspected by Mr. Darton, and other rumored deposits in the vicinity of Las Animas were investigated by L. F. Noble.

After a long interruption on account of work of more importance to the military program of the country, the preparation of the report on the ore deposits of the Santa Rita quadrangle was resumed by A. C. Spencer. A reported discovery of tin ore near Mogollon was inspected by Adolph Knopf and will receive further investigation.

The deposits of manganese ore in the vicinity of Socorro were examined by E. L. Jones, jr., and are described in his report on the "Deposits of manganese ore in New Mexico," which has been submitted for publication in "Contributions to economic geology" (Bulletin 710–B). The principal facts of war importance were promptly given to the press. The Federal Survey also cooperated with the State School of Mines in the preparation of a bulletin on manganese ores, published by the State. Data on the manganese deposits are contained in the paper by E. C. Harder and D. F. Hewett, published by the American Institute of Mining and Metallurgical Engineers.

On returning to the Survey after his discharge from the Army, Lieut. J. B. Reeside, jr., resumed the study of the data collected in 1915, 1916, and 1917 on the coal deposits of the San Juan region. Data for the classification of the land have also been prepared by Mr. Reeside.

A small area near Lumberton, Rio Arriba County, was examined by M. R. Campbell for the purpose of gathering information regarding the number and thickness of coal beds present, so as to determine the valuation to be placed on the lands.

Fossil bones discovered in the course of the investigation by Mr. Reeside are described in a paper by C. W. Gilmore on "Reptilian faunas of the Torrejon, Puerco, and underlying Upper Cretaceous formations of San Juan County, N. Mex," which is now in press as Professional Paper 119.

A report on "Coal in the Fruitland formation, San Juan County," by C. M. Bauer and J. B. Reeside, jr., is now in the hands of M. R. Campbell with a view to its early publication.

Publication of the report of W. T. Lee on coal in the Raton Mesa region is delayed in order that Mr. Lee may incorporate in it the results of exploration and development subsequent to his field examinations.

Reports on collections of Cretaceous invertebrate fossils in different parts of the State have been made by T. W. Stanton, and on small collections of Paleozoic invertebrates by Edwin Kirk.

NEW YORK.

A popular report describing the geographic features of the region embracing Camp Mills was prepared by W. C. Alden and published on the back of the topographic map of the region.

A geologic map and a map showing ground-water resources of each of the quadrangles in Long Island, with specially prepared oversheets to indicate the application of the geologic data to military purposes, were prepared by W. C. Alden.

Collections of Silurian invertebrates from this State were given preliminary classification by R. G. Mesler, and the stratigraphy of the Clinton was discussed by E. O. Ulrich.

Deposits of clay that may possibly be suitable for substitution for clays formerly imported were examined by Prof. Heinrich Ries in the summer of 1918 and are described in a report by Prof. Ries, now ready for publication.

To promote a more extended use of peat as a fertilizer and to furnish, under war conditions, more adequate data as to its availability as a fuel, the peat deposits of the State were examined and have been described in a report by Prof. E. K. Soper on the peats of the Lake and Atlantic Coast States.

NORTH CAROLINA.

Most of the work of the Survey in North Carolina during the year has been done in cooperation with the State Geological Survey. At the request of the State authorities the marls and limestones were investigated with reference to their availability for use for fertilizer, lime, road making, or general building. The marls of the eastern region were examined by E. W. Berry and J. A. Cushman, and a report written by Prof. Berry has been submitted for publication by the State Survey. The limestones of the Paleozoic area were examined by G. F. Loughlin, whose report is nearly ready for transmission to the State geologist.

A special report on water supply and sources of power for the proposed artillery cantonment (later named Camp Bragg) at Fayetteville was prepared for the Chief of Field Artillery under the direction of T. W. Vaughan. Subsequently L. W. Stephenson made a special field investigation of the resources (particularly material

suitable for concrete work) of Camp Bragg and vicinity and submitted a report of the results to the Construction Corps of the United States Army.

A special report on the geology of southern North Carolina adjacent to the border of the Coastal Plain and Piedmont was prepared by Mr. Stephenson for the Bureau of Yards and Docks, Navy Department; and a special report on the seismicity of the southeastern United States with particular reference to southern North Carolina was prepared by Prof. J. B. Woodworth, also for use by the Bureau of Yards and Docks.

Possible supplies of the more important war minerals in the State were both quantitatively and qualitatively reviewed in the early part of the year. The deposits of chrome and manganese ore were examined by J. Volney Lewis and F. C. Schrader, and a report on the chromite deposits of the State has been submitted by Mr. Lewis for publication in "Contributions to economic geology." Mr. Lewis made a reconnaissance for undeveloped chromite deposits in the peridotite areas in the northwestern part of the State. Deposits of zircon and monazite were investigated by W. T. Schaller.

Garnet and corundum deposits in Jackson and Clay counties were examined by F. J. Katz, who prepared reports for submission to the governmental agencies most concerned with the supply of abrasives needed for war purposes.

At the request of the State geologist a study of the principal deposits of iron ore in the State was begun by Prof. W. S. Bayley about the middle of June. It is purposed to carry this work to a stage permitting estimates of ore reserves and indicating possible extensions of present ore bodies or the occurrence of undiscovered deposits in favorably situated areas.

Many localities at which clays that may be substituted for imported clays have been worked or are reported to occur were reviewed by Prof. Heinrich Ries and Prof. W. S. Bayley, and a report by Prof. Bayley has been prepared for publication by the State Geological Survey. A summary of the results, including tests of samples by the Bureau of Mines, will be included in a general report by Prof. Ries on the high-grade clay deposits of the Eastern States.

Descriptions by J. A. Cushman of the Miocene and Pliocene Foraminifera of North Carolina are contained in Bulletin 676, recently issued. The early Tertiary and late Tertiary Bryozoa of the State are described by F. Canu and R. S. Bassler in the monographic reports being published as bulletins of the United States National Museum.

The peat deposits of North Carolina are discussed, with special reference to their availability for use as fertilizer and fuel, in a report by Prof. E. K. Soper on the peats of the Lake and Atlantic regions

of the United States. A portion of the peat-bearing area in the extreme northeastern part of the State is described and mapped in detail by C. C. Osbon in a report submitted for publication in "Contributions to economic geology" (Bulletin 711–C).

NORTH DAKOTA.

Reports on the New Salem lignite field, N. Dak., by E. T. Hancock, and the Mannarth lignite field, by C. J. Hares, have been revised by M. R. Campbell for publication.

The marine fauna of the Lance formation has been studied by T. W. Stanton.

OHIO.

A report on the geology of the Wellsville quadrangle, Ohio, by James H. Hance, has been submitted and is undergoing critical review.

The peat deposits of the State are discussed by Prof. E. K. Soper in a report on the peat resources available for fuel or fertilizer uses in the Lake and Atlantic Coast States. This report is nearly ready for publication as a bulletin.

OKLAHOMA.

The detailed structure mapping of the "west side" of the Osage Reservation, Okla., was compiled by Mr. Bowen, assisted by C. S. Ross, C. E. Dobbin, P. V. Roundy, and Frank Reeves, and the report is now in press as part S of Bulletin 686, "Structure and oil and gas resources of the Osage Reservation, Okla." The remainder of the "east side," in the Hominy quadrangle, was examined by R. H. Wood and C. E. Dobbin. A report describing the structure and oil resources of the area in the Hominy quadrangle, by Mr. Wood, is approaching completion for publication as a separate bulletin. Three additional chapters of Bulletin 686 are in press or under examination or revision and will be issued at an early date. The investigations in the Pawhuska quadrangle have been under the general supervision of Capt. K. C. Heald. Besides the geologists already mentioned, O. B. Hopkins, D. E. Winchester, W. A. English, Sidney Powers, J. P. Buwalda, H. M. Robinson, W. B. Emery, M. I. Goldman, E. R. Lloyd, F. R. Clark, K. F. Mather, and R. V. A. Mills have contributed to the reports published or in process of publication.

At the request of the Indian Office the geologic structure of the Chilocco Reservation was examined in February by Capt. K. C. Heald, whose report, with map, was promptly transmitted to the Commissioner of Indian Affairs.

The geologic structure and oil prospects of a part of Jefferson County are set forth in a short report submitted for publication by H. M. Robinson, whose examinations of certain areas in Pontotoc

and Hughes counties will be covered in a report now in preparation. A short report on the oil possibilities of a small area adjoining Red River, in the southern part of the State, was also prepared by Mr. Robinson and submitted to the Office of Indian Affairs.

The general structure of a portion of Marshall County, as mapped by H. M. Robinson, O. B. Hopkins, and Sidney Powers, is given in a paper by L. W. Stephenson, entitled "A contribution to the geology of northeastern Texas and southern Oklahoma," issued as Professional Paper 120–H. Detailed descriptions, with maps, will be found in a report by Messrs. Hopkins, Robinson, and Powers, submitted for publication in "Contributions to economic geology."

A short report on the manganese deposits of the State, examined by D. F. Hewett in cooperation with the State Geological Survey, was prepared by Mr. Hewett.

The zircon deposits near Cache, in the Wichita National Forest, were studied in August, by F. L. Hess, who prepared a report as to their availability for use in the manufacture of munitions. This examination was made at the request of the War Department, in cooperation with the Bureau of Mines.

The coal resources of the State were studied quantitatively and qualitatively by G. H. Ashley, who is preparing a summary report on the coal fields of Oklahoma for publication as a chapter in Professional Paper 100.

Collections of the Carboniferous invertebrates from the State, recently received by the Survey, were studied by G. H. Girty.

As a part of the field investigation and laboratory studies connected with the search for commercial potash deposits in the United States, the salt plains of western Oklahoma were examined and sampled by O. C. Wheeler, who occupies the field laboratory near Amarillo, jointly conducted by this Survey and the Texas Bureau of Economic Geology and Technology. Through the cooperation of many of the oil companies the logs of wells penetrating saline deposits in the region are submitted for examination, and cuttings and samples of brines from many points are examined by Mr. Wheeler, with especial reference to their potash content.

OREGON.

Deposits of manganese ore in the Lake Creek district, Jackson County, Oreg., were examined by J. T. Pardee; deposits of chrome ore in Josephine and other counties of the Klamath Mountains by J. S. Diller; and deposits of chrome ore in the eastern part of the State by L. G. Westgate. Reports on chromite in the Klamath Mountains and in eastern Oregon have been prepared by Mr. Diller and Mr. Westgate, respectively, for publication in "Contributions to economic geology," and data on chrome ore are given by Mr. Diller in his

review submitted to the American Institute of Mining and Metallurgical Engineers, and on manganese ore in the review by E. C. Harder and D. F. Hewett similarly published. Schedules reporting production capacity, reserves, etc., for manganese deposits in Curry, Jackson, and Josephine counties were compiled and submitted by Prof. G. D. Louderback.

A report on the platinum resources of California and Oregon is in preparation by L. M. Prindle. Quicksilver deposits in the Medford district, Jackson County, were examined by J. T. Pardee.

The region about the Rose Valley Borax Works near Andrews was examined by J. P. Buwalda, as a possible source of potash.

In view of the necessity for the discovery and development of new oil fields, and of the widespread interest in the possible discovery of oil and gas in commercial amounts in Oregon, an examination of the Tertiary formations east of the Cascade Mountains, to be conducted in cooperation with the State Bureau of Mines and Geology, was begun by Mr. Buwalda near the end of June.

PENNSYLVANIA.

The iron ore deposits and development at Rittenhouse Gap, in Berks County, Pa., were examined by Miss E. F. Bliss and E. C. Harder, in cooperation with the Bureau of Mines. Miss Bliss made a magnetic survey of the Gap district and submitted a report on it for the information of the War Industries Board.

A report on the economic geology of the Fairfield and Gettysburg quadrangles, by G. W. Stose, has been transmitted to the State geologist for publication by the State.

A detailed description, with maps, of the geology and mineral resources of the Somerset and Windber quadrangles has been nearly completed by G. B. Richardson, who has made considerable progress on the study of the geology and oil and gas resources of the New Kensington quadrangle.

The preparation of a general summary report on the bituminous coal deposits of the State, to be published as a chapter of Professional Paper 100, has occupied part of the time of G. H. Ashley, who has given particular attention to the establishment of a new system for classifying coals according to their chemical analysis.

In connection with the studies of high-grade clays that may possibly be suitable for substitution for imported clays, a month was spent by Prof. Heinrich Ries in the examination and sampling of a number of clay deposits, including several of great promise. The work was conducted in cooperation with the State geologist, and the results will be included in a general report which has been submitted by Prof. Ries on the high-grade clays of the eastern United States.

Collections of fossils from the Ordovician formations at several localities in the central regions of the State have been under examination by E. O. Ulrich.

Brief examinations of the graphite deposits at several localities were made by H. G. Ferguson.

A report entitled "Economic geology of the Allentown quadrangle, Pa.," has been submitted by Prof. B. L. Miller for publication as a bulletin by the Survey.

Several small deposits of peat in the northern portion of the State were examined by Prof. E. K. Soper in connection with the preparation of his report on the peat resources available for use as fuel or fertilizer in the Lake and Atlantic Coast States.

RHODE ISLAND.

The physical features of Rhode Island are described by Arthur Keith in a handbook on the geography of New England, which is nearly ready for submission as a publication of the Survey.

The peat resources of the State are briefly described in a general report by Prof. E. K. Soper, with special reference to the utilization of peat as fuel or fertilizer.

Some supplemental work was done by Prof. J. B. Woodworth on a report that includes accounts of the geology of the Elizabeth Islands and Block Island.

SOUTH CAROLINA.

The geologic conditions within certain areas in South Carolina that were considered as possible sites for a radio plant were examined for the Navy Department by T. W. Vaughan and L. W. Stephenson.

Data on well water at Poston were furnished to the Railroad Administration by C. W. Cooke.

A preliminary report on the geology and ground waters of the State is in preparation by Mr. Cooke, who devoted the major part of the year to that work. In connection with the preparation of this report, Mr. Cooke contributed for use as a part of the progressive military map of South Carolina, well data and other information of military importance, all of which was placed at the disposal of the Chief of Engineers, U. S. Army.

Miocene and Pliocene Foraminifera from South Carolina are described by J. A. Cushman in Bulletin 676, recently published. The early Tertiary and late Tertiary Bryozoa of the State are described by F. Canu and R. S. Bassler in bulletins of the United States National Museum.

In the course of searches for and investigations of supplies of essential war minerals deposits of manganese and pyrite were examined by J. Volney Lewis and F. C. Schrader. A report by Mr. Lewis on the manganese ores is nearly completed.

A number of granite quarries of the State were examined by G. F. Loughlin.

The clay mines and some of the more important reported deposits of high-grade clays in the State were studied and sampled by Prof. W. S. Bayley, whose report, including the results of the tests of samples by the Bureau of Mines, is incorporated in a general report by Prof. Heinrich Ries on the high-grade clays of the Eastern States that are possibly suitable for replacing clays hitherto imported.

To promote a more extensive use of peat in fertilizers or as fuels, the peat deposits of the State were examined in the autumn of 1918 by Prof. E. K. Soper and are described in his general bulletin on the subject.

SOUTH DAKOTA.

The tin deposits recently exploited at Hill City and Keystone, S. Dak., were examined by Adolph Knopf in August.

The geologic structure around Rapid City and Hot Springs was briefly examined by E. T. Hancock, with reference to the possibility of obtaining oil and gas.

TENNESSEE.

The greater part of the geologic work carried on by the Survey in Tennessee during the year was done in cooperation with the State Geological Survey.

The deposits of manganese ore in the eastern part of the State were examined by G. W. Stose and F. C. Schrader, who gave particular attention to the discovery of new deposits through the application of physiographic, structural, and stratigraphic principles that have been found by the Survey to exert a large control on the location and mode of occurrence of the manganese deposits in this general region. A detailed geologic map of the area has been prepared by Mr. Stose and a representative of the State Survey. A report on the manganese deposits of east Tennessee, by Messrs. Stose and Schrader, based on the work of the previous year, was published by the Tennessee Geological Survey in "The resources of Tennessee" for July and October, and a press bulletin was issued by the Federal Survey. The manganese and iron ores in the Sweetwater and Cleveland areas were briefly examined by E. F. Burchard, in company with Mr. Stose and E. O. Ulrich, who gave particular attention to the stratigraphy and paleontologic correlation of the deposits. Data on the manganese deposits are contained in the paper by E. C. Harder and D. F. Hewett published by the American Institute of Mining and Metallurgical Engineers.

The stratigraphy and structure of portions of Overton, Scott, Fentress, and Pickett counties were examined with special reference to oil and gas possibilities by Charles Butts, with assistance furnished

by the State, and a report with a map embodying the results has been transmitted for publication by the State geologist.

Mr. Butts also examined, for purposes of correlation, a section of Mississippian formations near Cowan and Sherwood.

In order to review the results of recent mining developments, the Ducktown district was revisited in February by F. B. Laney, and the results are to be included in the report on that district by W. H. Emmons, F. B. Laney, and Arthur Keith.

The deposits of white clay in western Tennessee were visited and sampled by Prof. Heinrich Ries in cooperation with the State geologist, with the object of procuring more adequate information as to the suitability of some of these clays as a satisfactory substitute for clays now imported.

Collections of fossil invertebrates from the Lenoir and Mosheim limestones were studied by E. O. Ulrich and R. D. Mesler, and Upper Cretaceous fossils from Coon Creek were prepared for review by T. E. Williard. The Upper Cretaceous flora is described by Prof. E. W. Berry in Professional Paper 112.

TEXAS.

Detailed studies of the geologic factors involved in the oil-field development in north-central Texas were begun in November, 1918, with E. R. Lloyd in charge, and were continued in 1919 under the supervision of K. C. Heald, with whom were associated C. S. Ross, P. V. Roundy, Frank Reeves, M. I. Goldman, C. E. Dobbin, and several instrument men with geologic training. Studies of the stratigraphy, structure, physiography, and paleontology were carried on both in the oil fields and in the central mineral region, to the south, where the oil-bearing Bend series crops out. Problems that involve determination of the criteria to permit definite subsurface correlation between wells and districts, and the establishing of the relations between the structure shown by the surface beds and that of the deep-lying oil-bearing Bend series, which is separated from the surface beds by two or more unconformities, demanded the undertaking of petrographic and micro-paleontologic investigations. These investigations are being made in Washington by M. I. Goldmand and P. V. Roundy, respectively, and promise to be two of the most important and helpful lines of study in connection with the oil-field problems under consideration by the United States Geological Survey. In this work the Survey is cooperating with the Texas Bureau of Economic Geology and Technology and with geologists outside the Survey who are interested in the outcome of the investigations. Descriptions of several areas with discussions of surface structure will soon be ready for publication as progress reports and will be introductory to the detailed reports, which will involve the

major problems connected with the development of the oil fields. This work covers parts of Eastland, Palo Pinto, Stephens, Brown, San Saba, Comanche, and McCullough counties.

A reconnaissance examination of a part of the Coastal Plain bordering the Rio Grande, with special reference to the underground water resources and the broad structural features that may affect the occurrence of oil and gas in commercial amount, was begun in June by A. C. Trowbridge and A. G. Maddren. The area to be examined will include portions or all of Maverick, Dimmit, Webb, Lasalle, Zapata, Jim Hogg, Starr, Brooks, Willacy, Hidalgo, and Cameron counties and will adjoin on the southwest the area previously covered by Dr. Alexander Deussen.

The examination of well cuttings and brines in the saliferous red beds of eastern New Mexico, northern Texas, southwestern Kansas, and western Oklahoma was continued during the summer and autumn by R. K. Bailey, who visited many borings to obtain samples and records and conducted work in the laboratory at Amarillo. Later the work was carried forward in cooperation with the Texas Bureau of Economic Geology and Technology, with Orby C. Wheeler as cooperative investigator. No potash deposits of commercial importance have been discovered, but the rapid spread of wildcat drilling in the basins that are known or believed to contain great thicknesses of salt insures abundant data to determine the potash-yielding possibilities of the saliferous areas.

The results of studies of the general stratigraphy and structural features of portions of Grayson, Fannin, and Lamar counties are described in Professional Paper 120–H, by L. W. Stephenson, who was assisted in the field by O. B. Hopkins and Sidney Powers.

A popular discussion of the physical features in the vicinity of Kelly Fields and Camp Travis, near San Antonio, was prepared by Mr. Stephenson and printed on the back of the San Antonio map. The studies in Bexar County were made with the cooperation of Dr. J. A. Udden, director of the State bureau, to whom copies of Mr. Stephenson's notes and maps were forwarded.

A map of Lasalle and McMullen counties, showing the locations of all known artesian wells, was transmitted to the office of the Chief of Engineers, United States Army, as a contribution to the military map of southwest Texas. Information on water resources and data on material available for highway construction were also transmitted to the Chief of Engineers.

Supplemental work on the paper on "Ground waters of the Coastal Plain of Texas west of Brazos River" was done by Alexander Deussen, and another report by Mr. Deussen on the "Geology of the

Coastal Plain of Texas between Brazos and Nueces rivers" is awaiting publication by the Survey.

The middle and upper Eocene floras of Texas are described by Prof. E. W. Berry in a manuscript now awaiting publication, and a second manuscript by the same author entitled "An Eocene flora from trans-Pecos Texas" has been submitted for publication as Professional Paper 125–A. The early Tertiary Bryozoa of the State are described by F. Canu and R. S. Bassler in a monograph prepared for the Survey but being published as Bulletin 106 of the United States National Museum.

A short paper by G. H. Girty on the fossil faunas of the Bend group was contributed for publication by the Association of American Petroleum Geologists, and more detailed studies of the same faunas were begun. The revision and description of the Comanche faunas were continued by T. W. Stanton, who submitted a special report on a small collection from the Edwards limestone of central Texas and on Cretaceous invertebrates from Presidio County and from the Abilene quadrangle. Miocene invertebrates in southeastern Texas were examined by W. H. Dall, and reports on Tertiary fossils found in cuttings from several oil wells were made by C. Wythe Cooke.

Rumored occurrences of nitrate in Presidio and Brewster counties were examined by H. M. Robinson, and the results were reported to the appropriate military authorities.

The results of an investigation of the Santo Tomas coal field in Webb County by G. H. Ashley, have been published as Bulletin 691–I, "The Santo Tomas cannel coal, Webb County, Tex."

UTAH.

The specimens of manganese ores collected in connection with the search for war minerals in Utah have been examined mineralogically by J. T. Pardee, who has in preparation a report describing the manganese deposits of the State. Press bulletins have been issued covering these ores in central Utah, in the Tintic district, and in the Green River district.

A paper on "The Farnham anticline, Carbon County, Utah," by F. R. Clark, is now in press as Bulletin 711–A.

A comprehensive report on the "Ore deposits of Utah" (Professional Paper 111), by B. S. Butler, is in press. Progress has been made by Mr. Butler and F. C. Calkins in the preparation of a report on the Cottonwood and Park City mining districts.

Deposits of oil shale in the vicinity of Trout Creek, near the Nevada line, were examined by J. P. Buwalda, and oil shales at Devils Slide, Ogden Canyon, and Laketown, in San Pete County, and in the Uinta Mountains near Vernal were sampled by D. Dale Condit and Frank

Reeves for distillation tests. The results will appear in Bulletin 711–B. Oil-shale deposits near Ephraim were examined and sampled for analysis by Frank Reeves.

Collections of Cretaceous and Jurassic invertebrates from the southwestern part of the State were examined by T. W. Stanton.

VERMONT.

The geography of Vermont is described by Arthur Keith in a handbook on the geography of New England, which is nearly ready for publication as a bulletin of the Survey. This report, which is designed to serve as a manual for the use of the layman, as well as the teacher, is accompanied by a base map of New England on the scale of 8 miles to the inch, with the topography sketched in 250-foot contours.

The peat resources of the State are discussed by Prof. E. K. Soper in a comprehensive report on the peats of the Lake and Atlantic Coast States, with reference to their utilization as fuels and fertilizers.

General stratigraphic and areal studies in the State were practically suspended during the war.

VIRGINIA.

Information on the ground-water resources at several places in Virginia were furnished to Army and Navy officials. A special field examination and report was made by W. T. Lee and R. D. Mesler on the ground waters east of Williamsburg, between York and James rivers, for the officers at Camp Abraham Eustis. Data on the same area were furnished to the Board of Control. Information on available artesian water at the Lower Proving Ground, Machodoc Creek, Va., was supplied by T. W. Vaughan.

The site of the proposed dam to be erected across Accotink Creek at the crossing of the Southern Railway was inspected by Mr. Vaughan in compliance with a request received from the constructing quartermaster at Camp Humphreys, and an opinion was given on the nature of the foundation for the dam.

Special field studies of the Tappahannock, Morattico, Heathsville, Urbana, Kilmarnock, Williamsburg, Mathews, and Yorktown quadrangles were made by W. T. Lee, A. G. Maddren, R. D. Mesler, and W. C. Mansfield, particular attention being paid to the ground waters and to material for highway construction. The results of this field work were prepared in preliminary form, and the entire body of information was transmitted to the office of the Chief of Engineers, in compliance with a request received from his office, and was incorporated in the military map of Virginia.

The fossils obtained in connection with the areal geologic work in Virginia were identified by W. C. Mansfield and C. W. Cooke.

The physiographic features of the Coastal Plain and Piedmont provinces of the State were studied by T. W. Vaughan.

Miocene Foraminifera from Virginia are described by J. A. Cushman in Bulletin 676, and Miocene Bryozoa by F. Canu and R. S. Bassler in a bulletin being published by the United States National Museum.

Manganese deposits and the stratigraphy of the manganiferous formations in Craig, Alleghany, Shenandoah, Frederick, Pulaski, Wythe, and Bland counties were examined by G. W. Stose, F. C. Schrader, H. D. Miser, and E. F. Burchard, and a report describing the manganese belt and the more important deposits on the east side of the Shenandoah Valley, by Messrs. Stose, Miser, and Katz, has been published by the State Geological Survey, with which the work was done in cooperation. The chapter describing the mines of the belt was prepared by D. F. Hewett. Data on the manganese deposits are contained in a publication of the American Institute of Mining and Metallurgical Engineers, by E. C. Harder and D. F. Hewett.

Mr. Stose also examined salt deposits of southwestern Virginia, at the request of the State geologist.

In connection with the field examination of high-grade clays that may be suitable as substitutes for the imported clays, the clays at a number of localities in the State were examined by Prof. Heinrich Ries in company with Dr. T. L. Watson, State geologist. The results, including reports on tests of the samples, are included in a general report on the high-grade clay deposits of the United States, by Prof. Ries, now ready for submission.

Rutile deposits at Roseland, Nelson County, were studied by F. L. Hess, in cooperation with the Bureau of Mines, at the request of the War Department, and zirconiferous sands in the vicinity of Ashland, near Richmond, were examined by W. T. Schaller and A. G. Maddren with reference to their availability for military purposes.

A report on the coal area of Tazewell County, in preparation by T. K. Harnsberger was, after the resignation of the author, completed by G. H. Ashley and transmitted to the State for publication. The report on Buchanan County by Henry Hinds, forwarded to the State the previous year, has been issued by the State Geological Survey. Field work in Russell and Dickenson counties was begun in June by Chester K. Wentworth, of the Federal Survey, with whom was associated A. W. Giles for the State, the mapping being under the direct supervision of Mr. Ashley.

The peat deposits of the State are described by Prof. E. K. Soper in a general report on the peat resources of the Lake and Atlantic Coast States and their availability for use as fuel or fertilizer. A detailed description, with maps, of the peats in the Dismal Swamp district, by C. C. Osbon, is in course of publication as Bulletin 711–C.

Examinations in the field of portions of the Piedmont region were made by Laurence LaForge, and of the Valley regions by G. W. Stose, in connection with the preparation of material for use in the geographic manual of the Virginian region. A rough draft of the chapter by L. W. Stephenson covering the Coastal Plain area of Virginia, Maryland, and Delaware has been submitted. The need for special attention to military considerations being less important since the signing of the armistice, the texts for this manual are under revision with the object of making them more comprehensive and of more general interest to the layman.

WASHINGTON.

Local examinations of coal outcrops in the vicinity of Ladd, Lewis County, Wash., were made by M. R. Campbell, for the purpose of procuring data needed for the classification of the coal and the valuation of the public lands.

Quicksilver deposits in the Mount Stuart region, Kittitas County, were examined by J. T. Pardee, who also investigated a number of manganese ore deposits in the Olympic Mountains. The ores were later submitted by Mr. Pardee to mineralogic examination in the office. A report on the ores and their geology is now in preparation by Mr. Pardee. The information of special war use was promptly given to the press. Data on the deposits of manganese ore are contained in a review by E. C. Harder and D. F. Hewett of recent studies of domestic manganese deposits, published by the American Institute of Mining and Metallurgical Engineers.

Collections of Pleistocene invertebrates in the region of Puget Sound were identified by W. H. Dall.

WEST VIRGINIA.

The gas resources in the vicinity of Cabin Creek, Kanawha County, W. Va., were examined in behalf of the Navy Department by G. S. Rogers, assisted by Frank Reeves.

A report on the Abram Creek-Stony River coal field of Grant, Mineral, and Tucker counties, was completed by G. H. Ashley and submitted for publication in "Contributions to economic geology" (Bulletin 711–F).

Observations of the temperature at different depths in the Lake well, near Clarksburg, were made by C. E. Van Orstrand. This work was done in cooperation with the State geologist, who has studied the

log and cuttings from the well, which had reached the unique depth of 7,579 feet when, in the later part of June, it was abandoned as a result of caving.

The geographic features of the State have been described by M. R. Campbell and G. W. Stose in a handbook on the geography of the Virginian region, which is nearly ready for submission for publication as a bulletin.

WISCONSIN.

Some progress was made in the preparation of a paper on the Quaternary history of the Lake Superior region, by Frank Leverett.

The peat deposits of Wisconsin are discussed with reference to their possible utilization as fertilizer or fuel in a general report by Prof. E. K. Soper on the peat resources of the Lake and Atlantic Coast States. This bulletin has been submitted for publication.

Fossils of Cambrian age from a number of localities were examined by E. O. Ulrich in the course of a revision of the Cambrian faunas of the upper Mississippi Valley. These studies were conducted in cooperation with the State Geological Survey.

WYOMING.

A special investigation with detailed mapping of the leucite rock deposits of Zirkel Mesa, in Sweetwater County, Wyo., was made by H. S. Gale, and additional samples were taken with special reference to tonnage estimates of the leucite available for use in the production of potash.

Reports on the manganese deposits of the State, examined under war conditions, have been compiled by E. L. Jones, jr. The more important conclusions were promptly given to the press.

The phosphate deposits of the Wind River Range, near Lander, have been described in a manuscript transmitted by D. Dale Condit.

A discussion of the mode of occurrence of petroleum and of the prospective and possible regions of undiscovered oil fields in the State has been prepared by W. B. Emery for publication as a chapter of Bulletin 689, "The oil resources of the public-land States."

The stratigraphy, structure, and oil prospects in the vicinity of Maverick Springs, in the Wind River Basin, and near Thermopolis were examined by A. J. Collier and Harvey Bassler. Reports on oil in the Warm Springs and Hamilton domes, on the anticlines in the Maverick Springs field, and on the Big Sand Draw anticlines have been submitted for publication in "Contributions to economic geology" (Bulletin 711).

The detailed examination of the geology and structure of the Lance Creek coal field was completed by E. T. Hancock, and a report by Mr. Hancock is practically ready for submission.

Deposits of oil shale near Cookeville, Crawford Mountains, and Fossil were examined and sampled by D. Dale Condit, assisted by Frank Reeves.

Reports on collections of Carboniferous fossil invertebrates were made by G. H. Girty, on Cretaceous invertebrates by T. W. Stanton, and on Eocene fossils from the Wind River region by W. H. Dall.

A report on the "Oil possibilities in and around Baxter Basin, in the Rock Springs uplift, Sweetwater County, Wyo.," by A. R. Schultz, has been transmitted for publication as a bulletin.

In June a detailed study of the Rock River coal and oil fields was begun by E. T. Hancock, assisted by C. E. Dobbin.

CANAL ZONE.

A report on the geology and paleontology of the Canal Zone, based on investigations made in compliance with an agreement between the Panama Canal Commission, the Smithsonian Institution, and the Geological Survey, has been prepared under the general supervision of T. W. Vaughan, with the cooperation of other geologists and paleontologists of the National Museum, the New York Botanical Garden, Harvard University, and the Carnegie Institution, and published as Bulletin 103 of the United States National Museum. It includes the following papers:

On some fossil and recent Lithothamnieae of the Panama Canal Zone, by Marshall A. Howe.

The fossil higher plants from the Canal Zone, by E. W. Berry.

The smaller fossil Foraminifera of the Panama Canal Zone, by Joseph A. Cushman.

The larger fossil Foraminifera of the Panama Canal Zone, by Joseph A. Cushman.

Fossil Echini of the Panama Canal Zone and Costa Rica, by Robert Tracy Jackson.

Bryozoa of the Canal Zone and related areas, by Ferdinand Canu and Ray S. Bassler.

Decapod crustaceans from the Panama region, by Mary J. Rathbun.

Cirripedia from the Panama Canal Zone, by Henry A. Pilsbry.

Fossil corals from Central America, Cuba, and Porto Rico, with an account of the American Tertiary, Pleistocene, and recent coral reefs, by Thomas Wayland Vaughan.

The sedimentary formations of the Panama Canal Zone, with special reference to the stratigraphic relations of the fossiliferous beds, by Donald Francis MacDonald.

The biologic character and geologic correlation of the sedimentary formations of Panama in their relation to the geologic history of Central America and the West Indies, by Thomas Wayland Vaughan.

A paper by Dr. D. F. MacDonald, formerly commission geologist, in which the general geologic features and geologic resources of the Panama Canal Zone and adjacent areas are described, was submitted some time ago but has not yet been published. A large collection of fossil Mollusca made by Drs. MacDonald and Vaughan still awaits adequate investigation.

HAWAII.

The molluscan faunas of Hawaii have been the subject of systematic examination by W. H. Dall.

PORTO RICO.

An examination of the manganese deposits of Porto Rico, both developed and reported, that might be utilized as sources of manganese supply for the United States, was completed early in July by Max Roesler, who submitted an informal report for the information of the governmental organizations interested.

In compliance with a request received from the Acting Secretary of the Navy, an investigation of the ground-water resources of eastern Porto Rico between Cape San Juan and Ensenada Honda was made by T. W. Vaughan during June. He also made a geologic reconnaissance of Culebra and Vieques islands with particular reference to the ground-water resources.

VIRGIN ISLANDS.

By request of the Acting Secretary of the Navy and the governor and naval commandant of the Virgin Islands, T. W. Vaughan made geologic reconnaissances, with particular reference to ground-water resources, of the islands of St. Thomas, St. John, and St. Croix during May and June. A paper entitled "Some features of the Virgin Islands of the United States" was read by Mr. Vaughan at the Baltimore meeting of the Association of American Geographers (December, 1918), and an abstract of it is in press as a part of the forthcoming Annals of the Association.

OTHER COUNTRIES.

Canada.

In continuation of the cooperation of the United States Geological Survey with the Geological Survey of Canada, collections of invertebrate fossils from Alberta and Saskatchewan were examined and reported on by T. W. Stanton, and Pleistocene invertebrates from the Arctic coast were identified by W. H. Dall, whose report on Tertiary and Pleistocene fossils collected by the Canadian Arctic Expedition is in press as Professional Paper 125–C.

Mexico and Central America.

Mexico.—Late Tertiary invertebrates from Lower California were identified by W. H. Dall and C. Wythe Cooke. A study of Mexican Foraminifera by J. A. Cushman is mentioned below, in connection with the work in Nicaragua.

Costa Rica and Panama.—In order to procure more definite data as to the value of certain reported manganese ores in Costa Rica, arrangement was made for the examination of these deposits by J. D. Sears, whose report, with maps of the more important manganese localities, has been submitted for publication in "Contributions to economic geology" (Bulletin 710–B). The ores from Costa Rica were studied

in the office by E. L. Jones, jr. Mr. Sears also examined several manganese deposits in Panama, and the results of these studies are given in the same pamphlet.

Nicaragua.—Fossil Foraminifera from Nicaragua and Mexico are described by J. A. Cushman in a paper on the genus *Lepidocyclina* and another on the genus *Orthophragmina*, submitted for publication.

West Indies.

General.—As a product of the geologic explorations conducted in cooperation with the Carnegie Institution, the Smithsonian Institution, and the New York Botanical Garden, under the general supervision of T. W. Vaughan, a volume has been submitted to the Carnegie Institution and is now in press as Publication 291 of that institution. It contains the following papers:

Introduction, by Thomas Wayland Vaughan.
Fossil calcareous algae from the Leeward Islands, by Marshall A. Howe.
Fossil Foraminifera from the West Indies, by Joseph Augustine Cushman.
Fossil Bryozoa from the West Indies, by Ferdinand Canu and Ray S. Bassler.
Fossil Mollusca from the Leeward Islands and Cuba, by Charles Wythe Cooke.
Fossil decapod Crustacea from the West Indies, by Mary J. Rathbun.

These papers, with the exception of the one by Mr. Cooke and a little work by Messrs. Cushman and Vaughan, were prepared without expense to the Geological Survey, but this organization encouraged and so far as was practicable cooperated in their preparation.

Dominican Republic.—Certain reported deposits of chromite ore in the Dominican Republic were examined late in June and early in July, 1918, by H. G. Ferguson, and the information gathered, with reference to the practicability of procuring supplies of chromite or manganese from that region in substitution for supplies brought from remote countries, was submitted to the proper governmental authorities.

In compliance with a request from the military government of the Dominican Republic that a geologic survey of that Republic be undertaken under the scientific direction of the United States Geological Survey, T. W. Vaughan, accompanied by D. Dale Condit, C. W. Cooke, and C. P. Ross, left New York for Santo Domingo on March 24. A general geologic reconnaissance of the Republic, except the peninsula south of Samana Bay, was made during April, May, and June. Except Mr. Vaughan's salary the entire expenses of this work were borne by the Dominican Government. The mode of procedure to be followed in the survey of the Republic was planned, and collections of invertebrates were made in order to facilitate the differentiation of the formations and the determination of their age in advance of the mapping, which should follow the preparation of the necessary topographic base.

Fossils from the Dominican Republic were studied by Messrs. Cushman, Vaughan, Canu and Bassler, and Cooke.

Haitian Republic.—At the request of the civil officers of the Republic of Haiti, T. W. Vaughan in April visited Port au Prince and made arrangements for a preliminary geologic survey of Haiti, the work to be conducted under the general supervision of the United States Geological Survey.

Collections of fossils from Haiti were studied by J. A. Cushman, T. W. Vaughan, and C. W. Cooke.

Cuba.—The cooperative investigations of the principal chromite and manganese deposits of Cuba by E. F. Burchard and Albert Burch (mentioned in the annual report for 1917–18) have been described by Mr. Burchard in papers published by the American Institute of Mining and Metallurgical Engineers. These papers and a press bulletin of the Survey, subsequently translated into Spanish and published by the Cuban Bureau of Mines, have helped to call attention to the importance of exploring and developing the mineral resources of the island in general, with the result that the Cuban Government is planning a geologic survey, in which the United States Department of the Interior has assured its cooperation. Numerous data have been furnished to officials of Cuba in regard to organization, scope, and methods of geologic work, and arrangements have been made for assistance to the Cuban Government in petrologic and paleontologic studies.

A series of samples from three deep wells in Cuba, bored near the city of Cardenas, were studied in detail by A. G. Maddren, under the direction of T. W. Vaughan.

Fossils from Cuba were examined and identified by J. A. Cushman, T. W. Vaughan, and C. W. Cooke. Many fossil organisms from Cuba are described in Bulletin 103 of the United States National Museum and in Publication 291 of the Carnegie Institution of Washington.

Leeward Islands.—A number of fossil organisms from the Leeward Islands are specially described in Publication 291 of the Carnegie Institution.

Trinidad.—Valuable collections of Tertiary fossils from Trinidad were forwarded by Messrs. F. W. Penny and J. A. Bullbrook to T. W. Vaughan. These fossils were studied by Mr. Vaughan and J. A. Cushman, who prepared manuscripts on the corals and the Foraminifera.

South America.

Venezuela.—Eocene Mollusca from Venezuela have been studied and reported on by W. H. Dall and C. W. Cooke.

Peru.—A small but important collection of Eocene corals from Peru was described by T. W. Vaughan for Prof. Henry Woods, of Sedgwick Museum, Cambridge, England.

Argentina.—Collections of Tertiary invertebrates from Argentina have been under study by W. H. Dall.

DIVISION OF ALASKAN MINERAL RESOURCES.

APPROPRIATION AND CLASSES OF WORK.

Under the appropriation of $75,000 made for the continuation of the investigation of the mineral resources of Alaska the work of the Geological Survey in Alaska has been continued as far as possible. As most of the topographers and several of the geologists of the Alaska division have entered the Army or have been assigned to tasks connected with the prosecution of the war, it has not been possible to attempt to maintain all the customary work. The work of the division during the year has therefore been directed toward those tasks of special immediate importance which have included investigations of deposits of chromite and tin ore, surveys and investigations in the region that is being developed by the Government railroad, and the continuation of records of stream flow in southeastern Alaska and of mineral production throughout the Territory.

PERSONNEL.

On July 1, 1918, the personnel of the division consisted of 1 acting geologist in charge, 7 geologists, 1 topographic engineer, 1 hydraulic engineer, and 3 clerks on annual salaries, 3 geologists on per diem salaries, and 10 temporary field employees. On June 30, 1919, the personnel included 1 geologist in charge, 7 geologists, 4 topographers, 1 hydraulic engineer, 1 draftsman, and 3 clerks on annual salaries, and 9 temporary field employees.

Of the members of the division who have been engaged in active military service Lieut. Col. Alfred H. Brooks, Capt. E. M. Aten, and Lieut. George L. Harrington returned to their former positions in the Geological Survey on May 5, February 8, and April 12, respectively. Maj. J. W. Bagley and Capt. C. E. Giffin are still engaged in active military service.

FIELD WORK DURING THE SEASON OF 1918.

Areas covered and allotments.—Ten parties were engaged during 1918 in Alaska surveys and investigations. Eight of the parties were engaged in geologic surveys, one in topographic surveys, and one in stream gaging. The areas covered by reconnaissance geologic surveys on a scale of 1:250,000 (4 miles to an inch) amount to 3,500 square miles. Much of the time of the geologists was devoted to the investigation of special problems relating to the occurrence of economic minerals, the results of which can not be expressed in terms of area. About 1,200 square miles was covered by reconnaissance topographic surveys on a scale of 1:250,000 (4 miles to an inch). In cooperation with the Forest Service, stream gaging was continued in southeastern Alaska. Of the parties whose work may be classified geographically, three parties worked in southeastern Alaska, three in the Cook Inlet-Susitna region, one in the Yukon Basin, and two in Seward Peninsula.

The funds available for the fiscal year ending June 30, 1919, included the specific appropriation of $75,000 and a statutory salary of $2,000. In addition to these funds, about $15,800 of the unexpended balance of the appropriation for the year ending June 30, 1918, was used in equipping parties for the season's field work. The following tables show the allotments, including both field and office work, of the appropriation for the year ending June 30, 1919, classified by regions, by kinds of surveys, and by kinds of expenditures. In the first table the general office expenses are apportioned to the several allotments, account being taken of variations in character of work. The results are expressed in round numbers. Salaries of the permanent staff, other fixed charges, and the total allotments for the work of the Anchorage and Juneau offices are included up to the end of the fiscal year 1919, but expenses other than these include only the cost of field and office work during 1918. The "general investigations" include, among other things, the collection of mineral statistics, office work relating to the field investigations of previous seasons, and investigations under the direct administration of the geologic branch. A balance of about $16,500 is available for equipping the field parties in 1919.

Approximate general distribution of appropriations for Alaska investigations, 1918–19.

Southeastern Alaska	$15,800
Copper River and Prince William Sound	1,300
Cook Inlet and Susitna Basin	19,700
Yukon basin	8,500
Seward Peninsula	7,300
General investigations	7,900
To be allotted to field work, 1919	16,500
	77,000

Approximate allotments to different kinds of surveys and investigations, 1918–19.

Reconnaissance geologic surveys	$13,000
Special geologic investigations	17,500
Reconnaissance topographic surveys	4,300
Investigation of water resources	5,100
Collection of mineral statistics	1,800
Miscellaneous, including administration, inspection, clerical salaries, office supplies and equipment, and map compilation	18,800
To be allotted to field work, 1919	16,500
	77,000

Allotments for salaries and field expenses, 1918–19.

Scientific and technical salaries	$26,328
Field expenses	20,259
Clerical and administrative salaries and miscellaneous expenses	13,913
To be allotted to field work, 1919	16,500
	77,000

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 a varying amount is spent each year on special investigations that yield results which can not be expressed in terms of area.

Progress of surveys in Alaska, 1898–1918.

Year.	Appropriation.	Areas covered by geologic surveys.			Areas covered by topographic surveys.[a]					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.	Stream volume measurements.
		Sq. m.	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Miles.*			
1898	$46,189	9,500	.....	.....	12,840	2,070	.....	.....	.....	.....	.....
1899	25,000	6,000	.....	.....	8,690	.....	.....	.....	.....	.....	.....
1900	60,000	3,300	6,700	.....	630	11,150	.....	.....	.....	.....	.....
1901	60,000	6,200	5,800	.....	10,200	5,450	.....	.....	.....	.....	.....
1902	60,000	6,950	10,050	.....	8,330	11,970	96	.....	.....	.....	.....
1903	60,000	5,000	8,000	96	.....	15,000	.....	.....	.....	.....	.....
1904	60,000	4,050	3,500	.....	800	6,480	480	86	19	.....	.....
1905	80,000	4,000	4,100	536	.....	4,880	787	202	28	.....	.....
1906	80,000	5,000	4,000	421	.....	13,500	40	.....	.....	14	286
1907	80,000	2,600	1,400	442	.....	6,120	501	95	16	48	457
1908	80,000	2,000	2,850	604	.....	3,980	427	76	9	53	556
1909	90,000	6,100	5,500	450	6,190	5,170	444	.....	.....	81	703
1910	90,000	.....	8,635	321	.....	13,815	36	.....	.....	69	429
1911	100,000	8,000	10,550	496	.....	14,460	246	.....	.....	68	309
1912	90,000	.....	2,000	525	.....	.....	298	.....	.....	69	381
1913	100,000	3,500	2,950	180	3,400	2,535	287	.....	.....	.....	.....
1914	100,000	1,000	7,700	325	600	10,300	10	.....	.....	.....	.....
1915	100,000	.....	10,700	200	.....	10,400	12	3	2	9	.....
1916	100,000	.....	5,100	636	.....	9,700	67	.....	.....	20	.....
1917	100,000	.....	1,750	275	.....	1,050	.....	.....	.....	19	.....
1918	77,000	.....	3,500	.....	.....	1,200	.....	.....	.....	.....	.....
	1,638,189	73,200	104,785	5,507	51,680	149,230	3,731	462	74	.....	.....
Percentage of total area of Alaska	.....	12.48	17.87	0.94	8.81	25.45	0.64	.....	.....	.....	.....

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

General work.—Alfred H. Brooks, geologist in charge of the division of Alaskan mineral resources, was engaged in military duty as lieutenant colonel of engineers, U. S. Army, and chief geologist of the American Expeditionary Forces until May 5. Since his return he has been engaged in work on problems in military geology and in the reading of referred manuscripts.

G. C. Martin, acting geologist in charge, was engaged in office work until July 26, when he started for Alaska. The time from August 12 to August 26 was devoted to a review of mining developments and

collection of statistics in the Fairbanks district. Some of the mines in the Chitina Valley were visited during the first week in September. He then spent one day in consultation with Mr. Chapin concerning the work of the office in Anchorage, and returned to Washington on September 26. In the office Mr. Martin devoted 74 days to the preparation of the progress, administrative, and statistical reports, 28 days to revision of papers and proof reading, 12 days to the preparation of the annual press bulletin, 19 days to field plans, and 108 days to administrative and miscellaneous duties. During Mr. Martin's absence in Alaska F. H. Moffit was acting geologist in charge and devoted considerable time to executive work.

During the absence of Capt. E. M. Aten on military service and since his resignation Miss Lucy M. Graves has continued as office assistant to the acting geologist in charge, and T. R. Burch has assisted in the collection and compilation of mineral statistics.

The preparation of a general summary report on the geography, geology, and mineral resources of the region tributary to the Government railroad was begun in January by S. R. Capps.

B. L. Johnson was engaged in the preparation of reports on the Prince William Sound region till January 24, when he was detailed to special work in the division of mineral resources.

Southeastern Alaska.—The investigation of the water resources of southeastern Alaska, begun in 1915 under a cooperative agreement with the Forest Service, was continued by G. H. Canfield, who maintained automatic gages throughout the year. In addition to these gages, others were installed in cooperation with individuals and corporations. This work could not have been carried on without the cordial cooperation of the Forest Service, many members of which have given substantial aid; particular acknowledgment should be made to W. G. Weigle, special agent at Ketchikan, and to Philip H. Dater, district engineer at Portland, Oreg.

A reconnaissance of the geology and mineral deposits of Admiralty Island and of the eastern part of Chichagof Island was made by Edwin Kirk. Field work was begun on May 31 and continued till August 27. An area of about 1,500 square miles was mapped on the scale of 1:200,000.

A study of the Carboniferous rocks of southeastern Alaska was assigned to George H. Girty, who studied the stratigraphy and made large collections of fossils from June 1 to July 30.

Cook Inlet and Susitna regions.—Because of the importance of the region tributary to the Government railroad and the growing demand for information concerning it, a special effort is being made to complete the mapping of that region.

A topographic reconnaissance survey of an area adjacent to the Government railroad between Talkeetna River and Broad Pass was made by D. C. Witherspoon from June 20 to September 19. An area of about 1,200 square miles was mapped on a scale of 1:180,000.

A special investigation of the chromite deposits of Port Chatham and Red Mountain, on lower Cook Inlet, was made by Prof. A. C. Gill, of Cornell University, who was engaged in field work from July 1 to August 25.

Detailed investigations of the structure and coal beds in the vicinity of the Matanuska coal mines were made by Theodore Chapin throughout the summer. Mr. Chapin also collected information concerning mining in the Willow Creek, Cook Inlet, Kenai Peninsula, and Prince William Sound districts.

Yukon region.—A geologic reconnaissance survey of the Tolovana placer district was made by R. M. Overbeck, who was engaged in this work from June 18 to September 25. An area of about 2,000 square miles was mapped on the scale of 1:250,000. Mr. Overbeck also collected data on the production of placer gold in the Tolovana and Rampart districts.

The placer and lode mines of the Fairbanks district were visited by G. C. Martin from August 11 to 26 for the purpose of obtaining information concerning recent mining conditions and developments.

Investigations of the Carboniferous rocks of the upper Yukon were made by George H. Girty in August.

Seward Peninsula.—A special examination of the tin deposits of the York district was made by Edward Steidtmann and S. H. Cathcart, who devoted the time from July 5 to September 16 to this work. Studies were made of the extent, occurrence, and origin of the known tin deposits, and of the stratigraphy and structure of the rocks associated with them. An area of about 50 square miles was mapped geologically on the scale of 1:125,000 and the reconnaissance mapping of additional areas was revised.

After the end of field work in the York district Mr. Cathcart made investigations of general mining developments in Seward Peninsula. He was engaged in this work till October 28.

FIELD WORK FOR THE SEASON OF 1919.

Field work was begun before the end of the fiscal year (during May and June) by three parties, as indicated below. S. R. Capps, assisted by S. H. Cathcart, began a geologic reconnaissance survey of the upper Kantishna district. Mr. Capps was accompanied by T. P. Pendleton, who will make a topographic reconnaissance survey of the same district. J. R. Eakin and R. M. Overbeck began a topographic and geologic reconnaissance survey of the Talkeetna-Broad Pass district R. H. Sargent and G. L. Harrington began a topographic and geologic

reconnaissance survey of the Goodnews Bay district. Theodore Chapin, in addition to maintaining the branch office of the Geological Survey at Anchorage, is engaged in geologic investigations in the Matanuska coal field for the benefit of the Alaskan Engineering Commission and of the Navy Department. G. H. Canfield is continuing the investigation of the water powers of southeastern Alaska in cooperation with the Forest Service. All the surveys and investigations will continue into the fiscal year 1919–20.

ALASKA OFFICE.

The branch office of the Geological Survey at Anchorage, in charge of Theodore Chapin, was maintained throughout the year. The main purpose of this office is to provide the means of close cooperation between the Geological Survey and those in charge of the operation of the Government coal mines in the Matanuska Valley. It is also the purpose of the resident geologist to do everything possible to aid the mining industry in the region tributary to the Government railroad, to keep in close touch with all local developments in mining and prospecting, and to furnish whatever aid may be rendered by giving information, advice, and publications to all who are engaged in mining and prospecting.

COLLECTION OF STATISTICS.

The collection of statistics of production of metals in Alaska, begun by the Alaska division in 1905, was continued as usual. Preliminary estimates of mineral production for 1918 were published on January 1, 1919.

PUBLICATIONS.

During the year the Survey published two professional papers (Nos. 109 and 120–D), and five bulletins (Nos. 662, 664, 668, 683, and 687) relating to Alaska. Nine topographic maps (Juneau and vicinity by D. C. Witherspoon, scale 1:24,000, contour interval, 50 feet; Pls. I, III, IV, and V, Professional Paper 109; Pl. I, Bulletin 668; Pls. I and II, Bulletin 683; and Pl. I, Bulletin 687) were published during the year.

One bulletin (No. 692) was in press at the end of the year.

Manuscripts of the following reports are completed:

Bulletin 682. Marble resources of southeastern Alaska, by E. F. Burchard and Theodore Chapin.

Bulletin 699. The Porcupine district, Alaska, by H. M. Eakin.

A geologic reconnaissance in the northern part of the Yukon-Tanana region, Alaska, by Eliot Blackwelder.

The geology and mineral resources of Latouche and Knight Island districts, Alaska, by B. L. Johnson.

The Port Valdez and Jack Bay district, Alaska, by B. L. Johnson.

The western Talkeetna Mountains, Alaska, by S. R. Capps.

Chromite of Kenai Peninsula, by A. C. Gill.

The geology of the Cape York tin deposits, by Edward Steidtmann and S. H. Cathcart.

A geologic reconnaissance of part of the Tolovana-Hess River district, by R. M. Overbeck.

The following reports are in hand:

Geology of the Glacier Bay and Lituya region, Alaska, by F. E. Wright.

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

The upper Matanuska basin, by G. C. Martin.

The Yakataga district, Alaska, by A. G. Maddren.

The Mesozoic stratigraphy of Alaska, by G. C. Martin.

The Kotsina-Kuskulana district, by F. H. Moffit.

The lower Kuskokwim region, by A. G. Maddren.

The Ruby-Kuskokwim region, Alaska, by J. B. Mertie, jr., and G. L. Harrington.

The Cretaceous and Tertiary floras of Alaska, by Arthur Hollick.

The Juneau district, Alaska, by A. C. Spencer and H. M. Eakin.

The Ketchikan district, Alaska, by Theodore Chapin.

The Seward-Fairbanks route, by S. R. Capps.

The geology of parts of Admiralty and Chichagof islands, by Edwin Kirk.

Office work on the maps listed below has been completed:

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

Lower Kuskokwim region, by A. G. Maddren; scale, 1:500,000; contour interval, 400 feet.

Ruby district, by C. E. Giffin and R. H. Sargent; scale, 1:250,000; contour interval, 200 feet.

The following topographic maps are in hand:

Innoko-Iditarod region, by R. H. Sargent and C. E. Giffin; scale, 1:250,000; contour interval, 200 feet.

Anchorage-Matanuska region, by J. W. Bagley and others; scale, 1:250,000; contour interval, 200 feet.

Yukon-Tanana Valley; compiled; scale, 1:500,000; contour interval, 400 feet.

Glacier Bay region; compiled; scale, 1:250,000; contour interval, 200 feet.

Port Wells region, by J. W. Bagley; scale, 1:250,000; contour interval, 200 feet.

Jack Bay district, by J. W. Bagley; scale, 1:62,500; contour interval, 50 feet.

Fidalgo-Gravina district, by D. C. Witherspoon; scale, 1:250,000; contour interval, 200 feet.

Susitna-Chulitna district, by D. C. Witherspoon; scale, 1:250,000; contour interval, 200 feet.

Seward-Fairbanks route; compiled; scale, 1:250,000; contour interval, 200 feet.

DIVISION OF MINERAL RESOURCES.

The staff of the division of mineral resources during the fiscal year 1918–19 comprised 35 geologists and engineer specialists, of whom 16 devoted essentially their entire time to the work of the division, the remainder dividing their time with the division of geology or with the division of chemistry and physics. The clerical and statistical force numbered 48, all of whom devoted full time to work on

mineral resources. Most of the members of this staff were employed in Washington, but branch offices were maintained in Denver, Salt Lake City, and San Francisco, as stated on page 117. The work of the division was conducted essentially upon a war basis from July to December, inclusive, and was readjusted to the peace-time basis in January. By order of the Director, dated January 2, 1919, Edson S. Bastin was designated as geologist in charge of the division, in place of H. D. McCaskey. Mr. McCaskey, who had continued his administrative duties throughout the war at considerable personal sacrifice and detriment to his health, was, at his own request, relieved of administrative duties, though retaining his connection with the division in an advisory capacity and for the pursuance of special investigations. G. F. Loughlin was relieved of his duties as geologist in charge of the section of nonmetals and placed in charge of the section of metals, the duties of the latter position having been carried previously by Mr. McCaskey in addition to his duties as chief of the division. A new section on mineral fuels was organized and placed in charge of C. E. Lesher. R. W. Stone was placed in charge of the section of nonmetals except fuels. A new section on foreign mineral deposits was created to continue and expand the work on foreign mineral resources which had been carried on during the last year of the war in preparation for the Peace Conference. J. B. Umpleby was placed in charge of this section.

Other changes in the personnel during the year included the resignation, effective February 8, of J. D. Northrop, for a number of years in charge of the statistical work on petroleum, natural gas, natural-gas gasoline, and asphalt. Mr. Northrop was succeeded by E. Russell Lloyd, who was transferred from the division of geology, and on May 22 E. G. Sievers was appointed to conduct the statistical work on natural gas and natural-gas gasoline, under Mr. Lloyd's general supervision. G. W. Stose relieved J. M. Hill of the work of specialist in charge of barytes and strontium.

The section of cooperation, in charge of Mr. Bastin, discontinued on January 2 under the order of reorganization, had been active from July until after the armistice in supplying information on mineral matters to other Government departments, particularly the military establishments and war boards. After July a large share of this cooperative work was directed by F. J. Katz, Mr. Bastin having been assigned by the Survey as mineral adviser to the Bureau of Research of the War Trade Board, an assignment resulting in fuller utilization of the mineral information of the Survey in all matters relating to foreign trade. The weekly statistics of production of copper, lead, zinc, and aluminum were furnished for the guidance of the Government purchasing agencies until January, 1919. A system of monthly reports covering the raw mineral materials of chief war

importance was established, beginning in June, 1918, with the issuance of diagrams showing graphically the available supply of each mineral month by month. These were replaced in September by a series of monthly mimeographed tables showing not only the supplies made available during the month but the estimated requirements from various sources during the remainder of the calendar year. These tables were prepared by the Survey in cooperation with the War Industries Board and the mineral specialists of the Shipping Board and were supplemented in October by a mimeographed monthly bulletin, also prepared cooperatively, reviewing the situation for a number of war minerals. Two numbers of this monthly bulletin were issued and were widely distributed within the Government departments. The establishment of this thorough system of regular monthly reports covering the mineral commodities of greatest war importance during October and November shows that in war management of mineral resources, as in so many other lines of war activities, the country had just about struck its gait at the time Germany yielded. The division of mineral resources also assisted during the months of July to November in the work of the Capital Issues Committee in the Treasury Department. By contributions of geologic information and by the judgment of its experienced specialists it aided this committee in directing capital into the fields of maximum usefulness under a war régime.

During the year the division also contributed reports on mercury, graphite, phosphate rock, manganese, antimony, tungsten, magnesite, emery and corundum, bauxite and aluminum, and platinum to a series of mimeograph pamphlets issued as Interior Department publications, under the direction of J. E. Spurr of the Bureau of Mines. These pamphlets dealt with the political and commercial control of these commodities throughout the world and were widely circulated among Government departments. Specialists of the division also contributed chapters on mineral commodities to reports on economic conditions in Japan and Sweden, prepared by the Bureau of Research of the War Trade Board.

The work of the section of cooperation was closely linked with the activities of the Joint Information Board on Minerals and Derivatives, of which Mr. Bastin was executive secretary and Mr. Katz assistant secretary. This informal interdepartmental board, representing 36 divisions and bureaus in the Government, was organized in February, 1918, to insure a better coordination and a minimum of duplication among bureaus and boards concerned with mineral matters and to provide a broader channel for the exchange of mineral information. Under the chairmanship of Pope Yeatman, of the War Industries Board, this information board performed a useful service, although handicapped by the failure of certain branches of the War Industries

Board to cooperate fully in its activities. As the war activities of the Government in minerals became better organized and more fully understood by all concerned the need for the information board declined, and between July 1 and the date of the armistice only two meetings were held, these being devoted to the nitrate and petroleum situations. A voluminous index of the mineral information in the possession of several Government organizations was compiled and was published in mimeograph form through the cooperation of the Central Bureau of Planning and Statistics in October. The Joint Information Board formally went out of existence on January 1, 1919, its records being deposited with the division of mineral resources of the Geological Survey.

The cooperation between the division and the Fuel Administration in the collection of statistics of the coal and coke industries, begun in October, 1917, was continued throughout the year. Through this cooperation the scope of the statistical work was greatly enlarged and the basis of frequency increased from annual to weekly and daily. This work was in charge of C. E. Lesher, who served in the dual capacity of geologist in charge of coal and coke statistics for the Survey and director of the bureau of statistics in the Fuel Administration. Mr. Lesher was assisted by W. T. Thom, jr. The result of this cooperation has been the accumulation of a vast fund of information on the production, distribution, consumption, and stocks of coal in the United States in 1917, 1918, and 1919, in a degree of detail and a frequency interval that would not have been possible with the limited Survey staff. Most of the detailed information will be published by the Fuel Administration, but the volumes of Mineral Resources will contain summaries of the more essential data. The staff employed in the busiest period in this cooperative work numbered about 450, as against 6 employed by the Survey prior to the war, the additional force being carried on the appropriation of the Fuel Administration. After the armistice the work of the Fuel Administration was gradually curtailed, and on June 30, 1919, it ceased entirely. A by-product of the cooperative work of the Fuel Administration was a report by Mr. Lesher on the history of coal prices during the war, contributed to a series of price studies compiled by the War Industries Board.

The increased frequency with which statistics of many of the mineral industries were obtained during the war had many obvious advantages, even for peace times. Monthly statistics of petroleum production had been begun in 1917, even before the United States entered the war, and will be permanently continued. The issuance of the weekly coal report could not be continued beyond the end of the fiscal year by the Survey's staff alone, but through the aid of clerical and other cooperative assistance obtained from the National

Coal Association its continuance is assured for several months at least, and it is hoped that the work may be made permanent. The weekly statistics of production of copper, lead, zinc, and aluminum collected during the war were never made public, but were obtained solely for the guidance of Government purchasing agencies. A special campaign of correspondence, undertaken after the armistice, to determine whether the industries concerned would cooperate with the Survey in the continued collection of these statistics on a monthly basis for publication showed that many of the larger producers did not desire the publication of such monthly statistics of production, although some were willing that they should be published, provided monthly statistics of consumption were also made public. On January 1, therefore, the statistics for these metals reverted to an annual and semiannual basis.

As for many years past, the division of mineral resources continued to maintain three branch offices in the mining States in the West, with the dual purpose of collecting statistics of mine production of gold, silver, copper, lead, and zinc with greater expedition and accuracy than is possible from Washington and of making Survey information more readily and quickly available to the mining interests of these communities. The personal contact between the technical men in charge of these offices and the mining men of their districts greatly facilitates the Survey work. The offices at Denver, Salt Lake City, and San Francisco are in direct charge of C. W. Henderson, V. C. Heikes, and C. G. Yale, respectively. In the Denver office are prepared the mine reports for South Dakota, Wyoming, Colorado, and New Mexico; in the Salt Lake City office the reports for Montana, Idaho, Washington, Utah, Nevada, and Arizona; and in the San Francisco office the reports for California and Oregon.

The work of compiling atlases and accompanying texts and card indexes showing the mineral production and resources of foreign countries carried on during the war by a group of Survey geologists in cooperation with the Department of State and in preparation for the Peace Conference, was, by the Director's order of January 2, placed on a permanent peace basis by the creation of the section of foreign mineral deposits under the continued guidance of J. B. Umpleby. Prior to the reorganization the following Survey geologists were engaged, for the major part of their time, on various phases of this work: Adolph Knopf, A. C. Spencer, H. G. Ferguson, S. R. Capps, Max Roesler, Eugene Stebinger, Miss E. F. Bliss, and Miss D. Monical. W. C. Alden and W. T. Lee were also associated with this work for brief periods. The staff, after the reorganization, included Mr. Stebinger, Mr. Roesler, B. L. Johnson, G. C. Martin, and Miss Monical. The organization of this work on a permanent basis was undertaken in recognition of the rapidly growing interest

of Americans in the development of trade with foreign countries and in investment in foreign mining enterprises and from a realization born of the war of the importance of certain foreign resources in our own domestic economy. Prior to the armistice the information collected had been kept confidential, but after the armistice most of it was made available to American capitalists and engineers interested in foreign mineral deposits by placing it in open files whose availability was widely advertised to the mining profession. At the same time mining men were urged to aid in the work of further compilation by making available to the Survey the unpublished reports of their engineers and geologists. Cooperation with the mining profession thus begun is proceeding satisfactorily, and this pooling of information from many sources will prove of inestimable benefit not only to the Government but to American commercial interests. A plan of organization in the section of foreign mineral deposits includes the assignment of each continent to a specialist; the exception is the assignment of coal and oil from all continents to one specialist because of the particular problems involved. Much information is now in hand for all continents, and atlases showing the mineral reserves of Europe and Latin America have been completed though not yet published. The world atlas of production has also been completed and during the last months of the fiscal year was being prepared for publication. The work of the section will be published only in part in the chapters of Mineral Resources of the United States; more of the material will be issued as bulletins and separate atlases with accompanying texts.

The work relating to foreign mineral resources is not confined, however, to this section. For many years the chapters of Mineral Resources have contained tables of world production for certain commodities and have reported various foreign developments of interest to American producers. In most of the reports for the calendar year 1918 much more attention has been devoted to foreign production and developments and resources than ever before, and the assembling of information on foreign deposits by the commodity specialist will proceed simultaneously with the studies of the continent specialist, each group strengthening the other.

In April, 1919, under the auspices of the foreign trade advisers of the Department of State, the Economic Liaison Committee was organized, comprising a representative of each Government department concerned in any important degree with foreign trade matters. The purpose of this committee has been to focus on certain foreign trade problems the expert knowledge of specialists in various Government departments, thus promoting harmonious and well-considered action among all the departments concerned. The division of mineral resources, through Mr. Bastin, its representative on this com-

mittee, and through a number of its specialists, shared largely in the work of the committee, particularly in the activities of its subcommittee on mineral raw materials, of which Mr. Bastin is chairman. The function of this subcommittee has included the formulation of recommendations as to governmental policy toward the exporting of coal and the acquisition of foreign petroleum resources, and these recommendations constitute a notable step toward the adoption of a definite governmental policy upon these important questions.

During the fiscal year preliminary arrangements were completed for cooperation with the Bureau of the Census in taking the census of mineral production for the calendar year 1919. The plans contemplate a full utilization of the knowledge and experience of the division of mineral resources in this work, including the activities not only of the Washington staff but of the Western branch offices.

The unavoidable delay in the publication of the final bound volumes of Mineral Resources of the United States, which must wait upon the completion of the slowest chapter, has been a serious inconvenience to business men, economists, and others who are interested in our mineral industries in the aggregate as well as in detail. It was therefore decided to begin in 1919 the preparation of a summary report on the mineral resources of the United States, to be issued in a preliminary edition as early as possible after the end of the year. The first one of these pamphlets, issued on August 8, 1919, consists almost wholly of tables giving the more essential statistical facts concerning all the mineral products of the United States. A brief review of the more significant features of the mineral industry during 1918 forms the only text accompanying the tables. It is hoped that this small pamphlet will be a timely and convenient reference book for mining men and the business public in general, and its statistics will be found to be only slightly revised in the final report.

Cooperation between Federal and State surveys was continued during 1918, including 18 States—Alabama, Florida, Georgia, Illinois, Iowa, Kansas, Maryland, Michigan, Minnesota, Missouri, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Virginia, Washington, and Wisconsin. This cooperation obviates the necessity of separate statistical campaigns by State officials, thus effecting material saving to the States, obviating annoyance to producers by duplicate requests for the same data, and insuring a better grade of service.

DIVISION OF CHEMICAL AND PHYSICAL RESEARCH.

The personnel of the division of chemical and physical research includes one geologist, nine chemists, two physicists, one clerk, two laboratory helpers, and one laborer. Dr. George F. Becker, geologist,

was in charge of the division until his death on April 20, 1919, and since that date George Steiger, chief chemist, has been acting in charge.

The work in chemistry is in charge of Mr. Steiger, and that in physics is under the supervision of C. E. Van Orstrand, physical geologist. Two members of the division resigned during the year—Benedict Salkover, junior chemist, on April 15, and M. A. Crews, laboratory aid, on May 1. J. G. Fairchild was appointed assistant chemist beginning July 1, 1919. E. T. Erickson was appointed junior chemist August 29 in order to assist in the examination of potash samples.

Normally the work in chemistry consists of (1) qualitative and quantitative analyses and mineralogic determinations of rocks and minerals collected by geologists; (2) the identification by inspection or simple tests of specimens received at the Survey from outside parties and the drafting of replies to correspondence from similar sources; and (3) researches or studies relating to various geochemical and mineralogic problems with which the geologists of the Survey are concerned. Research work of the ordinary type was practically suspended during the war. Time formerly allotted to such work was given to economic studies and to cooperation with the division of mineral resources.

During the year 1,499 chemical analyses were made, 607 of which were qualitative tests, 484 (including 111 platinum assays) were assays of ores, 145 were analyses of potash-bearing rocks, salts, and brines, 164 were for valuation as nitrate samples, and the remaining 99 were primarily for scientific use.

The search for domestic supplies of platinum, resulting from scarcity of the metal and unprecedented prices, caused an unusual demand on the Survey for platinum assays. Accordingly a furnace was installed, and 111 rocks were tested for platinum. Potash also continued of prime importance, and much of the energy of the laboratory was devoted to potash determinations. Special consideration of the production of potash was given by W. B. Hicks, who supervised the collection of statistics as to the sources and amounts of potash produced. Mr. Hicks made field trips to the experimental plants of the Atlantic Potash Co. at Stockertown, Pa., and of the Dexter Portland Cement Co. at Nazareth, Pa., and spent three months studying the potash-bearing alkali lakes of western Nebraska and the plants for extracting potash from them. The samples collected by Mr. Hicks have been analyzed, and the results are in preparation for publication.

Many of the mica localities in the Eastern States were visited by W. T. Schaller, who, in connection with the collection of statistics of consumption and production of mica, studied the methods of produc-

tion as well as the sources of raw materials. The information thus gathered was especially helpful to the mica section of the War Industries Board. A promising locality for monazite in North Carolina was examined by Mr. Schaller, who also made field studies of zircon districts in New Jersey and Virginia and prepared reports on them for the use of the War Industries Board and the War Department. Statistics of the production, available amounts, and consumption of industrial gem minerals were compiled by Mr. Schaller in connection with the preparation of the annual report on gems in the United States.

Aside from the regular chemical investigations R. C. Wells devoted considerable time to the preparation of the annual report on sodium and sodium compounds. Several industrial works producing sodium salts were visited and studied; producers, manufacturers, and consumers of these salts were consulted; and the information was made public. The remainder of Mr. Wells's time was devoted to work in physical chemistry, with special reference to the study of the hydrogen ion concentration of natural waters. Late in the year he visited the Marine Laboratory of the Carnegie Institution at Tortugas, Fla., at the request of that institution, for the purpose of making some chemical determinations of sea water, the results of which are to be used in studies now in progress in the Survey.

The disintegrating effect of nitric acid of different degrees of strength and under various conditions on a number of samples of rock submitted by the Navy Department was the subject of a series of experiments by George Steiger. The samples were tested to determine their availability for lining nitric acid towers, and the results of the special tests were reported to the Navy Department.

Observations of the temperatures at different depths in deep wells in Texas, Oklahoma, and West Virginia, were made by C. E. Van Orstrand, who completed an elaborate series of temperature observations at the Lake well near Fairmont, W. Va., where a temperature of 168.6° F. was recorded at a depth of 7,500 feet. In this well, the deepest in the world, the temperature has been taken at a depth greater than at any other point, exceeding by 215 feet the point of deepest temperature observation in Germany. To facilitate the observation of temperatures at such great depths Mr. Van Orstrand has designed and constructed a device for measuring the depths of wells by means of the sand line. His instrument has proved superior in most respects to the steel tape now in general use in the oil fields. A report summarizing the results of all recent observations of deep earth temperatures is in preparation by Mr. Van Orstrand.

Some applications of the kinetic theory of matter to special geophysical problems, such as the evaluation of the mass of helium in the earth's atmosphere, were made by Mr. Van Orstrand.

In the connection with the studies of the depreciation of oil and gas fields, conducted in cooperation with the Bureau of Internal Revenue of the Treasury Department, samples of oil sand were collected at many localities by A. F. Melcher and several geologists of the Survey. Porosity determinations of 33 samples were made by Mr. Melcher, who completed the preparation of a report on porosity determinations and their application to some of the problems in oil and gas geology.

Progress in the preparation of a table of the exponential function was made by M. A. Crews.

During a portion of the year G. F. Becker was engaged in theoretical investigations relative to interstitial space in rocks.

A recalculation of atomic weights, incorporating data of recent determination, was made by F. W. Clarke, chairman of the International Committee on Atomic Weights, and the manuscript of the work has been submitted to the Smithsonian Institution for publication. The reports of the International Committee on Atomic Weights having been suspended on account of the war, a manuscript for the 1919 report, including determinations made since the last report, has been completed by Professor Clarke and submitted for the approval of the French and English members of the committee.

During the year one bulletin, four chapters of Mineral Resources, and five scientific papers by members of the division have been printed in official or unofficial publications. One bulletin, one Smithsonian miscellaneous report, one professional paper, and one report for unofficial publication, the manuscripts of which have been completed, are awaiting publication.

Among the more notable reports prepared by the chemists and physicists during the year are papers by F. W. Clarke on "Inorganic constituents of marine invertebrates" (a revision and enlargement of Professional Paper 102), on the "Data of geochemistry" (fourth edition), and on a "Recalculation of atomic weights"; by F. W. Clarke and George Steiger on "Inorganic constituents of lobster shells"; by George Steiger on the "Precipitation of zirconium phosphate"; by George Steiger and T. L. Watson on "Titanium corundum spinellite"; by W. T. Schaller on "Plancheite and shattuckite, copper silicates"; by R. C. Wells and R. V. A. Mills on the "Evaporation and concentration of waters associated with petroleum and natural gas" (Bulletin 693); by W. B. Hicks on a "Review of the domestic potash industry"; and the reports on the production of mica, sodium salts, and potash in 1917, prepared by Messrs. Schaller, Wells, and Hicks, respectively, for publication in the annual volume of Mineral Resources. H. S. Gale is joint author of the potash report.

TOPOGRAPHIC BRANCH.

ORGANIZATION.

The organization of the topographic branch during the year was as follows:

Chief geographer, R. B. Marshall.

Northeastern, southeastern, central, and eastern departments, W. H. Herron and T. G. Gerdine, geographers in charge.

Western department, G. R. Davis, geographer in charge.

Inspectors of topography, W. M. Beaman, topographic engineer, in charge; A. M. Walker, topographic engineer; L. S. Leopold, topographer.

PERSONNEL.

Of the 113 members of the topographic branch who had received commissions in the Engineer Officers' Reserve Corps at the end of the fiscal year 71 had been reinstated in their former positions, including the chief geographer, 4 geographers, 31 topographic engineers, 2 topographers, 25 assistant topographers, 2 junior topographers, 1 draftsman, and 5 field assistants, and 42 were still attached to the Army. The technical force was also increased by the reinstatement of 1 junior topographer and the appointment of 9 and the reinstatement of 1 draftsman and was reduced by the transfer of 2 topographic engineers and the death of 1, the resignation of 1 topographer, the transfer of 1 assistant topographer and the resignation of 3, the resignation of 1 junior topographer and the death of 1, and the resignation of 9 draftsmen and the transfer of 2. In addition 2 draftsmen were detailed to the geologic branch. With these changes the corps now includes a chief geographer, 9 geographers, 45 topographic engineers, 7 topographers, 29 assistant topographers, 22 junior topographers, and 20 draftsmen—a total of 133. One assistant topographer was on furlough during the year. In addition 84 technical field assistants were employed during the whole or a part of the fiscal year. All the Engineer Reserve officers who were detailed from the War Department to the topographic branch during the period of the war to assist in topographic mapping and for training have been returned to the War Department. The clerical force comprises 14 clerks of various grades. One clerk was on furlough during the year.

PUBLICATIONS.

The published work of the topographic branch for the fiscal year consists of 180 published maps, a reprint of the book of Topographic Instructions, with additions and corrections, 4 new bulletins, and reprint of 2 bulletins, 514 and 551. A revision of Bulletin 226, "Boundaries of the United States," has been commenced. Manuscript containing results of triangulation and primary traverse of

the United States for the years 1916, 1917, and 1918 has been transmitted for publication as Bulletin 709.

ALLOTMENTS.

The total appropriations for topographic surveys for the fiscal year 1919 were as follows:

Topographic surveys	$142,196.00
Surveying national forests	74,219.60
Statutory salaries	9,200.00
Special funds for military mapping (contributed by War Department)	385,000.00
	610,615.60

COOPERATION.

Cooperation has been maintained in only five States, which contributed the following amounts, with the understanding that they were to be used in connection with the military surveys, to which the topographic branch devoted all its activities until the armistice:

California	$14,000
Kentucky	10,000
Maine	5,000
Virginia	4,000
Washington	10,500
	43,500

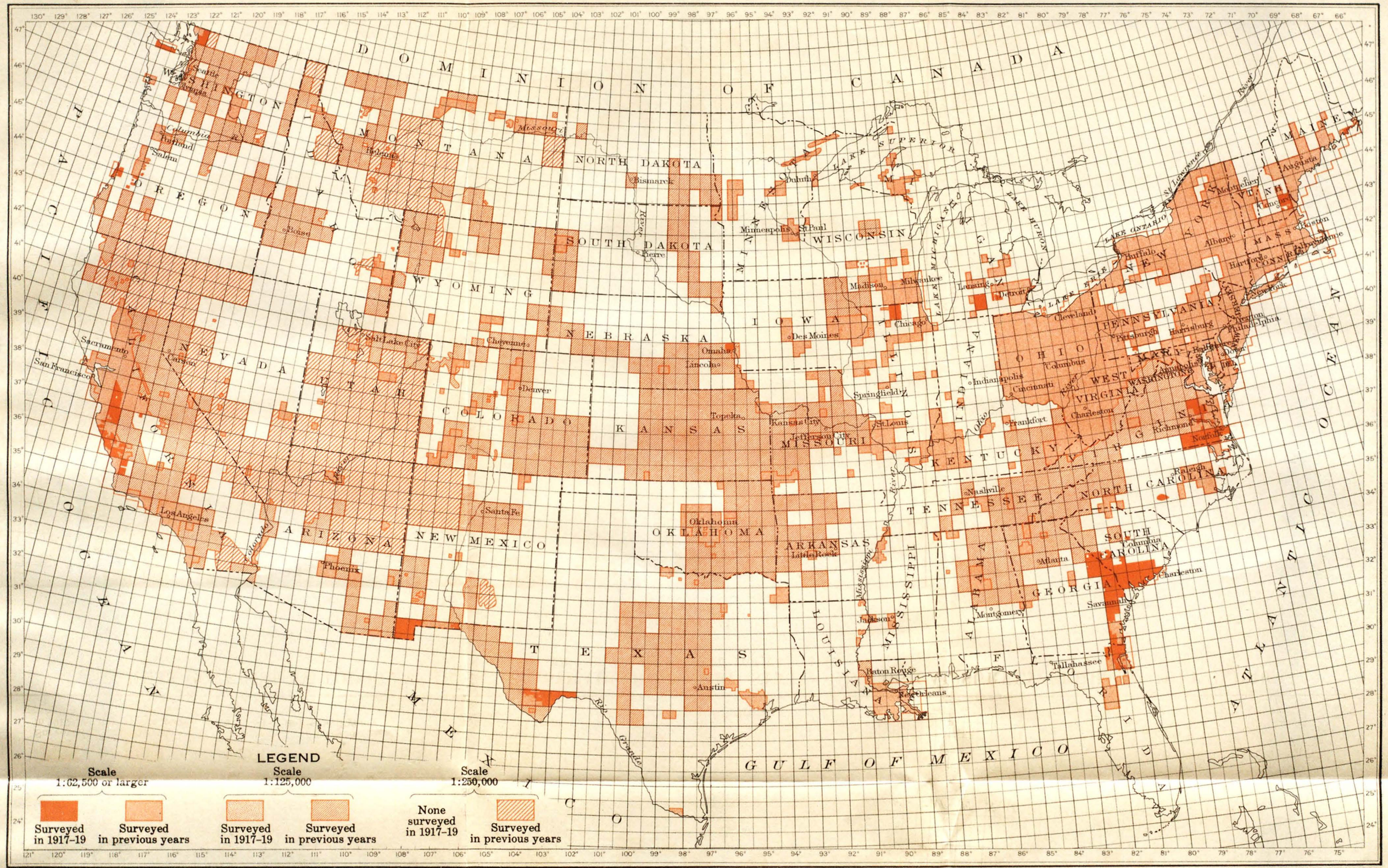
An additional allotment of $1,060 was made by the State of Arizona for cooperation in the compilation of the Arizona portion of the international map of the world, scale 1:500,000, the remainder of the expense to be met from Federal funds.

The following amounts were contributed by the States named below, for work in the spring of 1919, with the understanding that an equal amount be expended by the United States Geological Survey when Federal funds became available. This work was cooperative with the States but not with the War Department.

Idaho	$5,000.00
Illinois	7,000.00
Iowa	3,000.00
Michigan	14,866.67
Pennsylvania	5,000.00
Vermont	3,000.00
West Virginia	1,109.43
Wisconsin	20,000.00
	58,976.10

SUMMARY OF RESULTS.

Practically all the funds available for topographic mapping were allotted to areas selected by the War Department for special military surveys. As shown in the following tables, the new area mapped was 10,068 square miles, making the total area mapped in the



LEGEND

Scale 1:62,500 or larger		Scale 1:125,000		Scale 1:250,000	
Surveyed in 1917–19	Surveyed in previous years	Surveyed in 1917–19	Surveyed in previous years	None surveyed in 1917–19	Surveyed in previous years

AREAS COVERED BY TOPOGRAPHIC SURVEYS MADE BY UNITED STATES GEOLOGICAL SURVEY PRIOR TO JULY 1, 1919

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

United States at the end of the fiscal year 1,289,958 square miles, or 42.6 per cent of the entire country. (See Pl. II.)

In connection with these surveys 4,206 linear miles of primary and precise levels were run and 1,420 permanent bench marks were established, making 278,162 miles of primary and precise levels run since the authorization of this work by Congress in 1896.

Primary traverse lines aggregating 4,217 miles were run, in connection with which 611 permanent marks were set.

Triangulation stations to the number of 61 were occupied, and 50 were permanently marked.

Present condition of topographic surveys of the United States and new area surveyed July 1, 1918, to June 30, 1919.

	New area mapped July 1, 1918, to June 30, 1919.	Total area mapped to June 30, 1919.	Percentage of total area of State mapped to June 30, 1919.
	Sq. miles.	*Sq. miles.*	
Alabama		19,192	37
Arizona		70,136	62
Arkansas		21,494	40
California	840	123,348	78
Colorado		50,980	49
Connecticut		4,965	100
Delaware		2,370	100
District of Columbia		70	100
Florida		4,716	7
Georgia	3,166	24,673	41
Idaho		28,196	33
Illinois	112	16,907	29
Indiana		3,609	10
Iowa		11,916	21
Kansas		64,159	78
Kentucky	71	18,165	45
Louisiana		8,366	17
Maine	178	10,297	31
Maryland		12,327	100
Massachusetts		8,266	100
Michigan	273	9,358	16
Minnesota		7,354	9
Mississippi		2,126	4
Missouri		36,913	53
Montana		58,511	40
Nebraska		27,117	35
Nevada		51,141	46
New Hampshire	10	4,133	44
New Jersey		8,224	100
New Mexico		42,588	34
New York		44,663	91
North Carolina	327	18,876	36
North Dakota		9,814	14
Ohio		41,040	100
Oklahoma		39,908	57
Oregon	515	25,235	26
Pennsylvania	93	25,229	56
Rhode Island		1,248	100
South Carolina	2,480	11,826	38
South Dakota		19,032	25
Tennessee		21,283	50
Texas		73,384	28
Utah		69,025	82
Vermont	103	4,576	47
Virginia	1,416	35,750	83
Washington	410	30,464	44
West Virginia		24,170	100
Wisconsin	74	12,775	23
Wyoming		30,043	31
Total United States (exclusive of Alaska)	10,068	1,289,958	42.6
Hawaii		1,393	

NOTE.—For Alaska surveys see p. 107–113.

GENERAL OFFICE WORK.

Results of computations for vertical and horizontal control were copied and catalogued.

The computations of control data were made principally by D. H. Baldwin, F. J. McMaugh, E. C. Bebb, C. F. Urquhart, G. T. Hawkins, J. B. Metcalfe, jr., A. C. Roberts, A. T. Fowler, Jacob Lenovitz, G. Risegari, D. T. McNair, Harold Dewhirst, W. E. Trimble, A. W. Phelps, C. A. Hahn, C. L. Nelson, and G. E. Mills, under the immediate supervision of E. M. Douglas, geographer. S. S. Gannett, geographer, was engaged in preparing manuscript and compiling data for bulletins submitted for publication and in miscellaneous computations.

J. H. Renshawe, geographer, was engaged during the year in preparing shaded relief maps of southern California, southwestern Arizona, Great Falls of the Potomac and vicinity, and the Black Hills, South Dakota-Wyoming; and also, upon request of agencies engaged in work for the Peace Commission, relief maps of southwestern Russia and regions south, between the Baltic and Black seas, including Poland, Ukrainia, Rumania, and the Crimea.

INSPECTION OF TOPOGRAPHIC MAPPING.

W. M. Beaman, assisted by L. S. Leopold, spent the entire year in the office in general supervision of the preparation of all results of military surveys for engraving, photolithography, or other reproduction. A. M. Walker returned from foreign service and assisted in this work from March to June. Mr. Beaman was also in charge of the reports giving confidential military information submitted to the War Department.

DRAFTING.

The compilation of the United States portion of the international map of the world, under the immediate supervision of A. F. Hassan, was discontinued for the greater part of the year in order that the drafting force might be utilized in drafting the military topographic maps. During the year the force was decreased from 33 to 20 draftsmen.

In addition to 82 topographic maps and 69 accompanying military-information tracings completed during the year, a map of the United States showing the location of military activities and a large wall map of the world in colors for the Shipping Board were prepared. The compilation of the base of the Arizona portion of the international map was undertaken in cooperation with that State, and about 65 per cent of it was completed.

From May, 1918, to February, 1919, detachments of the enlisted personnel of the Four hundred and seventy-second Engineers were detailed to the Geological Survey for training in topographic map

drafting. Upon completing their training they assisted in the drafting of the military maps in this office or were assigned to similar duty in other offices. In all about 100 men reported for instruction, a notable contribution to the war program.

NORTHEASTERN DEPARTMENT.

FIELD WORK.

Summary.—During the season topographic mapping was carried on in Maine, New Hampshire, and Vermont. This work comprised the completion of the survey of 2 quadrangles, in addition to which 2 quadrangles were partly surveyed. The total new area mapped was 291 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. In connection with this work 5 miles of primary levels were run and 1 permanent bench mark was established.

Triangulation was carried on by one party in Vermont, 8 stations being occupied and 3 marked.

Topographic surveys in northeastern department from July 1, 1918, to June 30, 1919.

State.	Contour interval.	For publication on scale of 1:62,500 (new).	Primary levels.		Triangulation.	
			Distance run.	Bench marks.	Stations occupied.	Stations marked.
	Feet.	*Sq. mi.*	*Miles.*			
Maine	20	178	.....	.....	.....	.....
New Hampshire	20	10	.....	.....	.....	.....
Vermont	20	103	5	1	8	3
	.....	291	5	1	8	3

Maine.—For the continuation of cooperative topographic surveys in Maine the Public Utilities Commission allotted $5,000 and the United States Geological Survey allotted an equal amount, the amount necessary to complete the surveys being paid from Federal funds. The survey of the Columbia Falls and Great Wass Island quadrangles, in Washington County, was completed by W. H. Griffin, Olinus Smith, and P. A. Power, the total area mapped being 178 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet.

New Hampshire.—The survey of the Suncook quadrangle, in Merrimack, Rockingham, and Hillsboro counties, N. H., was begun by Olinus Smith, the total area mapped being 10 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet.

Vermont.—In the spring of 1919 the State geologist of Vermont allotted $3,000 for cooperative topographic surveys in Vermont, with the understanding that an equal amount would be expended by the United States Geological Survey when Federal funds became

available. The survey of the Waitsfield quadrangle, in Washington and Addison counties, was continued by Hersey Munroe and R. L. McCammon, the total area surveyed being 103 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of this area and that of the Royalton, Barre, and Northfield quadrangles Oscar Jones occupied 8 triangulation stations and marked 3.

OFFICE WORK.

The drafting of the following topographic maps was completed: Columbia Falls, Great Wass Island, Maine; York, Maine–N. H.; Alton, Gilmanton, Mount Pawtuckaway, N. H.

Preliminary geographic positions were computed for the following quadrangles: Bolton, Montpelier, and Waitsfield, Vt.

EASTERN DEPARTMENT.

FIELD WORK.

Summary.—During the season topographic mapping was carried on in Maryland, Pennsylvania, and Virginia. This work included the completion of the survey of 1 special area, 10 quadrangles, and 4 reservoir sites, in addition to which 1 quadrangle was partly surveyed. In addition to this work, the map of an area covering 159 square miles in Virginia was revised. The total new area mapped was 1,512 square miles, 1,412 square miles for publication on the scale of 1:62,500, 97 square miles for publication on the scale of 1:24,000, and 3 square miles for publication on the scale of 1:4,800. In connection with this work 225 miles of primary levels were run and 107 permanent bench marks were established, and 133 miles of primary traverse were run and 20 permanent marks set.

Topographic surveys in eastern department from July 1, 1918, to June 30, 1919.

State.	Contour intervals.	For publication on scale of—			Total area surveyed.	Primary levels.		Primary traverse.	
		1:62,500 (new).	1:24,000 (new).	1:4,800 (new).		Distance run.	Bench marks.	Distance run.	Permanent marks.
	Feet.	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Miles.*		*Miles.*	
Maryland	3	.....	.....	3	3	52	70	.....	.....
Pennsylvania	20	93	.....	.....	93	107	34	133	20
Virginia	10	1,319	97	.....	1,416	66	3	.....	.....
	.....	1,412	97	3	1,512	225	107	133	20

Maryland.—The survey of the Gunpowder Neck filling plant, in Harford County, Md., was completed by J. G. Staack, R. M. Herrington, J. L. Lewis, Cornelius Schnurr, and W. H. Schoewe, the total area mapped being 3 square miles, for publication on the scale of 1:4,800, with a contour interval of 3 feet. For the control of this

area H. S. Senseney ran 52 miles of primary levels and established 70 permanent bench marks.

Pennsylvania.—In the spring of 1919 the Topographic and Geological Survey Commission of Pennsylvania allotted $5,000 for cooperative topographic surveys in that State, with the understanding that an equal amount would be expended by the United States Geological Survey when Federal funds became available. The survey of the Meyersdale and Confluence quadrangles, in Fayette and Somerset counties, was begun by Duncan Hannegan, J. M. Whitman, C. E. Bardsley, A. L. Ackers, H. A. Bean, and Bishop Moorhead, the total area mapped being 93 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of these quadrangles F. L. Shalibo and C. E. Bardsley ran 107 miles of primary levels and established 34 permanent bench marks, and C. R. Fisher ran 133 miles of primary traverse and set 20 permanent marks.

Virginia.—For the continuation of cooperative topographic surveys in Virginia the State geologist allotted $4,000 and the United States Geological Survey an equal amount, the amount necessary to complete the surveys being paid from Federal funds. The survey of the Homeville, Ivor, Jarratt, Lawrenceville, and McKenney quadrangles, in Sussex, Southampton, Dinwiddie, Greensville, Brunswick, Surry, Isle of Wight, and Nottoway counties, was completed by Basil Duke, J. J. Phelan, E. E. Harris, J. E. Blackburn, E. M. Levy, U. S. Grant, W. J. Lloyd, S. L. Parker, F. B. Hatch, G. W. Morton, C. D. S. Clarkson, R. H. Chapman, H. S. Paul, Duncan Hannegan, R. W. Burchard, Fred McLaughlin, M. J. Gleissner, Bishop Moorhead, and A. H. Dewey, the total area mapped being 708 square miles, for publication on the scale of 1:62,500, with a contour interval of 10 feet.

In addition to this work, the survey of Reservoir Sites Nos. 1, 2, 3, and 4, in Clarke, Hampshire, Loudoun, and Rockingham counties, was completed by R. W. Burchard, B. W. Brown, A. L. Ackers, K. K. Kimball, F. L. Whaley, W. R. Chenoweth, and R. L. Harrison, the total area surveyed being 97 square miles, for publication on the scale of 1:24,000, with a contour interval of 10 feet. For the control of these reservoir sites B. W. Brown ran 4 miles of primary levels, no permanent bench marks being established.

In addition to this work, J. I. Gayetty revised the map of the Surry quadrangle, the area covered being 159 square miles, for publication on the scale of 1:62,500.

Virginia-North Carolina.—The survey of the Arringdale, Boykins, Elwood, Emporia, and White Plains quadrangles, in Brunswick, Greensville, Southampton, Sussex, Isle of Wight, and Nansemond counties, Va., and Hertford, Northampton, Gates, Warren, and

Halifax counties, N. C., was completed by A. B. Searle, A. C. Schilling, H. L. Spaulding, W. R. Chenoweth, R. L. Harrison, R. H. Runyan, H. A. Bean, F. L. Whaley, Fred McLaughlin, J. M. Whitman, A. L. Ackers, K. K. Kimball, J. L. Lewis, F. D. Kramer, J. J. Phelan, J. G. Staack, Duncan Hannegan, M. J. Gleissner, R. J. McManamy, A. M. Ockerblad, C. E. Bardsley, R. F. Wilcoxon, and J. E. Blackburn, the total area mapped being 744 square miles, for publication on the scale of 1:62,500, of which area 611 square miles lie in Virginia and 133 square miles lie in North Carolina. For the control of these areas R. B. Steele ran 62 miles of primary levels and established 3 permanent bench marks.

OFFICE WORK.

The drafting of the following topographic maps was completed: Gunpowder Neck, Md.; Camp Abraham Eustis (scale 1:10,000 and 1:20,000), Cape Henry, Jarratt, Ivor, Newport News, Smithfield: King William, Reservoir Sites Nos. 1, 2, 3, and 4, Va.; Boykins, Elwood, Emporia, Suffolk, Va.-N. C.

Progress in the drafting of additional sheets was made as follows, Homeville, Va., 20 per cent; McKenney, Va., 10 per cent; Arringdale, Va.-N. C., 65 per cent; White Plains, Va.-N. C., 75 per cent.

Primary level circuits were adjusted for the following quadrangles: Gunpowder Neck, Md.; Boykins, Va.-N. C.

Geographic positions were computed for the following quadrangles: Camp Abraham Eustis, Cape Henry, and Newport News, Va.; Elwood, Va.-N. C.; Berlin and Meyersdale, Pa.

SOUTHEASTERN DEPARTMENT.

FIELD WORK.

Summary.—During the year topographic mapping was carried on in Georgia, North Carolina, and South Carolina. The work included the completion of the survey of 3 special areas and 24 quadrangles, in addition to which 8 quadrangles were partly surveyed. The total new area mapped was 5,973 square miles, 411 square miles for publication on the scale of 1:10,000, and 5,562 square miles for publication on the scale of 1:62,500. In connection with this work 2,135 miles of primary levels and 231 miles of precise levels were run, and 751 permanent bench marks were established, and 2,673 miles of primary traverse were run and 340 marks were set.

Triangulation was carried on by one party, 19 stations being occupied and 5 permanently marked.

Topographic surveys in southeastern department from July 1, 1918, to June 30, 1919.

State.	Contour interval.	For publication on scale of—		Total area surveyed.	Levels.			Primary traverse.		Triangulation.	
		1:10,000 (new).	1:62,500 (new).		Primary.	Precise.	Bench marks.	Distance.	Permanent marks.	Stations occupied.	Stations marked.
		Sq. mi.	*Sq. mi.*	*Sq. mi.*	*Mi.*	*Mi.*		*Mi.*			
Georgia	10, 20 feet, 5 meters.	114	3,052	3,166	168	.....	208	235	103	.....	.....
North Carolina	5 meters	194	133	327	515	55	127	453	78	19	5
South Carolina	10 feet, 5 meters	103	2,377	2,480	1,452	176	416	1,985	159	.....	.....
		411	5,562	5,973	2,135	231	751	2,673	340	19	5

Georgia.—The survey of the Millen, Bascom, Sylvania, Hephzibah, Register, Brooklet, Dearing, Gough, Egypt, Glennville, Claxton, Spread, and Pembroke quadrangles, in Jenkins, Screven, Burke, Warren, McDuffie, Bulloch, Richmond, Columbia, Emanuel, Jefferson, Effingham, Tattnall, Liberty, and Bryan counties, Ga., was completed, and that of the Meldrim, Rocky Ford, and Appling quadrangles, in Jenkins, Screven, Bulloch, Columbia, Jefferson, Lincoln, McDuffie, Warren, and Glascock counties, was begun by J. F. McBeth, Robert Muldrow, G. E. Sisson, V. S. Seward, Gilbert Young, J. H. Wilke, W. B. Brewer, C. E. Crook, E. B. Hill, J. C. Hilliard, C. B. Childs, E. J. Essick, C. L. Sadler, C. B. Moore, A. T. Fowler, J. J. Phelan, C. W. Goodlove, Edgar Allen, H. R. Kilmer, C. R. de Medicis, R. L. McCammon, J. H. Jennings, W. C. Perkins, Horace Roberts, James Dolan, J. F. McCook, Fred Graff, jr., E. H. Stelle, Olinus Smith, C. W. Rowell, J. L. Lewis, J. A. Duck, Crawford Dickey, R. D. Cummin, J. P. Harrison, O. B. Walsh, W. H. S. Morey, W. C. F. Bastian, G. F. Brockman, A. J. Ogle, W. K. McKinley, J. W. Lewis, W. L. Miller, J. M. Rawls, T. F. Slaughter, and J. A. Duck, the total area mapped being 2,637 square miles, for publication on the scale of 1:62,500, with contour intervals of 10 and 20 feet. For the control of the Appling quadrangle L. F. Biggs ran 8 miles of primary levels but established no permanent bench marks, and for the control of the Dearing quadrangle O. B. Walsh ran 20 miles of primary traverse and set one permanent mark.

In addition to this work the survey of the Camp Hancock artillery range, in Richmond County, was completed by J. H. Jennings, C. B. Childs, E. B. Hill, J. C. Hilliard, E. H. Stelle, James Dolan, J. F. McCook, Horace Roberts, W. C. Perkins, David Adams, Gilbert Young, E. M. Peeples, W. B. Brewer, J. P. Harrison, E. E. Harris, and O. B. Walsh, the total area mapped being 114 square miles, for publication on the scale of 1:10,000, with a contour interval of

5 meters. For the control of this special area Horace Roberts, C. H. Semper, W. E. Baird, and E. E. Harris ran 160 miles of primary levels and established 208 permanent bench marks, and E. L. McNair, H. S. Senseney, and O. B. Walsh ran 215 miles of primary traverse and set 102 permanent marks.

Georgia–South Carolina.—The survey of the Peeples, Robbins, Greens Cut, and Clarks Hill quadrangles, in Columbia, Lincoln, Burke, Richmond, and Screven counties, Ga., and Aiken, Hampton, and Barnwell counties, S. C., was completed, and that of the Augusta and Warrenville quadrangles, in Richmond County, Ga., and Aiken County, S. C., was continued, the total area mapped being 1,109 square miles, 415 square miles in Georgia and 694 square miles in South Carolina, for publication on the scale of 1:62,500, with a contour interval of 10 feet. For the control of the Clarks Hill quadrangle L. F. Biggs ran 27 miles of primary levels and established 4 permanent bench marks.

North Carolina.—The survey of the Camp Bragg artillery range, in Cumberland County, N. C., was completed by C. L. Sadler, G. F. Brockman, W. C. F. Bastian, E. K. Nelson, G. R. Richardson, R. T. Mafit, T. S. Marlor, E. N. Murphy, N. E. Ballmer, N. A. Huth, E. G. Hamilton, C. D. Curry, R. A. Furrow, B. A. Jenkins, W. G. Carson, E. J. Essick, and C. W. Stump, jr., the total area mapped being 194 square miles, for publication on the scale of 1:10,000 with a contour, interval of 5 meters. For the control of this special area R. G. Clinite, G. F. Brockman, R. T. Mafit, R. B. Steele, E. K. Nelson, and H. P. Kilby ran 515 miles of primary levels and established 127 permanent bench marks, and C. H. Semper ran 55 miles of precise levels; while E. L. McNair, P. W. McMillen, and L. F. Biggs ran 383 miles of primary traverse and set 74 permanent marks. Triangulation was carried on by G. T. Hawkins and E. L. McNair, 19 stations being occupied, 5 of which were permanently marked.

In addition to this work, for the control of the Southport and Shallotte quadrangles, Oscar Jones ran 70 miles of primary traverse and set 4 permanent marks.

North Carolina–Virginia.—(See Eastern department, pp. 129–130.)

South Carolina.—The survey of the Lodge, St. George, Ridgeville, Summerville, Talatha, Montmorenci, and Allendale quadrangles, in Bamberg, Colleton, Barnwell, Aiken, Edgefield, Dorchester, and Berkeley counties, S. C., was completed, and that of the Moncks Corner, Williston, and Bamberg quadrangles, in Bamberg, Orangeburg, Barnwell, and Aiken counties, was begun by C. W. Goodlove, H. R Kilmer, J. E. King, Edgar Allen, E. V. Holloway, H. D. Clement, F. W. Farnsworth, C. C. Shepard, W. P. Bittenger, C. E. Cooke, E. J. Francis, T. T. Ranney, G. C. Cooke, W. H. Griffin, E. L. Hain, W. B. Upton, jr., Robert Muldrow, C. B. Moore, R. L. Harrison,

H. A. Bean, R. H. Runyan, T. F. Slaughter, A. B. Searle, W. R. Chenoweth, F. L. Whaley, C. R. de Medicis, J. I. Gayetty, W. S. Beames, A. L. Ackers, F. D. Kramer, Basil Duke, R. H. Reineck, and W. K. McKinley, the total area mapped being 1,683 square miles, for publication on the scale of 1:62,500, with a contour interval of 10 feet. For the control of these areas and of the Branchville, Orangeburg, Edgefield, Batesburg, Chicora, Eutawville, Mayesville, Bonneau, Edmund, Hopkins, Fort Motte, and Sumter quadrangles H. L. Hudson, S. L. Parker, L. F. Biggs, C. H. Semper, R. G. Clinite, P. W. McMillen, H. P. Kilby, F. L. Shalibo, and H. S. Senseney ran 1,201 miles of primary levels and established 384 permanent bench marks. For the control of the Lexington, Edmund, Hopkins, Fort Motte, Sumter, Mayesville, Manning, Kingstree, Bonneau, Moncks Corner, Ladson, Melgrove, Charleston, and Summerville quadrangles C. H. Semper also ran 177 miles of precise levels. For the control of the Elloree, Rimini, Orangeburg, Edgefield, Batesburg, Chicora, Eutawville, Branchville, Prosperity, Bamberg, Saluda, Bowman, Chapin, Woodford, Rhems, Trio, Scranton, Columbia, Conway, Yauhannah, Oakton, Hyman, Indiantown, Parksville, Seivern, Lexington, Edmund, Hopkins, Fort Motte, Sumter, Mayesville, Manning, Kingstree, Bonneau, Nixonville, Myrtle Beach, and Wampee quadrangles, Oscar Jones, R. B. Steele, and E. L. McNair ran 1,735 miles of primary traverse and established 125 permanent marks.

In addition to this work the survey of the Camp Jackson artillery range, in Richland and Kershaw counties, was completed by C. E. Cooke, E. J. Essick, C. W. Stump, jr., C. B. Childs, J. W. Lewis, R. D. Cummin, J. H. Wilke, C. G. Cooke, W. C. Perkins, E. B. Hill, C. E. Crook, J. C. Hilliard, J. F. McCook, James Dolan, T. T. Ranney, and E. J. Francis, the total area mapped being 103 square miles, for publication on the scale of 1:10,000, with a contour interval of 5 meters. For the control of this special area L. F. Biggs and F. L. Shalibo ran 224 miles of primary levels and established 28 permanent bench marks, and G. T. Hawkins and L. F. Biggs ran 250 miles of primary traverse and set 34 permanent marks.

OFFICE WORK.

The drafting of the following topographic maps was completed: St. Marys, Fla.–Ga.; Claxton, Camp Hancock, Egypt, Glennville, Gough, and Sylvania, Ga.; Greens Cut and Peeples, Ga.–S. C.; Camp Bragg, N. C.; Allendale, Bulls Island, Camp Jackson, Capers Island, Charleston, Cottageville, Fort Moultrie, Green Pond, Cummings, James Island, Johns Island, Edisto Island, Kiawah Island, Ladson, Legareville, Melgrove, Pineland, Shirley, Sewee Bay, Olar, Ravenels, The Jetties, Wando, and Wadmelaw Island, S. C.

Progress in the drafting of additional sheets was made as follows: Cumberland Island, Ga., 80 per cent; Millen, Ga., 55 per cent; Register, Ga., 5 per cent; Ridgeville, S. C., 5 per cent; Spread, Ga., 10 per cent; and Summerville, S. C., 75 per cent.

Primary-level circuits were adjusted for the following quadrangles: Agricola, Appling, Bascom, Brooklet, Claxton, Dearing, Egypt, Glennville, Hephzibah, Meldrim, Millen, Pembroke, Register, Rocky Ford, Rosier, Spread, Stellaville, Sylvania, and Wadley, Ga.; Augusta, Clarks Hill, Greens Cut, Robbins, and Shirley, Ga.-S. C.; Argyle, Camp Bragg, Fayetteville, and Southern Pines, N. C.; Allendale, Camp Jackson, Cummings, Edgefield, Edmund, Eutawville, Hopkins, Moncks Corner, Montmorenci, Olar, Parksville, Peeples, Pineland, Ridgeville, Robbins, St. George, Summerville, Sumter, Talatha, Varnville, and Warrenville, S. C.

Precise-level circuits were adjusted for the following quadrangles: Egypt, Millen, Rocky Ford, Savannah, and Sylvania, Ga.; Augusta, Greens Cut, and Hardeeville, Ga.-S. C.; Allendale, Batesburg, Bonneau, Charleston, Edgefield, Edmund, Fort Motte, Hopkins, Kingstree, Lexington, Mayesville, Manning, Moncks Corner, Summerville, Sumter, and Warrenville, S. C.

Geographic positions were computed for the following quadrangles: Agricola, Altamaha, Camp Hancock, Chalker, Hephzibah, Jesup, Lumber City, Macon, Meriwether, Milledgeville, Perrys Mills, Sandersville, Sparta, Warrenton, Wilcox, Wrightsville, and Wyley, Ga.; Guide and Wampee, N. C.-S. C.; Camp Bragg, Shallotte, Southport, and Wilmington, N. C.; Bamberg, Batesburg, Bonneau, Branchville, Camp Jackson, Conway, Edgefield, Edmund, Florence, Hyman, Indiantown, Kingstree, Lexington, Lodge, Loris, Manning, Marion, Mayesville, Myrtle Beach, Nichols, Nixonville, Oakton, Poston, Prosperity, Rhems, Ridgeville, St. George, Saluda, Scranton, Seivern, Sumter, Timmonsville, Trio, Williston, Woodford, and Yauhannah, S. C.

CENTRAL DEPARTMENT.

FIELD WORK.

Summary.—During the season topographic mapping was carried on in Illinois, Iowa, Kentucky, Michigan, West Virginia, and Wisconsin. The work included the completion of one special area, in addition to which six quadrangles were partly surveyed. The total new area mapped was 530 square miles, 459 square miles for publication on the scale of 1:62,500 and 71 square miles for publication on the scale of 1:10,000. In connection with this work 914 miles of primary levels were run and 377 permanent bench marks were established, and 1,411 miles of primary traverse were run and 251 marks set.

Triangulation was carried on in West Virginia by one party, 15 stations being occupied and 13 permanently marked.

Topographic surveys in central department from July 1, 1918, to June 30, 1919.

State.	Contour interval.	For publication on scale of—		Total area surveyed.	Primary levels.		Primary traverse.		Triangulation.	
		1:10,000	1:62,500		Distance run.	Bench marks.	Distance run.	Permanent marks.	Stations occupied.	Stations marked.
		Sq. mi.	*Sq. mi.*	*Sq. mi.*	*Miles.*		*Miles.*			
Illinois	20 feet		112	112	112	33	124	9		
Iowa					82	21	158	28		
Kentucky	5 meters.	71		71	222	213	177	135		
Michigan	10 feet		273	273	218	52	436	35		
West Virginia									15	13
Wisconsin			74	74	280	58	516	44		
		71	459	530	914	377	1,411	251	15	13

Illinois.—In the spring of 1919 the Department of Registration and Education allotted $7,000 for cooperative topographic mapping in Illinois, with the understanding that an equal amount would be expended by the United States Geological Survey when Federal funds became available. The survey of the Dongola and Vermont quadrangles, in Fulton, McDonough, Schuyler, Union, Johnson, and Pulaski counties, was begun by C. C. Holder, W. K. McKinley, and J. A. Duck, the total area surveyed being 112 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet. For the control of these areas S. L. Parker and Crawford Dickey ran 112 miles of primary levels and established 33 permanent bench marks, and F. J. McMaugh ran 124 miles of primary traverse and set 9 bench marks.

Iowa.—In the spring of 1919 the State Geological Survey allotted $3,000 for cooperative topographic mapping in Iowa, with the understanding that an equal amount would be expended by the United States Geological Survey when Federal funds became available. For the control of the Dakota, Lehigh, Corwith, Eagle Grove, Gilmore City, Gowrie, Jefferson, Ogden, Livermore, Ottosen, and Webster City quadrangles J. M. Rawls ran 82 miles of primary levels and established 21 permanent bench marks, and F. J. McMaugh ran 158 miles of primary traverse and set 28 bench marks.

Kentucky.—For the continuation of cooperative topographic surveys in Kentucky the Commissioner of Geology and Forestry allotted $10,000 and the United States Geological Survey allotted an equal amount, the amount necessary to complete the surveys being paid from Federal funds. The survey of the West Point artillery range, in Brewster, Bullitt, Hardin, Jefferson, and Meade counties, was completed by J. G. Staack, J. M. Whitman, C. D. S. Clarkson, R. M. Herrington, C. E. Bardsley, W. R. Chenoweth, R. W. Burchard, R. F. Wilcoxon, E. C. Bebb, Cornelius Schnurr, F. D. Kramer, K. K. Kimball, A. L. Ackers, R. H. Runyan, H. A. Bean, F. L. Whaley, R. L. Harrison, J. L. Lewis, W. W. Keeler, W. H. Schoewe, and

Louis Stroh, the total area surveyed being 71 square miles, for publication on the scale of 1:10,000, with a contour interval of 5 meters. For the control of this area H. S. Senseney and E. C. Bebb ran 177 miles of primary traverse and set 135 permanent marks, and C. F. Urquhart, R. B. Steele, and E. E. Harris ran 222 miles of primary levels and established 213 permanent bench marks.

Michigan.—In the spring of 1919 the State geologist allotted $14,866.67 for cooperative topographic surveys in Michigan, with the understanding that an equal amount would be expended by the United States Geological Survey when Federal funds became available. The survey of the Rives Junction and Springport quadrangles, in Ingham, Jackson, Calhoun, and Eaton counties, was begun by J. H. Jennings, C. L. Sadler, A. J. Ogle, E. J. Essick, N. E. Ballmer, C. W. Stump, jr., R. T. Mafit, and G. R. Richardson, the total area mapped being 273 square miles, for publication on the scale of 1: 62,500, with a contour interval of 10 feet. For the control of the Stockbridge, Schoolcraft, Sturgis, Burt, Durand, Lapeer, Imlay City, Seymore Lake, Holly, Almont, and Flint quadrangles, G. T. Hawkins ran 436 miles of primary traverse and set 35 bench marks. For the control of the Stockbridge, Schoolcraft, Burt, and Flint quadrangles E. E. Harris ran 218 miles of primary levels and established 52 permanent bench marks.

West Virginia.—In the spring of 1919 the State geologist allotted $1,109.43 for cooperative topographic surveys in West Virginia, with the understanding that the United States Geological Survey would expend an equal amount when Federal funds became available. For the control of the Moorefield, Petersburg, Maysville, Onego, Orkney Springs, White Sulphur Springs, and Elk Garden quadrangles E. L. McNair occupied 15 triangulation stations and marked 13.

Wisconsin.—In the spring of 1919 the State geologist allotted $20,000 for cooperative topographic surveys in Wisconsin with the understanding that an equal amount would be expended by the United States Geological Survey when Federal funds became available. The survey of the Kendall and Mauston quadrangles, in Monroe and Juneau counties, was begun by C. E. Cooke, J. G. Staack, O. H. Nelson, E. B. Hill, C. W. Rowell, H. E. Simmons, J. C. Hilliard, and C. B. Childs, the total area mapped being 74 square miles, for publication on the scale of 1: 62,500, with a contour interval of 10 feet. For the control of these quadrangles and of the Monroe, Browntown, Blanchardville, New Glarus, Ashland, Odanah, Upson, Mellen, Marys, and Hurley quadrangles S. R. Archer and R. G. Clinite ran 280 miles of primary levels and established 58 permanent bench marks, and H. S. Senseney, D. S. Birkett, R. B. Steele, and Oscar Jones ran 516 miles of primary traverse and set 44 bench marks.

OFFICE WORK.

The drafting of the following topographic maps was completed: Camp Knox, Ky.; Fort Omaha, Nebr., scale 1: 20,000.

Primary-level circuits were adjusted for the following quadrangles: Jonesboro and Vermont, Ill.; Camp Knox, Ky.; Stockbridge, Mich.

Geographic positions were computed for the following quadrangles: Dakota and Lehigh, Iowa; Camp Knox, Ky.; Coldwater, Schoolcraft, Stockbridge, Sturgis, and Union City, Mich.

SOUTHERN DEPARTMENT.

No field work was done in the southern department during the fiscal year.

OFFICE WORK.

The drafting of the following topographic maps was completed: Animas Peak, Antelope Wells, Canutillo, Cienega Springs, Playas, and Pratt, New Mexico; Beaver Creek, Fowlkes, and Maravillas Canyon, Tex.

Progress in the drafting of additional sheets was made as follows: Oatman special, Ariz., 85 per cent.

Geographic positions were computed for the following quadrangles: Camel Mountain, Canutillo, Mount Riley, and Noria, N. Mex.

WESTERN DEPARTMENT.

FIELD WORK.

Summary.—During the year topographic mapping was carried on in California, Idaho, Oregon, and Washington. The work included the completion of 10 quadrangles, in addition to which 11 were partly surveyed. The total new area mapped was 1,765 square miles, 1,575 square miles for publication on the scale of 1:62,500, 60 square miles for publication on the scale of 1:31,680, and 130 square miles for publication on the scale of 1:125,000. In connection with this work 696 miles of primary levels were run and 184 permanent bench marks were established.

Primary triangulation was carried on by two parties in California and Idaho, 19 stations being occupied and 29 permanently marked.

Topographic surveys in western department from July 1, 1918, to June 30, 1919.

State.	Contour interval.	For publication on scale of—			Total area surveyed.	Primary levels.		Triangulation stations.	
		1: 62,500 (new).	1: 31,680 (new).	1:125,000 (new).		Distance run.	Bench marks.	Occupied.	Marked.
	Feet.	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Sq. mi.*	*Miles.*			
California	5,25,50,100	670	60	110	840	646	173	14	23
Idaho	.....	.....	.....	.....	.....	24	6	5	6
Oregon	25,50	515	.....	.....	515	26	5	.....	.....
Washington	25,50	390	.....	20	410	.....	.....	.....	.....
	.....	1,575	60	130	1,765	696	184	19	29

California.—For the continuation of cooperative topographic surveys in California the Department of Engineering allotted $14,000 and the United States Geological Survey an equal amount, the amount necessary to complete the surveys being paid from Federal funds. The survey of the Hollister and Orestimba quadrangles, in Merced, Stanislaus, San Benito, Monterey, and Santa Clara counties, was completed, and that of the Mount Boardman, Pozo, and Nipomo quadrangles, in San Luis Obispo, Santa Clara, and Stanislaus counties, was begun by E. P. Davis, R. A. Hamilton, William Stranahan, F. C. Witt, Adolph Fankhauser, R. H. Sargent, N. B. Green, C. P. McKinley, C. A. Stonesifer, and R. A. Kiger, the total area mapped being 552 square miles, for publication on the scale of 1:62,500, with contour intervals of 25 and 50 feet. For the control of these areas and of the Avenal and Cholame quadrangles L. F. Biggs and Gerald Fitzgerald ran 167 miles of primary levels and established 48 permanent bench marks. Triangulation was carried on by L. F. Biggs, 14 stations being occupied and 23 permanently marked.

In cooperation with the State of California but not with the War Department, the survey of the Tracy 7½-minute quadrangle, in San Joaquin and Stanislaus counties, was completed, and that of the Trimmer 30-minute quadrangle, in Fresno County, was continued by R. H. Sargent, Charles Hartmann, R. F. Wilcoxon, and B. A. Jenkins, the total area mapped being 228 square miles, 110 square miles for publication on the scale of 1:125,000, and 118 square miles for publication on the scale of 1:62,500, with contour intervals of 50 and 100 feet. For the control of the Tracy quadrangle L. F. Biggs ran 33 miles of primary levels and established 6 permanent bench marks.

Work in San Joaquin Valley was again resumed in cooperation with the State, the survey of the No. 16 quadrangle, in Madera County, being commenced by C. A. Stonesifer and Gerald Fitzgerald, 60 square miles being mapped for publication on the scale of 1:31,680, with a contour interval of 5 feet.

For the control of the Mendota, Madera, No. 16, No. 19, No. 20, Herndon, Bridge, No. 21, Clovis, No. 25, No. 26, San Joaquin, Kearney Park, Carrisalito Spring, Raisin, Helm, Center School, Dos Palos, Oxalis, No. 18, Sheep Ranch, No. 23, Chaney Ranch, No. 24, Tranquillity, Jamison, Kerman, No. 14, No. 17, Wheatville, Firebaugh, Burrel, Conejo, Laton, Riverdale, Fresno, and Caruthers quadrangles L. F. Biggs ran 446 miles of primary levels and established 119 permanent bench marks.

Idaho.—In the spring of 1919 the State Bureau of Mines and Geology allotted $5,000 for cooperative topographic mapping in Idaho, with the understanding that an equal amount would be expended by the United States Geological Survey when Federal funds became available. For the control of the Seven Devils mining district

R. W. Burchard ran 24 miles of primary levels and established 6 permanent bench marks, and R. W. Berry occupied 5 triangulation stations and marked 6.

Oregon.—The survey of the Siltcoos Lake and Heceta No. 4 quadrangles, in Lane and Douglas counties, Oreg., was completed, and that of the Cottage Grove, Yoncalla, Alsea No. 3, Wendling No. 3, and Scottsburg No. 2, in Lane, Douglas, and Linn counties, was begun by E. G. Hamilton, N. A. Huth, C. P. McKinley, R. M. Wilson, R. H. Sargent, W. G. Carson, William Stranahan, F. C. Witt, W. C. Renshaw, W. L. Francis, and E. P. Davis, the total area mapped being 515 square miles, for publication on the scale of 1 : 62,500, with contour intervals of 25 and 50 feet. Of the area mapped in the Siltcoos Lake, Heceta No. 4, Scottsburg No. 2, and Alsea No. 3 quadrangles, 206 square miles lies in the Siuslaw National Forest. For the control of the Scottsburg No. 2 quadrangle, H. B. Ward ran 26 miles of primary levels and established 5 permanent bench marks.

Washington.—For the continuation of cooperative topographic surveys in Washington the State Board of Geological Survey allotted $10,500 and the United States Geological Survey allotted an equal amount, the amount necessary to complete the surveys being paid from Federal funds. The mapping of the Wickersham, Pysht, Crescent Lake, Port Crescent, and Van Zandt quadrangles, in Skagit, Whatcom, and Clallam counties, was completed, and that of the Walla Walla quadrangle, in Columbia County, was begun by C. P. McKinley, R. T. Evans, J. P. Harrison, N. E. Ballmer, R. H. Sargent, R. A. Hamilton, H. B. Ward, E. N. Murphy, T. S. Marlor, K. C. McMurray, C. D. Curry, R. A. Furrow, W. G. Carson, and F. A. Danforth, the total area mapped being 410 square miles, 390 square miles for publication on the scale of 1:62,500, and 20 square miles for publication on the scale of 1:125,000, with contour intervals of 25 and 50 feet. Of the Pysht, Crescent Lake, and Port Crescent quadrangles, 226 square miles lies in the Olympic Forest Reserve.

OFFICE WORK.

The drafting of the following topographic maps was completed: Adelaida, Bradley, Bryson, Crevison Peak, King City, Junipero Serra, Las Garzas Creek, Lucia, Orestimba, Paso Robles, Point Sur, San Benito, San Luis Creek, San Simeon, Calif.; Heceta (southeast quarter) and Siltcoos Lake, Oreg.; Port Crescent and Van Zandt, Wash.

Progress in the drafting of additional sheets was made as follows: Daulton, Calif., 98 per cent; Elgin, Calif., 85 per cent; Gilroy Hot Springs, Calif., 85 per cent; Gonzales, Calif., 15 per cent; Hollister, Calif., 15 per cent; Jamesburg, Calif., 85 per cent; Los Banos, Calif., 50 per cent; Metz, Calif., 90 per cent; No. 10, Calif., 85 per cent;

Crescent Lake, Wash., 10 per cent; Pysht, Wash., 95 per cent; and Wickersham, Wash., 35 per cent.

Primary-level circuits were adjusted for the following quadrangles: Adelaida, Cayucos, Gorda, Lucia, Madera, Mount Boardman, Mojave (Tehachapi Pass), Piedras Blancas, San Luis Obispo, San Simeon, and Tracy, Calif.; Van Zandt and Wickersham, Wash.

Geographic positions were computed for the following quadrangles: Academy, Adelaida, Berenda, Bonanza, Bradley, Bryson, Bridge, Clovis, Daulton, Dos Palos, Fresno, Friant, Gonzales, Gustine, Helm, Herndon, Hollister, Ingomar, Jamison, Junipero Serra, Jamesburg, Kearney Park, Kerman, King City, Kings River, Los Banos, Madera, Malaga, Metz, No. 8, No. 10, No. 16, No. 17, No. 19, No. 20, No. 21, No. 22, No. 23, No. 24, Paso Robles, Point Sur, Reedley, Salinas Valley, San Benito, Sandy Mush, San Joaquin, Sanger, San Luis Ranch, San Miguel, San Simeon, Selma, Sharon, Sheep Ranch, Squaw Valley, Sultana, Tranquillity, Volta, and Wahtoke, Calif.; Coppereid, Lovelocks, and Rochester, Nev.; Alsea No. 3, Oreg.; Pysht, Wash.

WATER-RESOURCES BRANCH.

ORGANIZATION.

The work of the water-resources branch is conducted under the supervision of N. C. Grover, chief hydraulic engineer, and is organized in five divisions:

Division of surface water, John C. Hoyt, hydraulic engineer, in charge.
Division of ground waters, O. E. Meinzer, geologist, in charge.
Division of quality of water, Alfred A. Chambers, assistant chemist, in charge.
Division of power resources, W. B. Heroy, geologist, in charge.
Division of enlarged and stock-raising homesteads, H. C. Cloudman, classifier, in charge.

PERSONNEL.

During the year the technical force was reduced by 86, of whom 34 entered the military service and 52 resigned, died, or were transferred, and was increased by 43, through reinstatements of men from military service and new appointments—a net reduction of 43. At the end of the year the force consisted of 1 chief hydraulic engineer, 18 hydraulic engineers, 18 engineers, 27 assistant engineers, 11 junior engineers, 1 geologist, 3 associate geologists, 3 assistant geologists, 1 assistant chemist, 3 junior chemists, 3 classifiers, 9 assistant classifiers, and 20 junior classifiers, a total of 118. Of this number 1 hydraulic engineer, 2 assistant engineers, 1 classifier, 6 assistant classifiers, and 14 junior classifiers are on furlough, and 1 hydraulic engineer, 13 engineers, 1 assistant engineer, and 1 classifier are employed occasionally.

In the clerical force there were 14 separations and 9 accessions, and at the end of the year the force numbered 32.

The following members of the water-resources branch entered the military service. The status given is that of June 30, 1919.

Richard Aitken, Naval Reserve.
Herbert A. R. Austin, first lieutenant; honorably discharged December 17, 1918.
Charles R. Bell, Artillery Observation Service training camp; honorably discharged November 24, 1918.
Leland Bell, ensign, U. S. Naval Reserve; inactive duty April 10, 1919.
Revoe C. Briggs; honorably discharged December 24, 1918.
John S. Brown, second lieutenant; honorably discharged January 11, 1919.
Kirk Bryan,[1] second lieutenant; honorably discharged February 27, 1919.
Earl H. Buchanan, Company A, One Hundred and Twenty-eighth Engineers.
John W. Campbell,[1] second lieutenant.
Harold C. Cloudman,[1] captain; honorably discharged April 19, 1918.
Frederick C. Corey, U. S. Naval Reserve officers' training school, inactive duty February 19, 1919.
George S. Cowdery, jr.[1]
Aldace H. Davison,[2] captain; honorably discharged June 18, 1919.
Henry J. Dean,[2] first lieutenant; honorably discharged June 30, 1919.
Jesse E. Dickerson, honorably discharged December 18, 1918.
William E. Dickinson,[2] second lieutenant; honorably discharged April 16, 1918.
Joseph J. Dirzulaitis; honorably discharged January 16, 1919.
Charles J. Downing, ensign, U. S. Naval Reserve; inactive duty April 17, 1919.
Max Drill, Coast Artillery school for officers; honorably discharged November 21, 1918.
Donald A. Dudley,[1] sergeant; honorably discharged June 4, 1919.
Joe B. Entringer,[1] second lieutenant; honorably discharged December 3, 1918.
Albert G. Fiedler,[1] second lieutenant; inactive duty November 28, 1918.
Edgar O. Francisco, first lieutenant; honorably discharged April, 1919.
Raymond E. Gaylord, second lieutenant; honorably discharged December 18, 1918.
Wilbur R. Gore, honorably discharged December 14, 1918.
Marcus L. Gossard.
Eugene L. Grant,[1] ensign, U. S. Naval Reserve; inactive duty March 6, 1919.
Homer E. Grosbach,[1] Aviation Service.
Warren E. Hall,[1] captain.
Oliver W. Hartwell,[2] first lieutenant; honorably discharged October 20, 1917.
Bryant L. Hopkins, honorably discharged November 28, 1918.
Bernard A. Howell,[1] second lieutenant.
Clarence C. Jacob,[2] captain; honorably discharged December 11, 1917.
Reid Jerman,[1] second lieutenant; honorably discharged December 1, 1918.
Fred E. Keating, base-hospital laboratory, Camp Upton, N. Y.
Joseph Krauskopf,[1] corporal; honorably discharged April 9, 1919.
W. A. Lamb, captain; inactive duty February 7, 1919.
George K. Larrison,[2] captain; honorably discharged December 31, 1918.
Otto Lauterhahn,[1] sergeant, Q. M. C. Graves Registration Service.
Ariel Lindquist, honorably discharged November 29, 1918.
George J. Lyon,[1] captain.
Floyd B. McGregor, honorably discharged February 20, 1919.
Lester R. McNeely,[1] honorably discharged May 8, 1919.
Paul G. Mayer,[1] corporal; honorably discharged April 3, 1919.
Oscar E. Meinzer, captain; honorably discharged December 13, 1918.
Arthur H. Montford,[1] honorably discharged December 11, 1918.
Robert E. Morgan, sergeant; honorably discharged February 17, 1919.
J. Wendell Moulton,[1] honorably discharged December 3, 1918.

[1] Reported fiscal year 1918. [2] Reported fiscal year 1917.

Malcolm G. Murray,[1] honorably discharged June 12, 1919.
John R. Neale.[1]
Carl G. Paulsen, sergeant; honorably discharged December 21, 1917.
Charles H. Pierce,[2] first lieutenant; inactive duty April 12, 1918.
Roy H. Quinn, sergeant; honorably discharged January 8, 1919.
James P. Reddick,[1] inactive duty April 17, 1919.
Clyde P. Ross, private; honorably discharged December 12, 1918.
John J. Sanford,[1] first lieutenant; inactive duty August 7, 1917.
Merritt L. Shearer, honorably discharged December 11, 1918.
Albert H. Shunk, musician; honorably discharged February 6, 1919.
George H. Smalley,[1] ensign, U. S. Naval Reserve; inactive duty March 26, 1919.
M. Reginald Stackpole, honorably discharged November 27, 1918.
James E. Stewart,[1] honorably discharged November 20, 1917.
Herman A. Stone, honorably discharged December 9, 1918.
Harry Thompson,[1] captain; inactive duty February 11, 1918.
Marion I. Walters, corporal; honorably discharged February 5, 1919.
Arnold N. Weeks, ensign, U. S. Naval Reserve.
Eugene L. Williams,[1] first lieutenant; honorably discharged December 23, 1918.
Allen L. Willie, honorably discharged December 3, 1918.
Leon Willie,[1] U. S. Navy, honorably discharged December 24, 1918.

ALLOTMENTS.

The appropriation for gaging streams was $148,244.10. The cooperative funds made available by State allotments, totaling $126,195, have been increased in some States and decreased in others, making necessary corresponding adjustments of this work.

The appropriation for examination of lands under the stock-raising homestead law enacted December 29, 1916, was $197,268.60.

The appropriations were allotted as follows:

For gaging streams:			
General administration:			
Direct	$9,898.98		
Denver office	2,200.00		
		$12,098.98	
Scientific and technical equipment		863.55	
Editorial work		1,747.50	
Branch administration		6,500.00	
Computations		10,500.00	
Reviewing manuscripts		1,800.00	
Inspection		1,000.00	
			$34,510.03
Surface water:			
New England:			
Maine and Connecticut	$1,350.00		
New Hampshire	1,000.00		
Vermont	900.00		
Massachusetts	2,250.00		
		5,500.00	
New York		4,000.00	
Middle Atlantic States		600.00	
South Atlantic States		5,000.00	
Texas		4,000.00	

[1] Reported fiscal year 1918.

[2] Reported fiscal year 1917.

For gaging streams—Continued.			
Surface water—Continued.			
Upper Mississippi River:			
Wisconsin	$2,500.00		
Minnesota and Iowa	2,500.00		
Illinois	1,000.00		
		$6,000.00	
Colorado, Wyoming, and New Mexico		7,000.00	
Montana	$4,000.00		
North Dakota	300.00		
		4,300.00	
Great Basin:			
Utah	4,000.00		
Nevada	2,500.00		
		6,500.00	
Idaho		2,800.00	
Oregon		4,000.00	
Washington		4,000.00	
California		4,000.00	
Hawaii at Honolulu	$4,000.00		
Hawaii at Washington	500.00		
		4,500.00	
Kansas		2,500.00	
Arizona		2,500.00	
			$67,200.00
Ground water:			
General		14,000.00	
Coastal Plain		1,400.00	
			15,400.00
Quality of water			9,500.00
Power resources			12,000.00
Land-classification board			7,000.00
Utilization			2,300.00
Contingent			334.07
			148,244.10
For enlarged and stock-raising homesteads:			
Field work		$120,209.41	
Land-classification board		55,000.00	
General administration		14,179.19	
Branch administration		7,880.00	
			197,268.60

Of the total appropriations, 85 per cent was allotted for work in public-land States.

COOPERATION.

States.—The following amounts were expended by several States from cooperative allotments:

Alabama		$205.00
Arizona		3,015.00
California:		
State engineer	$7,190.00	
State Water Commission	8,530.00	
City of San Francisco	2,145.00	

California—Continued.		
San Bernardino, Riverside, and Orange counties	$3,000.00	
		$20,865.00
Colorado		700.00
Georgia		505.00
Hawaii		19,000.00
Idaho		1,310.00
Illinois		2,550.00
Iowa:		
State Geological Survey	$545.00	
State Highway Commission	1,150.00	
		1,695.00
Kansas		3,250.00
Kentucky		250.00
Maine		5,000.00
Massachusetts		3,240.00
Montana		2,205.00
Nevada		2,085.00
New Hampshire		2,395.00
New York:		
State engineer	$2,380.00	
Conservation Commission	8,630.00	
		11,010.00
North Carolina		280.00
North Dakota		600.00
Oregon		5,735.00
South Dakota		180.00
Tennessee		660.00
Texas		9,830.00
Utah		7,290.00
Vermont		1,330.00
Washington		11,035.00
Wisconsin		5,160.00
Wyoming		4,815.00
		126,195.00

The work done under cooperative agreement with the States has been restricted to studies of stream flow, except in California.

War Department.—Many reports based on special field investigations and office studies were prepared and submitted to the War Department and bureaus engaged in the conduct of the war.

Reclamation Service.—The measurement of streams that are to furnish water to reclamation projects under construction has been continued in cooperation with the United States Reclamation Service. The field work is done by Survey engineers who are employed in the locality, and the actual cost is repaid by the Reclamation Service through transfer of funds.

The Survey also continued to assist the Reclamation Service in an investigation undertaken to obtain a basis for the equitable distribution of the waters of Milk and St. Mary rivers—a work carried on

under cooperative agreement with the Canadian Department of the Interior.

Office of Indian Affairs.—In accordance with authorization by the Office of Indian Affairs, stream gaging was continued on the Menominee, Crow, Fort Hall, Yakima, Colville, Quinault, Klamath, Warm Springs, Gila River, western Shoshone, and Uinta Indian reservations.

National Park Service.—Streams in the Yosemite and Yellowstone national parks were measured during the year at stations maintained in cooperation with the National Park Service.

Forest Service.—A study of stream flow in the Angeles National Forest, in southern California, was continued in cooperation with the Forest Service.

City of San Francisco.—In connection with the proposed storage of the water of Tuolumne River in Hetch Hetchy Valley as a water supply for the city of San Francisco, measurement of that stream was continued in cooperation with the city government.

PUBLICATIONS.

The publications of the year prepared by the water-resources branch comprise 14 reports and 2 separate chapters. Titles and brief summaries of these publications are given on pages 35–37. At the end of the year 21 reports were in press and 13 manuscripts were awaiting editorial examination.

GENERAL SUMMARY.

Investigations of surface streams have been continued by maintaining gaging stations for measuring their discharge in 38 States and in Hawaii and Alaska. Cooperation with States and other Federal organizations has made possible the large amount of work in progress. Twenty-three cooperating States (including Hawaii) have contributed $126,195 for work in these States, and the Indian Office, Engineer Corps, National Park Service, and Reclamation Service have also contributed largely to the study of the flow of particular streams.

General ground-water investigations have been in progress in 12 States. In addition many special investigations of the quantity and quality of ground-water supplies for various army and naval establishments have been made.

Many investigations of the present and probable future use of both surface and ground waters have been made in connection with the classification of public lands, with special reference to their use for power, under permit, or for agriculture, under the enlarged-homestead, desert-land, or Carey acts. The results of such investigations are generally incorporated in unpublished special reports to the Commissioner of the General Land Office and to the Secretary of the Interior.

Investigations, made in cooperation with the United States Fuel Administration, of problems relating to the operation of power plants, interconnection of transmission systems, and substitution of water power for fuel power, have led to improvement in service and to conservation of fuel. The statistical studies of power resources and output have been continued since the signing of the armistice.

DIVISION OF SURFACE WATERS.

ORGANIZATION.

The work of the division of surface waters consists primarily of the measurement of the flow of rivers, but it includes also special investigations of conditions affecting stream flow and the utilization of the streams.

In carrying on the work the United States is divided into 16 districts, including Hawaii. The location of the districts and district offices and the names of the engineers in charge are given in the following list:

New England: C. H. Pierce, Customhouse, Boston, Mass.
New York: C. C. Covert, Journal Building, Albany, N. Y.
Pennsylvania: R. A Boehringer, Telegraph Building, Harrisburg, Pa.
Middle Atlantic and Ohio River: G. C. Stevens, Washington, D. C.
South Atlantic and eastern Gulf: W. E. Hall, Post Office Building, Atlanta, Ga.
Upper Mississippi River: W. G. Hoyt, Capitol Building, Madison, Wis.; suboffices, Kimball Building, Chicago, Ill., and Ames, Iowa.
Kansas: R. C. Rice, Federal Building, Topeka, Kans.
Upper Missouri River: W. A. Lamb, Montana National Bank Building, Helena, Mont.
Rocky Mountain: Robert Follansbee, New Post Office Building, Denver, Colo.
Great Basin: A. B. Purton, Federal Building, Salt Lake City, Utah.
Idaho: C. G. Paulsen, Idaho Building, Boise, Idaho.
Washington: G. L. Parker, Federal Building, Tacoma, Wash.
Oregon: F. F. Henshaw, Post Office Building, Portland, Oreg.
California-Arizona: H. D. McGlashan, Customhouse, San Francisco, Calif.; suboffices, Federal Building, Los Angeles, Calif., and Tucson, Ariz.
Texas: C. E. Ellsworth, Capitol Building, Austin, Tex.
Hawaii: James E. Stewart, Capitol Building, Honolulu, Hawaii.

CHARACTER AND METHODS OF WORK.

Field investigations necessary to the work are made from the district offices, where the results are sufficiently analyzed to insure accuracy and completeness. At selected places, known as gaging stations, the volume of water carried by the streams is measured and records of stage and other data are collected from which the daily flow of the streams is computed. Data collected from the district offices are transmitted to Washington, where they are reviewed in the computing section and prepared for publication. By this review the records obtained in different parts of the country are brought to a uniform standard, and standardization is further effected through annual conference of the engineers.

At the end of the year 1,251 gaging stations were being maintained, including 81 in Hawaii; 173 stations were discontinued and 242 new stations established during the year. Records for about 190 addi-

tional stations were received, ready for publication, from other Government bureaus and private persons, and a number of Government and State organizations and individuals also cooperated in the maintenance of many of the regular gaging stations.

Gaging stations and cooperating parties for the year ended June 30, 1919.

State.	Geological Survey alone.	Reclamation Service.	Forest Service.	Indian Office.	Army engineers.	Weather Bureau.	Other Federal bureaus.	State cooperation.	Municipal cooperation.	Private persons.	Counted more than once.	Maintained at end of year.	Established during year.	Discontinued during year.	Regular gagings during year.	Miscellaneous gagings during year.
Alabama	....	....	....	....	1	....	....	4	....	1	....	6	1	....	17	2
Arizona	....	1	....	4	2	....	....	13	....	1	4	17	....	7	237	61
California	....	....	26	1	....	2	5	161	29	33	96	161	9	10	952	358
Colorado	7	2	15	....	....	1	....	12	2	5	1	43	1	6	130	4
Connecticut	....	....	....	....	....	....	....	....	....	2	....	2	1	....	13	.....
Florida	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Georgia	....	....	....	....	....	3	....	7	....	13	1	22	5	2	81	15
Idaho	....	4	1	14	....	1	....	30	1	124	25	150	113	24	644	46
Illinois	....	....	....	....	1	....	....	24	1	1	3	24	1	3	81	.....
Indiana	....	....	....	....	....	....	....	....	....	1	....	1	1	1	....	.....
Iowa	....	....	....	....	....	3	....	24	....	5	8	24	3	....	113	.....
Kansas	....	....	....	....	....	1	....	11	....	....	1	11	4	2	79	2
Kentucky	....	....	....	....	....	....	....	4	....	....	....	4	....	....	....	.....
Maine	....	....	....	....	....	....	....	16	....	2	2	16	....	....	50	.....
Maryland	3	....	....	....	....	....	....	....	....	....	....	3	....	....	2	.....
Massachusetts	....	....	....	....	....	....	....	16	....	1	1	16	1	....	120	2
Michigan	....	....	....	....	....	....	....	....	1	1	....	2	....	....	....	.....
Minnesota	1	....	....	....	3	2	....	1	....	....	....	7	....	1	13	.....
Montana	8	49	4	7	....	....	....	18	....	3	....	89	3	19	408	129
Nevada	....	2	....	2	....	1	....	27	....	6	11	27	....	5	85	3
New Hampshire	....	....	....	....	....	....	....	10	....	7	7	10	....	....	70	1
New Jersey	1	....	....	....	....	....	....	....	....	....	....	1	....	....	....	.....
New York	....	....	....	....	1	1	....	56	1	11	17	56	13	2	278	44
North Carolina	....	....	....	....	....	1	....	3	....	4	....	8	3	....	26	2
North Dakota	....	....	....	....	....	....	3	9	....	....	....	12	6	....	9	6
Ohio	....	....	....	....	2	....	....	....	....	....	....	2	....	....	....	.....
Oklahoma	1	....	....	....	2	....	....	....	....	....	....	3	....	1	....	.....
Oregon	....	4	1	10	....	2	....	16	13	45	1	90	12	8	336	43
South Dakota	....	....	....	....	....	....	....	1	....	....	....	1	1	5	3	.....
Tennessee	....	....	....	....	....	8	....	11	....	5	7	17	12	3	42	5
Texas	....	1	....	....	....	3	....	42	5	4	13	42	1	1	352	194
Utah	....	1	....	5	....	....	....	110	2	75	83	110	3	6	719	73
Vermont	....	....	....	....	....	....	....	9	....	4	4	9	....	....	56	.....
Virginia	2	....	....	....	....	1	....	....	....	2	....	5	....	....	....	.....
Washington	2	1	7	11	....	....	1	5	9	34	1	69	10	2	434	13
West Virginia	5	....	....	....	6	....	....	....	....	....	....	11	....	5	....	.....
Wisconsin	....	....	....	2	2	....	....	46	....	12	16	46	1	....	195	8
Wyoming	....	9	5	....	....	1	3	43	....	7	15	53	21	52	368	36
Hawaii	....	....	....	....	....	....	....	81	2	31	33	81	16	8	390	29
	30	74	59	56	20	34	12	810	66	440	350	1,251	242	173	6,303	1,077

PUBLICATIONS.

For convenience and uniformity in publication the United States has been divided into 12 primary drainage basins, and the results of stream measurements are published annually in a series of progress reports that correspond to these 12 divisions. Prior to 1914 the records for each division were contained in a single water-supply paper; since 1914 the records for the twelfth division have been published in three papers. In addition to the progress reports, special reports on various hydraulic subjects have been completed for publication during the year, including a report on the water supply of St. Mary and Milk rivers, which was prepared in cooperation with the Reclamation Service, Department of the Interior, Canada, for publication by the International Joint Commission.

The following table shows the division into drainage areas and gives the numbers of water-supply papers containing results of stream measurements for 1899 to 1919:

Numbers of water-supply papers containing results of stream measurements, 1899–1919.

Year.	I North Atlantic slope (St. John River to York River).	II South Atlantic and eastern Gulf (James to the Mississippi).	III Ohio River.	IV St. Lawrence River and Great Lakes.	V Hudson Bay and upper Mississippi River.	VI Missouri River.	VII Lower Mississippi River.	VIII Western Gulf of Mexico.	IX Colorado River.	X Great Basin.	XI Pacific slope in California.	XII North Pacific slope basins.		
												Pacific slope in Washington and upper Columbia River.	Snake River basin.	Lower Columbia River and Pacific slope in Oregon.
1899 [a]	35	[b] 35, 36	36	36	36	[c] 36, 37	37	37	[d] 37, 38	38, [e] 39	38, [f] 39	38	38	38
1900 [g]	47, [h] 48	48	48, [i] 49	49	49	49, [j] 50	50	50	50	51	51	51	51	51
1901	65, 75	65, 75	65, 75	65, 75	[k] 65, 66, 75	66, 75	[k] 65, 66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75
1902	82	[b] 82, 83	83	[l] 82, 83	[k] 83, 85	84	[k] 83, 84	84	85	85	85	85	85	85
1903	97	[b] 97, 98	98	97	[k] 98, 99, [m] 100	99	[k] 98, 99	99	100	100	100	100	100	100
1904	[n] 124, [o] 125, [p] 126	[p] 126, 127	128	129	[k] 128, 130	130, [q] 131	[k] 128, 131	132	133	133, [r] 134	134	135	135	135
1905	[n] 165, [o] 166, [p] 167	[p] 167, 168	169	170	171	172	[k] 179, 173	174	175, [s] 177	176, [r] 177	177	178	178	[t] 177, 18
1906	[n] 201, [o] 202, [p] 203	[p] 203, 204	205	206	207	208	[k] 205, 209	210	211	212, [r] 213	213	214	214	214
1907–8	241	242	243	244	245	246	247	248	249	250, [r] 251	251	252	252	252
1909	261	262	263	264	265	266	267	268	269	270, [r] 271	271	272	272	272
1910	281	282	283	284	285	286	287	288	289	290	291	292	292	292
1911	301	302	303	304	305	305	307	308	309	310	311	312	312	312
1912	321	322	323	324	325	326	327	328	329	330	331	332–A	332–B	332–C
1913	351	352	353	354	355	356	357	358	359	360	361	362–A	362–B	362–C
1914	381	382	383	384	385	386	387	388	389	390	391	392	393	394
1915	401	402	403	404	405	406	407	408	409	410	411	412	413	414
1916	431	432	433	434	435	436	437	438	439	440	441	442	443	444
1917	451	452	453	454	455	456	457	458	459	460	461	462	463	464
1918	471	472	473	474	475	476	477	478	479	480	481	482	483	484
1919	501	502	503	504	505	506	507	508	509	510	511	512	513	514

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39. Tables of monthly discharge for 1899 in Twenty-first Annual Report, Part IV.
[b] James River only.
[c] Gallatin River.
[d] Green and Gunnison rivers and Grand River above junction with Gunnison.
[e] Mohave River only.
[f] Kings and Kern rivers and south Pacific slope basins.
[g] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52. Tables of monthly discharge for 1900 in Twenty-second Annual Report, Part IV.
[h] Wissahickon and Schuylkill rivers to James River.
[i] Scioto River.
[j] Loup and Platte rivers near Columbus, Nebr., and all tributaries below junction with Platte.
[k] Tributaries of Mississippi from east.
[l] Lake Ontario and tributaries to St. Lawrence River proper.
[m] Hudson Bay only.
[n] New England rivers only.
[o] Hudson River to Delaware River, inclusive.
[p] Susquehanna River to Yadkin River, inclusive.
[q] Platte and Kansas rivers.
[r] Great Basin in California except Truckee and Carson river basins.
[s] Below junction with Gila.
[t] Rogue, Umpqua, and Siletz rivers only.

DIVISION OF GROUND WATERS.

WAR WORK.

During the fiscal year 1918–19 the energies of the division of ground waters were devoted chiefly to war work. By the end of the war half the men of the division were with the colors, and the rest, working as civilians, were occupied almost exclusively with problems of military water supplies. Capt. O. E. Meinzer and Second Lieut. Kirk Bryan were assigned to duty as water-supply geologists in the geologic section of the general headquarters of the American Expeditionary Forces, but the armistice was signed before they were able to render productive service in these assignments.

The war work of the division consisted of (1) giving information and advice to the War and Navy departments and to other Government departments engaged in war work in regard to water supplies from wells and springs, (2) mapping and describing water supplies along the international border and the Atlantic coast for the progressive military map of the United States.

During the war information and advice were given to the War and Navy departments in regard to water supplies at about 100 military and naval establishments in the United States, such as cantonments, forts, navy yards, aviation fields, powder factories, arsenals, and supply depots. A large part of the advice was based on data previously procured, but field investigations were made at many points. Most of the work for the War Department was done at the request of and in cooperation with the water-supply section of the Constructing Quartermaster's Division; most of the work for the Navy Department was done for the Bureau of Yards and Docks. In this work the division cooperated closely with the section of Coastal Plain geologic investigations, and many of the investigations and reports were made by the geologists of that section, under the direction of T. W. Vaughan, geologist in charge. (See pp. 60–61.) This war work is not here described in detail.

Maps were prepared to show the water supplies in the region along the international border from Nogales, Ariz., to the Pacific coast. These maps were based on field maps of surveys of desert watering places made during the preceding fiscal year. They were completed and transmitted to the War Department at the request of the Corps of Army Engineers for use on the progressive military map of the United States. Surveys were made for the same purpose in the Atlantic Coastal Plain, chiefly in Virginia and South Carolina, under the direction of T. W. Vaughan. (See pp. 153, 154.)

During Mr. Meinzer's absence in the military service A. J. Ellis was the acting chief of the division, and many of the investigations for the War Department were made by him or under his direct supervision.

OTHER WORK.

During the preceding fiscal year about 60,000 square miles in southern California and southwestern Arizona was surveyed with a view to mapping the desert watering places of the region and describing them and the routes to them in a series of guidebooks. The work included also the erection of 305 signposts bearing 635 enameled sign boards, each giving the direction and distance of one to five watering places. The preparation and publication of the guidebooks was seriously delayed by the war, but before the end of the fiscal year the manuscript and maps for two of the books were transmitted to the Director and the work on the rest was well advanced. This work was done under a comprehensive plan for mapping and marking the watering places in the entire arid region east of the Sierra Nevada and Cascade Mountains and west of a line running approximately from eastern Oregon through Salt Lake City and Santa Fe to the mouth of Pecos River.

The exploratory drilling project in Steptoe Valley, Nev., to discover water for irrigation was brought to an end soon after the beginning of the fiscal year with a pumping test of the third well drilled, which showed that the well would yield enough water to irrigate 80 acres of land. A report on this project was completed by W. O. Clark and C. W. Riddell, with an introduction by O. E. Meinzer. Copies of this report were filed for consultation by the public in the Washington and Salt Lake City offices of the United States Geological Survey and with the mayor of Ely, Nev. A copy was also transmitted to the Director for publication as a water-supply paper.

A bibliography of the publications of the United States Geological Survey relating to ground water, with brief abstracts, detailed index, and map, by O. E. Meinzer, was published as Water-Supply Paper 427.

An outline and glossary of terms relating to ground water was prepared by Mr. Meinzer and was submitted to numerous authorities for criticism.

During the last few months of the fiscal year Mr. Meinzer made much progress on a general treatise on ground water in the United States. Some work was also done on a comprehensive study, begun several years ago, of the Pleistocene and present physiography and hydrology of the closed basins of the western United States.

Mr. Ellis continued his work as specialist on mineral waters for the division of mineral resources. The chapter on the production of mineral waters in 1917 was published, and the chapter on the production in 1918 was prepared. A forecast of the mineral-water trade in 1919 was prepared and sent to the Director.

Cooperation with the committee on physiography was continued through Mr. Meinzer, who serves on that committee.

WORK BY STATES.

Below are summaries, by States, of the investigations of ground water that were in progress during the year, except those relating directly to the war. Nearly all these investigations were delayed by the war. Much information of general value was also obtained in connection with the military investigations in Alabama, California, Massachusetts, North Carolina, New York, Rhode Island, Texas, Virginia, and other States.

Arizona.—Half the work on desert watering places was done in Arizona. The region south of Gila River, extending from Tucson and Nogales to Yuma, was covered by Kirk Bryan; Gila Valley and the region extending north from this valley to Wickenburg and Parker was covered by C. P. Ross. Guides to watering places, with descriptions of the geography, geology, and water resources of these regions, are being prepared.

A brief report on the geology and water resources of the San Carlos Indian Reservation, written in a previous year by A. T. Schwennesen, was sent to the Government Printing Office for publication as a part of "Contributions to hydrology" (Water-Supply Paper 450–A).

California.—Half the work on desert watering places was done in California. The desert parts of San Bernardino County and adjoining areas were surveyed by D. G. Thompson, and those of Imperial, Riverside, and San Diego counties were surveyed by J. S. Brown.

Guides and maps for the entire region were completed and were transmitted to the Director for publication. More comprehensive water-supply papers, which contain much information on the geography, geology, and water resources of the region, are in preparation.

A report on ground water in San Jacinto and Temecula basins, by G. A. Waring, sent to the Government Printing Office in the preceding fiscal year to be published as Water-Supply Paper 429, remained unpublished at the end of this fiscal year on account of the congestion of printing caused by the war.

A report on the geology and ground-water resources of the western slope of San Diego County, by A. J. Ellis and C. H. Lee, was sent to the printer to be published as Water-Supply Paper 446.

A report on ground water in Ivanpah, Mesquite, and Pahrump valleys, by G. A. Waring, was transmitted for publication as one of the "Contributions to hydrology" (Water-Supply Paper 450–C).

A report on ground water in Lanfair Valley, by D. G. Thompson, was also transmitted to the Director to be published as one of the "Contributions to hydrology" (Water-Supply Paper 450–B).

A comprehensive report on ground water in Sacramento Valley, by Kirk Bryan, was completed and transmitted to the Director for publication as a water-supply paper.

A large report on ground water in Santa Clara Valley, the product of several years of investigation by W. O. Clark, was nearly completed at the end of the fiscal year. On account of his service in war work Mr. Clark was able to make very little progress on his investigations of the ground water in Salinas Valley. In connection with certain war work, however, he collected valuable data on the wells and water resources of Napa Valley.

Measurements of depth to the water level in a series of wells in southern California have been made at intervals since 1900 for the purpose of obtaining a long record of the relation between the contributions to the subterranean reservoirs in the rainy seasons and the withdrawals from them in the dry seasons, when ground water is pumped for irrigation and is withdrawn in large quantities by evaporation and transpiration. These measurements were continued by F. C. Ebert. Mr. Ebert also compiled the Survey's records of the water levels in southern California and transmitted the resulting report for publication as a water-supply paper.

All the ground-water work in California is done in financial cooperation with the State Department of Engineering.

Connecticut.—Three completed reports based on investigations made in previous years in cooperation with the State Geological and Natural History Survey, H. E. Gregory, State geologist, are awaiting publication. These reports cover the Meriden area, by G. A. Waring (Water-Supply Paper 449); the Southington-Granby area, by H. S. Palmer (Water-Supply Paper 466); and the Norwalk, Suffield, and Glastonbury areas, by H. S. Palmer (Water-Supply Paper 470). The delay in the publication of these reports is due chiefly to the exigencies of the war.

An investigation of the ground-water conditions in Pomperaug Valley, by A. J. Ellis, remains unfinished.

In March Mr. Meinzer, in company with Prof. Gregory, made a brief trip to the northeastern part of the State to devise plans for increasing the water supplies of the State Agricultural College and the State Training School and Hospital near Mansfield.

In April J. S. Brown, in extension of the systematic ground-water survey of the State, began field work on the ground waters along the coast of Connecticut, giving special consideration to the effect of sea water on the quality of these waters. This investigation is under the direction of Prof. Gregory and is paid for chiefly by the State.

Mississippi.—The investigation of ground water in Mississippi, which was begun in a previous year, was continued in cooperation with the section of Coastal Plain investigations.

Montana.—An investigation of ground water in Montana was begun in August, 1915, by A. J. Ellis. In 1915 and 1916 the region south of Yellowstone River was covered by field work, and in the summer of 1917 a ground-water survey was made of Musselshell

County. Reports on both regions are in preparation, but the work has been greatly delayed.

Nevada.—A report on ground water in Reese River valley and an adjacent part of Humboldt River valley, by G. A. Waring, was published as Water-Supply Paper 425–D. The area covered in the report by Mr. Waring on the Ivanpah, Mesquite, and Pahrump valleys lies in part in Nevada. (See California.)

The exploratory drilling in Steptoe Valley was brought to a close with very satisfactory results. A report on the test wells and on the ground-water conditions and irrigation prospects of the valley was prepared by W. O. Clark and C. W. Riddell and was transmitted to the Director for publication as a water-supply paper.

New Mexico.—A report on ground water in the Animas, Playas, Hachita, and San Luis basins, in Grant County, N. Mex., by A. T. Schwennesen, with analyses of water and soil by R. F. Hare, was published as Water-Supply Paper 422. Analyses of samples of water and of the water-soluble contents of samples of soil from these basins were made, through cooperation, by the New Mexico Agricultural Experiment Station.

Oklahoma.—In September, 1918, D. G. Thompson examined a newly discovered artesian basin in the vicinity of Gage, Okla. A manuscript report prepared by Mr. Thompson on the results of his investigation was made public by being submitted to Hon. James V. McClintic.

South Carolina.—The survey of the ground-water resources of the Coastal Plain province of South Carolina was continued in cooperation with the section of Coastal Plain investigations, the work being done by C. W. Cooke, under the direction of T. W. Vaughan. Samples of water collected in connection with this investigation were sent to the water-resources laboratory for analysis.

South Dakota.—A report on artesian water in the vicinity of the Black Hills, S. Dak., by N. H. Darton, was published as Water-Supply Paper 428. This report is a revision of earlier reports on the area by Mr. Darton and includes much new material.

Texas.—The work in Texas was carried on in cooperation with the section of Coastal Plain investigations. The field of study included the central and western parts of the Coastal Plain province.

Special ground-water investigations were made by Mr. Thompson for the Bureau of Mines in the vicinity of Petrolia in October, 1918.

Utah.—In the spring of 1918 a reconnaissance of the geology and water resources of a part of southeastern Utah was made by Prof. H. E. Gregory. The field work was completed soon after the beginning of the present fiscal year, and some progress was made in the preparation of a report on the region.

Virginia.—In the spring of 1918 detailed field work on ground water was begun in parts of the Coastal Plain province in connection with military mapping by the section of Coastal Plain investigations, under the direction of W. T. Lee. Some of the results obtained are to be published later.

Washington.—A report on ground water in Quincy Valley, Wash., by A. T. Schwennesen and O. E. Meinzer, was published as Water-Supply Paper 425–E.

Dominican Republic.—In the spring of 1919 a geologic reconnaissance of the Dominican Republic was made by the United States Geological Survey under the authority of the military governor of the Republic. C. P. Ross, of the ground-water division, was the hydrologist of the exploring party. He left for Santo Domingo on March 20, 1919, and was engaged in field work during the rest of the fiscal year.

DIVISION OF QUALITY OF WATER.

The principal work of the division of quality of water is the mineral analysis of samples of the surface and ground waters of the United States and the interpretation of the analyses to determine how far the mineral content of the waters may affect their domestic use or their use in irrigation or in manufacturing.

During the year the division analyzed 377 samples of water and made computations and classification preparatory to the use of the analyses in reports. This number includes about 50 analyses made for the War and Navy departments as a part of reports on the quality of water required for troops, munition plants, boiler supplies, laundry supplies, and other purposes.

The division also spent considerable time in the technical criticism of 29 reports on quality of water prepared in other divisions. About 300 analyses made outside the Survey have also been computed and classified.

A report on "The nature and cause of calcareous deposits in the water-supply system of Port au Prince, Haiti," was prepared for the Navy Department by A. A. Chambers, besides several other reports to the War Department on the quality of water at numerous localities. Mr. Chambers has made considerable progress in the preparation of analytical data to be used in a report by him on the ground waters of Mississippi.

In considering certain problems connected with the mineral analysis of water C. H. Kidwell devised methods that considerably increase the accuracy of the analyses and save much time in the laboratory work.

DIVISION OF POWER RESOURCES.

The division of power resources has for its function the investigation of power development and utilization. It studies methods of converting natural source of energy into mechanical and electrical power, to the end that the permanent sources, such as water power, may be more fully utilized and the exhaustible sources, such as mineral fuels, may be wisely used and the life of the deposits prolonged. Accordingly this division collects and compiles information showing the magnitude and distribution of water-power sites and fuel deposits, placing special emphasis on the relative importance of the sources from which energy is obtained and giving due consideration to future requirements of energy. The utilization of mechanical and electrical power in various industries and the production of machinery for power development have also received some consideration.

In the performance of this work both statistical and engineering investigations have been required. The statistical work undertaken during the year was the collection of information concerning the installed capacity, fuel requirements, operation, and output of electric-power plants. As a basis for this work a list of all concerns engaged in business as electrical utilities has been compiled.

The engineering work of the division has consisted of the investigation of specific power problems and the preparation of reports thereon and the formulation of plans to remedy faults and to improve power service. Some of the problems studied during the war period were reported shortages of power and poor power service affecting the production of war necessities, especially in the mining of coal; economies to be gained by interconnection of electric power stations; opportunities for the substitution of water power for fuel power; installation of additional generating equipment of power plants; increase of facilities for water storage and for use of stored water to increase the production of power by hydroelectric plants; the feasibility of financing and constructing new water-power developments; and the obtaining of licenses for the purchase of construction materials and generating equipment required for such developments.

During most of the year the work of the division was done in cooperation with the Bureau of Conservation and the Bureau of Statistics of the United States Fuel Administration. At the time of its organization the Bureau of Conservation was without a force of field engineers, and it was therefore advantageous to use in the investigations of such problems as arose the services of the engineers of the Geological Survey. Accordingly a cooperative agreement was made in the spring of 1918 by which Survey engineers were detailed to the Fuel Administration whenever specific problems required investigation.

Under the terms of this agreement there was a rapid expansion of the engineering work of the division of power resources, which continued until the armistice was signed. After the armistice, however, the necessity for rigid measures of conservation passed, and under date of November 18 the Bureau of Conservation requested that further investigations be undertaken only when they might directly contribute to the saving of fuel during the winter of 1918–19 and that other investigations in progress be terminated as soon as practicable. On November 22 Dr. H. A. Garfield, United States Fuel Administrator, suggested that the part of the work of the Fuel Administration relating to the development of power that might be of value to the country in time of peace be continued by the Survey, and on December 11 the Survey expressed its willingness to take over and carry on such features as appeared to have permanent usefulness. During the month of January this cooperation was concluded, as the Bureau of Conservation ceased its activities on January 15.

For the Bureau of Statistics of the Fuel Administration the Geological Survey undertook to ascertain the fuel requirements of electrical utilities and to assist in obtaining and compiling weekly reports showing their consumption of fuel. As an aid in fuel conservation and to assist in determining the conditions of power supply the division of power resources requested that electrical utilities report also their production of electric power. Statistical inquiry was also made concerning the conditions of power production in private electric plants. This cooperative arrangement with the Bureau of Statistics was continued until February 1, 1919, when the division of power resources took over the statistical work relating to the consumption of coal by electrical utilities and the production of electric power.

The personnel of the division has varied throughout the year in accordance with the requirements of the work. Six employees of the Geological Survey were regularly employed in the Washington office, and four clerks were detailed from the Fuel Administration to assist in work of the division. The engineering investigations have in general been conducted by the engineers in charge of the district offices of the water-resources branch. When it became evident that there would be a marked shortage of power throughout the country 13 engineers were appointed to make engineering investigations in the field. Most of these engineers were engaged in consulting practice, but all accepted appointment at a per diem salary as an opportunity for patriotic service. The following engineers accepted such appointment: Howard T. Critchlow, Trenton, N. J., Alger A. Conger, Worcester, Mass.; G. F. Harley, Columbus, Ga.; Fred H. Vose, Cleveland, Ohio; Elmer J. McCaustland, Columbia, Mo.; Francis J. Seery, Ithaca, N. Y.; H. N. Sulliger, Santa Monica, Cal.,

Timothy R. Atkinson, Bismarck, N. Dak.; Clinton B. Stewart, Madison, Wis.; Roy C. Brett, Cleveland, Ohio; Chester S. Colson, New York City; Horace W. King, Ann Arbor, Mich.; John C. Stevens, Portland, Oreg. To assist in the statistical work of the division additional temporary clerks and stenographers were detailed by the Fuel Administration, reporting for duty in the evening. The number of such clerks at the period of maximum activity was about 50.

The engineering work of the division revealed many opportunities for the conservation of fuels and the increase in electric power supply for war necessities. During the first part of the fiscal year and up to the signing of the armistice over 50 field investigations had been undertaken by the division, and a large number of reports had been submitted to the Fuel Administration. Reports were also made for the War Industries Board, the Capital Issues Committee, and the War and Navy departments. Some of the typical investigations made and results accomplished are stated below.

An examination and study of the generation and use of power in and around Albany, N. Y., indicated that much coal could be saved by making use of existing interconnections of electric power plants made primarily for use in emergencies by utilizing more completely a large hydroelectric plant, and by using for generating power water that was stored for navigation. As a result of a conference at Albany of State officials and representatives of the power companies, of the division of power resources, and of the Fuel Administration, arrangements were made to utilize the interconnections of certain power plants and to replace steam power with water power. The plan was placed in operation October 23, 1918, with an estimated saving of over 50,000 tons of coal a year.

Investigations were made in New England with a view of developing and utilizing stored water to increase the power available at hydroelectric plants in the Connecticut River basin. A report was made to the Capital Issues Committee on the request of the city of Watertown to issue bonds to complete a water-power development in connection with the city waterworks.

The power service furnished by the Central Illinois Public Service Co. to the coal mines in southern Illinois was investigated, and a peculiarly difficult power shortage was adjusted equitably to the power users by placing a representative of the Fuel Administration in the load dispatcher's office of the power company. The company was also assisted in obtaining material and equipment for repairing and enlarging one of its power plants.

The municipal power plant at Nashville, Tenn., was shut down because it was shown that coal would be saved by purchasing power from a hydroelectric plant. A report was made on the conditions of the water-power plants utilizing water from the power canal at

Augusta, Ga. The Navy Department was furnished with maps showing the location of transmission lines and power plants for use in selecting a site for a wireless station in South Carolina. An investigation and detailed report was made on the possibility of saving fuel in the St. Paul-Minneapolis district, in Minnesota. Investigation of duplication of power plants at Grand Island, Nebr., showed that about 7,000 tons of coal a year could be saved by interconnection and action was taken accordingly. As a result of an investigation of power furnished to coal mines at Sheridan, Wyo., emergency installation of additional generating equipment was recommended and assistance was given to the power company in procuring the equipment required. A report was made on the desirability of interconnecting the plants of the Spokane Light & Power Co., Spokane, Wash., and the Washington Water Power Co. A report was prepared showing the quantity of coal that would be saved by utilizing the water power at the Austin dam, Texas.

The quantity of fuel that can be saved at any operation or plant can not always be determined definitely by such investigations, but the aggregate quantity of fuel conserved by the work done was undoubtedly large, and the saving had a material effect on the coal supply. With the signing of the armistice the tremendous demand for power and fuel rapidly subsided, and no additional measures of fuel conservation were necessary.

The statistical work done included the obtaining of reports and the compilation of returns showing the coal consumed by electric utilities during the years 1916, 1917, and 1918. Preliminary estimates of the consumption for 1918 were furnished to the Bureau of Statistics of the Fuel Administration in June, 1918, and a final report was transmitted in December. Reports were prepared and published on the production of electrical power in the United States, showing the power derived from water and that derived from fuels and the quantities of fuels consumed for this purpose during the months of February and March, 1919.

As a basis for further studies of power production it was found necessary to prepare maps showing the location of power plants and transmission lines. Numerous power companies were requested to furnish blue prints giving such information as was available to show the location of their lines and their switching connections. Where no maps were available topographic sheets of the Geological Survey were sent to the companies for use in furnishing the information. Through this work, which has been in charge of Guy D. Thomas, a large amount of valuable material has been collected, and considerable progress has been made in the preparation of the maps. Maps of New Hampshire, Vermont, and New York are being printed; maps of Massachusetts and Virginia are practically compiled; and progress

has been made on maps of Connecticut, Rhode Island, North Carolina, South Carolina, Alabama, Ohio, Indiana, and Illinois.

In order to obtain a statistical measure of the progress of water-power development the manufacturers of water wheels were requested to furnish to the Geological Survey information concerning their shipments of wheels and the orders they received. The manufacturers furnished the information desired, and a report showing the number of water wheels manufactured and shipped in 1918 was prepared and will be published shortly.

A large amount of valuable statistical information relative to the private electric power plants of the United States was obtained in cooperation with the Fuel Administration, but the force available has not been sufficient to analyze and compile the statistics furnished. Two card indexes of electric-power concerns have been prepared, however, one segregated by States and the other arranged in alphabetic order. These indexes are believed to be the most complete lists of producers of electric energy in the United States. The names of all companies operating as electric utilities have been put on addressograph stencils, so that it is possible to send out requests for information from such companies with a minimum of effort.

DIVISION OF ENLARGED AND STOCK-RAISING HOMESTEADS.

About 100 men were employed in examining lands applied for under the enlarged and stock-raising homestead acts until November, 1918, when, because of the depletion of the appropriation, the force was reduced to 25 and transferred to the Washington office, where the men prepared and reviewed reports and participated in conferences with the land-classification board.

During the season of 1918 applications pending in the land districts of the following States were examined: Utah, all districts; Arizona, all districts; Washington, all districts; California, north half of the San Francisco and Sacramento districts, all of the Independence, Los Angeles, and Eureka districts, and about half of the Susanville district; Oregon, all districts except one-third of The Dalles district; Idaho, the Lewiston district and half of the Hailey district; Colorado, the Montrose, Durango, Denver, and Pueblo districts; Wyoming, the Lander district and four-fifths of the Evanston district; Montana, all districts except Kalispell and parts of the Miles City, Lewistown, and Great Falls districts; Oklahoma, the Guthrie district.

At the end of the fiscal year the field force was being reorganized in order to resume the field work as soon as the appropriation for the ensuing year should become available.

LAND-CLASSIFICATION BOARD.

ORGANIZATION AND PERSONNEL.

The land-classification board consists of a division of mineral classification, the work of which pertains to lands valuable for coal, oil, phosphate, and various other minerals, and a division of hydrographic classification, organized in three sections, one pertaining to water-power lands, one to irrigated and dry farming lands, and one to stock-raising homesteads. Technical men attached to other branches of the Survey act in consultation with the board on matters of classification involving the work upon which they are engaged.

The organization and personnel at the end of the year were as follows:

Chief of branch: W. C. Mendenhall, geologist.

Secretary of board: Elsie Patterson.

Division of mineral classification: E. H. Finch, geologist, acting chairman; R. W. Howell, geologist; N. W. Bass, assistant classifier.

Division of hydrographic classification: Herman Stabler, chief engineer, in charge.

Power section: R. W. Davenport, hydraulic engineer, chairman; R. M. Davis and N. J. Tubbs, engineers; D. J. Guy, assistant engineer.

Irrigation section: J. F. Deeds, engineer, chairman; F. J. Sopp, W. N. White, and F. B. Howe, classifiers; C. E. Nordeen, assistant topographer.

Grazing section: A. E. Aldous, classifier, chairman; G. W. Holland, classifier; J. G. Mathers, assistant engineer; W. L. Hopper, assistant classifier.

The force at the end of the year included also 38 other employees of various grades. During the year there were 22 additions to and 18 separations of employees on the permanent roll, and about half a dozen temporary clerks were engaged at different times. For six months of the winter period about 20 classifiers normally engaged in field examinations under the stock-raising homestead law were assigned to office work in connection with the classifications based on their field work.

FUNDS.

The work of the board for the fiscal year was supported by the following allotments from the appropriations made to the Survey:

Geologic surveys, etc	$23,000
Topographic and forest surveys	8,000
Gaging streams	7,000
Enlarged and stock-raising homesteads	55,000
	93,000

SUMMARY OF WORK OF CLASSIFICATION.

During the year 6,439 acres of land were classified as to their coal character. Of this amount 2,736 acres were classified as noncoal land and 3,703 acres as coal land. Coal-land withdrawals during the year amounted to only 2,415 acres, and coal-land restorations to

3,331,522 acres. The area withdrawn for classification as to coal at the end of the year was 40,428,381 acres.

Net withdrawals of probable oil lands amounting to 239,946 acres were made during the year, and an area of 931 acres was restored because examination determined that the lands were not favorable for the accumulation of oil. The result of the year's work, therefore, has been an increase of the area of oil reserves from 6,519,819 acres to 6,758,834 acres.

The net result of withdrawals and restorations of oil-shale lands has been to reduce the oil-shale reserves 3,754 acres, leaving 128,267 acres in existing reserves, practically all of which are reserved for the use of the Navy. In addition to this, 129,421 acres have been classified as to oil-shale content. Of this area 4,080 acres were classified as nonmineral land and 125,341 acres were classified as lands valuable as a source of petroleum and nitrogen. There is now a total area of 4,117,377 acres classified as oil-shale land and valuable for mineral. This, with the 128,267 acres of land withdrawn, gives a grand total area of oil-shale land classified or withdrawn of 4,245,644 acres.

No action was taken in respect to phosphate lands, and the area included in phosphate reserves remains the same as a year ago, 2,724,394 acres.

No further potash reserves were created during the year, but the existing reserves were redueed by the restoration of 440 acres, leaving outstanding reserves of 130,029 acres.

Withdrawals of lands believed to be valuable for power sites aggregated 7,392 acres, and restorations of lands previously withdrawn, because they were found to be without value for power and for other reasons, amount to 6,037 acres, the net effect upon reserved areas being an increase from 2,564,372 to 2,565,727 acres. The only change in power-site designations during the fiscal year was the cancellation of a power-site classification of 6,355 acres in Arizona, the total area so designated in that State being reduced to 758,083 acres.

The Secretary of the Interior, upon recommendation of the Geological Survey, designated 8,452,637 acres of land as nonirrigable under the enlarged-homestead act during the year, and designations of an area of 5,254 acres were canceled on information received indicating that the lands are irrigable and therefore not properly designated as nonirrigable. The net increase in the area classified under these acts was 8,447,383 acres, and the total area so classified on June 30, 1919, was 288,797,241 acres. These areas include 3,400 acres in Idaho designated under the nonresidence provisions of the enlarged-homestead act during the year. The total designations under the nonresidence provisions of the acts, on June 30, 1919, amounted

to 512,837 acres in Idaho and 1,424,274 acres in Utah; 5,415 petitions for designation under these acts were pending at the beginning of the year, and 3,512 were received during the year. Of this total of 8,927, 4,806 were acted upon, leaving 4,121 cases pending on June 30, 1919. During the period 434 other cases were reconsidered.

At the end of the year 20,181,868 acres had been designated as subject to entry under the stock-raising homestead law of December 29, 1916 (39 Stat., 862), as the result of field examination and office study. The number of applications pending on June 30, 1918, was 34,649, and during the year 14,248 other applications were received, making a total of 48,897 in hand for consideration. Of this number 29,176 were disposed of during the year, leaving 19,721 cases for consideration at its close.

The area added to public water reserves during the year was 22,422 acres, and the area eliminated from such reserves was 1,375 acres. The net increase in the area thus reserved was from 204,634 to 225,681 acres.

CORRESPONDENCE.

During the year 27,255 letters and petitions were received by the land-classification board. This is a decrease of about 60 per cent from the number for the preceding fiscal year. This large decrease does not, however, indicate an abnormal reduction in the general annual volume of the board's correspondence. The year 1917–18 was in itself unusual, inasmuch as the passage of the stock-raising homestead act on December 29, 1916, was followed by a very large influx of petitions for designation of lands under this act, which increased the correspondence by 157 per cent over that of the preceding fiscal year. The correspondence for the year 1918–19 is a return to the average for the last few years, with this exception. In addition to the correspondence listed, 2,485 copies of letters, decisions, etc., from various bureaus were sent to the board for its information and filing; this material is largely made up of General Land Office letters to its local officers and of reports on the character of lands by its inspectors and agents; coal and homestead receipts; and departmental decisions.

Within the same period 15,382 letters and reports were prepared in the board. This is an increase of 43 per cent over the output of last year.

For the working days of the year, these figures indicate daily receipt of about 89 and daily dispatch of about 50 pieces of mail.

PUBLICATIONS.

No general publications have been issued during the year, but supplemental mimeographed lists showing current withdrawals and restorations of oil lands have been prepared and issued. These, with

Press Bulletin 355, published February, 1918, and Press Bulletin 363, published April, 1918, as supplements to Bulletin 623, "Petroleum withdrawals and restorations," cover all except the most recent actions. There has also been issued a mimeographed list of oil-shale lands in Colorado, Utah, and Wyoming, classified as mineral lands and valuable as a source of petroleum and nitrogen. This list includes all lands that have been so classified.

COOPERATION WITH GENERAL LAND OFFICE.

The cooperation with the General Land Office, under which reports are submitted by the Survey containing information as to the mineral value and water resources of lands for which applications under the public-land laws have been filed, was continued unchanged during the year. Similar cooperation exists with the Indian Office. In addition to 1,532 requests for information as to the mineral character, power value, and value for public watering places pending June 30, 1918, 5,034 such requests were received during the fiscal year. Of these requests 4,259 were acted upon, leaving 2,307 awaiting action at the end of the year.

At the beginning of the year 295 requests for information as to mineral character only were pending, and during the year 1,665 such cases were received. Reports were made in 971 of these cases, leaving 989 cases pending at the end of the year.

During the year 151 requests for report as to water resources only were received, and 35 cases were pending at the beginning of the year. Reports were submitted in 151 cases, leaving 35 cases pending June 30, 1919.

The Survey also furnished to the General Land Office reports upon the feasibility of irrigation projects and proposed power developments under the terms of the general cooperative plan between the two bureaus. Closely related to this cooperation is the duty of the Survey to classify land under the enlarged and stock-raising homestead acts and to prepare appropriate orders for departmental approval designating lands under those acts. The number of cases requiring such action which have been received and the number considered by the Survey are set forth in the following summary:

General summary of cooperative cases.

Classes of cases.	Pending June 30, 1918.	Received during year.	Disposed of during year.	Pending June 30, 1919.	Gain (+) or loss (−).
Mineral character only:					
General Land Office requests for information	20	554	144	430	−410
General Land Office field-service reports	212	899	667	444	−232
Applications for classification as to minerals	63	212	160	115	−52
	295	1,665	971	989	−694
Water resources only:					
General Land Office requests for information	1	10	6	5	−4
General Land Office field-service reports	12	12	12	12	.....
Cases in national forests	4	30	32	2	+2
Applications for reclassification as to water resources	18	99	101	16	+2
Applications for rights of way	46	160	168	38	+8
Lists under Carey Act	.....	3	3	.....	.....
Reports of irrigating projects	34	41	72	3	+31
Applications under enlarged-homestead acts	5,415	3,512	4,806	4,121	+1,294
Applications under stock-raising homestead act	34,649	14,248	29,176	19,721	+14,928
	40,179	18,115	34,376	23,918	+16,261
Mineral character and water resources:					
General Land Office requests for information	1,159	4,290	3,477	1,972	−813
General Land Office field-service reports	235	596	579	252	−17
General Land Office requests for information as to water resources, accompanied by field-service reports as to mineral character	123	113	160	76	+47
Indian Office requests for information	15	35	43	7	+8
	1,532	5,034	4,259	2,307	−775
Grand total	42,006	24,814	39,606	27,214	+14,792

MINERAL CLASSIFICATION.

COAL.

Regulations.—No changes in the coal regulations have been made. All coal valuations continue to be made under the regulations adopted in 1913, as modified on February 16, 1915 (43 L. D., 520), requiring classification to be made by quarter-quarter sections and surveyed lots.

Timber values.—By the decision of Charles D. Mahaffie, solicitor of the Department of the Interior, dated December 23, 1918, it was held that, "under the law as it now stands, there is vested in the department the power and authority in connection with the appraisal of timbered coal lands to take into consideration and include the timber value as an element in the appraised selling price of the land." In accordance with this decision steps have been taken to secure, by cooperation with the Forest Service of the Department of Agriculture, equitable timber valuations of classified coal lands lying within national forests, but as yet no appraisals embracing combined coal and timber values of such lands have been made.

Withdrawals and restorations.—The total area of coal lands withdrawn during the year was only 2,415 acres. The tracts included in this withdrawal were coal lands in Colorado which had reverted to the United States through cancellation of patents. Withdrawal

was made to protect the lands from coal entry pending an examination and appraisal of their coal value. A total of 3,331,522 acres, the classification and appraisal of which was completed, was restored and made available for purchase under the coal-land laws. Of this restored land 3,329,886 acres is in North Dakota, and the remainder is scattered through four States. With the exception of the large restoration of North Dakota coal lands, the cancellation of withdrawals was practically at a standstill during the year, owing both to the lack of necessary field data for classification and to the diversion of effort to other and more pressing channels.

The following table shows the results of the year's work:

Coal withdrawals and restorations, fiscal year 1918–19, in acres.

	Outstanding June 30, 1918.	New withdrawals 1918–19.	Restorations 1918–19.	Outstanding June 30, 1919.
Arizona	141,945			141,945
California	17,643			17,643
Colorado	4,498,376	2,415	280	4,500,511
Idaho	4,761			4,761
Montana	10,612,112		80	10,612,032
Nevada	83,833			83,833
New Mexico	5,586,244		1,036	5,585,208
North Dakota	14,232,501		3,329,886	10,902,615
Oregon	4,361			4,361
Utah	5,314,075		240	5,313,835
Washington	824,074			824,074
Wyoming	2,437,563	160		2,437,723
	43,757,488	2,575	3,331,522	40,428,381

Classification.—Field examination for the purpose of classification as coal land or noncoal land of areas included in existing coal withdrawals was limited entirely to a few small tracts the restoration of which was especially urgent. No general examinations of coal land were undertaken during the year because of the war conditions, and the new classifications based on field examinations made during the year comprised but 4,379 acres; the reclassification of 2,060 acres brought the total area classified during the year to 6,437 acres. Coal classifications in Colorado, Montana, Nevada, New Mexico, North Dakota, and Utah constituted 3,143 acres of this total, and classifications as noncoal land in Colorado, Montana, and North Dakota the remaining 1,236 acres.

In the first of the following tables the classifications made during the year are summarized by States. In the same table the classifications are divided into two groups—reclassifications, which constitute a revision of previous classifications, and new classifications, which comprise the classifications of withdrawn areas or areas not previously considered. The sum of classifications in these two groups represents the total classification. The net increase or decrease in total areas classified in any State, as shown in the last two columns,

is obtained directly from the other columns of the table. The two succeeding tables show the result of the actions given in the first table as they affect outstanding classifications (second table) and as they affect outstanding appraisals (third table).

Land classified as coal and noncoal land, fiscal year 1918–19, in acres.

State.	Total classification.			Reclassification.		New classification.		Net increase or decrease.	
	Coal.	Noncoal.	Total.	Previous noncoal, now coal.	Previous coal, now noncoal.	Coal.	Noncoal.	Coal.	Noncoal.
Colorado	120	160	280	.....	.....	120	160	120	160
Montana	1,580	2,476	4,056	1,420	460	160	2,016	1,120	1,056
Nevada	923	.....	923	.....	.....	923	.....	923	.....
New Mexico	640	.....	640	.....	.....	640	.....	640	.....
North Dakota	80	100	180	80	100	.....	.....	20	20
Oregon	.....	.....	.....	.....	.....	.....	.....	.....	.....
Utah	240	.....	240	.....	.....	240	.....	240	.....
Wyoming	120	.....	120	.....	.....	120	.....	120	.....
	3,703	2,736	6,439	1,500	560	2,203	2,176	3,143	1,236

Classification of coal and noncoal land, June 30, 1919, in acres.

State.	Classification outstanding June 30, 1918.		Net results of classification, 1918–19.		Classification outstanding June 30, 1919.		
	Coal.	Noncoal.	Coal.	Noncoal.	Coal.	Noncoal.	Total.
Arizona	.....	42,492	.....	.....	.....	42,492	42,492
Arkansas	60,715	70,038	.....	.....	60,715	70,038	130,753
California	8,720	228,502	.....	.....	8,720	228,502	237,222
Colorado	3,366,353	9,357,330	+ 120	+ 160	3,366,473	9,357,490	12,723,963
Idaho	4,603	8,272,256	.....	.....	4,603	8,272,256	8,276,859
Montana	5,896,759	21,803,316	+1,120	+1,056	[a]55,897,805	[a]21,804,357	[a]27,702,162
Nevada	5,880	2,428	+ 923	.....	6,803	2,428	9,231
New Mexico	683,517	3,753,000	+ 640	.....	684,157	3,753,000	4,437,157
North Dakota	11,409,789	2,847,334	− 20	+ 20	11,409,769	2,847,354	14,257,123
Oregon	17,444	1,062,095	.....	.....	17,444	1,062,095	1,079,539
South Dakota	244,874	6,961,357	.....	.....	244,874	6,961,357	7,206,231
Utah	1,087,752	3,307,091	+ 240	.....	1,087,992	3,307,091	4,395,083
Washington	149,426	1,584,849	.....	.....	149,426	1,584,849	1,734,275
Wyoming	7,413,384	15,491,090	120	.....	7,413,504	15,491,090	22,904,594
	30,349,216	74,783,178	+3,143	+1,236	30,352,285	74,784,399	105,136,684

[a] The resurvey of a land net of one township in Montana caused a reduction of 74 acres of coal land and 15 acres of noncoal land, or a total reduction of 89 acres of land previously classified.

Area and valuation of coal lands June 30, 1919.

State.	Appraised coal land June 30, 1918.	Coal land appraised, 1918–19.		Net result of appraisals, 1918–19.	Total appraisals coal land outstanding June 30, 1919.	Total valuation of appraised coal land outstanding June 30, 1919.	Average value per acre.
		Total coal land appraised.	Coal land reclassified as noncoal land and rewithdrawn.				
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*		
Arkansas	60,715	.....	.....	.....	60,715	$1,473,762	$24.27
California	7,720	.....	.....	.....	7,720	585,086	75.70
Colorado	2,881,374	+ 120	.....	+ 120	2,881,494	195,531,620	67.86
Idaho	4,603	.....	.....	.....	4,603	89,624	19.47
Montana	5,782,216	+1,580	+460	+1,120	5,783,336	137,410,916	23.76
Nevada	5,880	+ 923	.....	+ 923	6,803	126,830	18.64
New Mexico	665,565	+ 640	.....	+ 640	666,205	16,392,111	24.61
North Dakota	11,409,789	+ 80	+100	− 20	11,409,769	199,382,266	17.47
Oregon	7,195	.....	.....	.....	7,195	[a]174,843	24.30
South Dakota	244,874	.....	.....	.....	244,874	2,711,462	10.07
Utah	1,069,631	+ 240	.....	240	1,069,871	45,101,333	42.16
Washington	1,866	.....	.....	.....	1,866	38,520	20.64
Wyoming	7,238,515	120	.....	120	7,238,635	387,820,153	53.58
	29,379,943	3,703	560	3,143	29,383,086	986,828,526	33.59

[a] Coal values in Oregon were automatically increased $46,792 as a result of the completion of a railroad to a point within 15 miles of one of the coal fields.

Applications for classification as to coal.—During the year the Survey received 69 applications for classification, 51 of which were requests for classification as coal land and 18 as noncoal land. At the beginning of the year 35 applications for coal classification and 2 for noncoal were pending. Of the total 106 received and pending cases, 58 were acted on—41 as coal and 17 as noncoal. At the end of the year 48 requests for classification were pending, of which 45 were for coal and 3 for noncoal.

OIL.

Field investigation of prospectively valuable oil and gas territory was greatly curtailed during the year as a result of the diversion of personnel and funds to problems more directly contributing to war efforts. None of the areas examined were considered sufficiently promising to warrant withdrawal. Two withdrawals were made during the year, however, one of 135,503 acres in Colorado and another of 98,657 acres in Wyoming. These withdrawals, which were recommended during the preceding fiscal year on the basis of previous field work, were not promulgated until the present year.

A total of 931 acres of land in Wyoming previously included in outstanding petroleum reserves was eliminated from withdrawal because reconsideration of available information indicated the nonoil character of the land. The following table summarizes the year's work and shows the areas, by States, of the present outstanding petroleum reserves:

Oil withdrawals and restorations, fiscal year 1918-19, in acres.

State.	Withdrawals outstanding June 30, 1918.	New withdrawals, 1918-19.	Restorations, 1918-19.	Withdrawals outstanding June 30, 1919.
Arizona	230,400			230,400
California	1,257,229			1,257,229
Colorado	87,474	135,503		222,977
Louisiana	467,030			467,030
Montana	a 1,351,891			a 1,351,891
North Dakota	84,894			84,894
Utah	1,962,787			1,962,787
Wyoming	1,083,900	98,657	931	1,181,626
	6,525,605	234,160	931	6,758,834

a This item is 5,786 acres greater than was given in the report for the preceding fiscal year. The discrepancy is the result of an error in computing the acreage of a withdrawal in Montana made and reported during the last fiscal year. The withdrawn area in Montana outstanding June 30, 1918, should have been reported as here given.

Classification.—Aside from work conducted wholly by the geologic branch on the lands of the Osage Reservation, Okla., there has been no classification of oil land during the year, nor has any public land been so classified with the exception of certain early classifications of California lands. Except for occasional classifications, as mineral land prospectively valuable for oil or gas, of areas within Indian reservations and hence not subject to the provisions of the withdrawal act, it is the present policy of the department to withdraw rather than classify lands on which oil is known or believed to be present in commercial quantities. Lands withdrawn are so held until further detailed examinations shall have determined their mineral character or until legislation providing for their disposition by lease or otherwise is enacted. Lands included in oil withdrawals may therefore be considered tentatively as oil lands, although, with the exception of the early California classifications previously mentioned, they have not been formally so classified.

Further field work on the oil shales of the Western States showed that certain areas not previously acted upon contained deposits of rich oil shale. As a result of these investigations, 56,221 acres in the Debeque district, Colo., were classified as mineral lands valuable as a source of petroleum and nitrogen, and 4,080 acres in the same region previously classified as oil-shale lands were found to have insufficient mineral value to warrant this classification and were accordingly reclassified as nonmineral lands. The classified oil-shale lands of Utah were also increased by the addition of an area in the Uinta Basin extending northward toward the Colorado State line from the area previously classified. Field evidence having shown these lands to be underlain by valuable oil-shale deposits, 69,120 acres were classified as mineral land. The total area of oil-shale land classified as mineral land, including areas previously classified, is 4,117,377 acres.

Applications for classification.—During the year the Survey received 12 applications for classification as nonoil lands. At the beginning of the year 1 application was pending, making a total for the year of 13 cases. Six of these cases were acted on during the year, and 7 remained pending at the end of the year.

POTASH.

Reconnaissance work in search of commercial deposits of potash was continued by the geologic branch during the year, and special investigations were made of certain areas selected for inclusion in extensive proposed prospecting territory under the terms of the potash leasing act (40 Stat., 297). Partly as a result of the geologic work, it was possible to eliminate certain nonmineral lands from the Searles Lake Potash Reserve, and 440 acres in all were restored.

Potash-leasing act.—The act of Congress approved October 2, 1917, entitled "An act to authorize exploration for and disposition of potassium" (40 Stat., 297), authorizes the Secretary of the Interior, in his discretion, to issue permits giving the exclusive right for two years to prospect for chlorides, sulphates, carbonates, borates, silicates, nitrates, and other salts of potassium on not more than 2,560 acres of vacant public land, and to issue leases for the exploitation of the deposits. Patents may be issued for one-fourth of the area covered by a prospector's permit, if a commercial deposit of potash is discovered. Applications for such prospecting permits are submitted to the Commissioner of the General Land Office within whose jurisdiction falls the decision as to granting or refusing the permit. During the year 130 such applications were submitted to the Survey for report and recommendation. At the beginning of the year there were also pending 24 applications, making a total for the year of 154 applications. With the approach of peace and the consequent unsettled conditions of the potash market in anticipation of a decline from the prevailing high market price of potash there was a decided reduction in the number of applications received. Action has been taken on 95 applications, and the remaining 59 were awaiting action at the end of the year.

PHOSPHATE.

Regulations.—No change in the procedure affecting the classification of phosphate land has been made. Under the regulations defining phosphate lands, adopted by the Survey in 1912 to guide its recommendations for withdrawal and restoration, lands underlain by deposits containing less than 30 per cent of tricalcium phosphate are considered nonmineral lands. Phosphate beds that are from 1 foot to 6 feet or more in thickness and contain 70 per cent or more of tricalcium phosphate are held to depths ranging from zero along the outcrop to the maximum of 5,000 feet in direct ratio to the variation

of the thickness of the bed from 1 foot to 6 feet. For beds containing less than 70 per cent of tricalcium phosphate the depth limit varies from zero to the depth of a 70 per cent bed of any given thickness in direct ratio to the variation in tricalcium phosphate content from 30 to 70 per cent.

Withdrawals and restorations.—Field investigation of phosphate deposits was suspended during the year, and as no data warranting either further withdrawals or restorations were at hand, no action was taken. The withdrawals outstanding at the end of the present fiscal year are the same as of June 30, 1917, and are as follows:

Phosphate withdrawals outstanding June 30, 1919.

	Acres.
Florida	119,737
Idaho	1,015,717
Montana	287,883
Utah	302,465
Wyoming	998,592
	2,724,394

Classification.—Examinations of land in Indian reservations are frequently made for the information of the Office of Indian Affairs. If these examinations are made for the purpose of determining whether the lands contain phosphate, the results are transmitted not as withdrawals or restorations but as classifications either as phosphate or nonphosphate lands. Mineral classifications of certain phosphate lands within the Northern Pacific land grant have been reported to the Commissioner of the General Land Office, but these lands are a part of the phosphate reserves and are included in the table just given.

In addition, therefore, to the classifications that are reported as withdrawals and restorations in the preceding list, direct classifications of lands in the Fort Hall Indian Reservation, Idaho, and the Wind River Reservation, Wyoming, have been made. No such action was taken during the fiscal year 1918–19, however. The area of land classified as to phosphate is the same as that outstanding on January 30, 1918, and is given in the following table:

Phosphate classifications of Indian lands outstanding June 30, 1919, in acres.

State.	Phosphate land.	Nonphosphate land.
Idaho	4,080	17,440
Wyoming	20,576	85,515
	24,656	102,955

METALLIFEROUS LANDS.

Classification.—Except for action on cases involving small individual tracts of land which were referred to the Survey by the Commissioner of the General Land Office and which are mentioned under the heading "Cooperation with the General Land Office," no classification of metalliferous lands has been made during the past year.

Withdrawals.—No new areas were withdrawn, and no change was made in the mineral-land withdrawal of 8,507 acres in Arizona.

HYDROGRAPHIC CLASSIFICATION.

WATER POWER.

Withdrawals and restorations.—The classification of the public lands with relation to their value in connection with water-power development was continued during the year, the withdrawals being made under the acts of June 25, 1910 (36 Stat., 847; 36 Stat., 855, 858), and August 24, 1912 (37 Stat., 497). On July 1, 1918, the area included in withdrawals was 2,564,372 acres. During the year 7,392 acres additional were withdrawn and 6,037 acres previously included in power-site reserves were restored to entry. On June 30, 1919, the total area withdrawn in connection with water power was 2,565,727 acres. The definite information regarding the power-site possibilities of much of this area is still very meager, and it is likely that as opportunity is afforded to make detailed examinations in the field considerable adjustment will be necessary.

Power sites withdrawn, restored to entry, and outstanding, fiscal year 1918–19, in acres.

	Withdrawals outstanding June 30, 1918.	New withdrawals, 1918–19.	Restorations, 1918–19.	Withdrawals outstanding June 30, 1919.
Alabama	120	.....	.....	120
Alaska	81,015	.....	.....	81,015
Arkansas	22,354	.....	.....	22,354
Arizona	300,368	701	5,221	295,848
California	277,223	11,749	78	288,894
Colorado	276,514	622	.....	277,136
Idaho	265,467	.....	6,994	258,473
Michigan	1,240	.....	.....	1,240
Minnesota	12,309	.....	.....	12,309
Montana	164,412	27	8	164,431
Nevada	27,361	182	.....	27,543
Nebraska	761	.....	.....	761
New Mexico	62,602	.....	.....	62,602
Oregon	421,972	1,760	988	422,744
Utah	477,628	2,351	1,281	448,698
Washington	113,533	.....	285	113,248
Wyoming	89,493	.....	1,182	88,311
	2,564,372	17,392	16,037	2,565,727

Water-power designations.—The act of June 9, 1916 (39 Stat., 218), revesting in the United States title to lands in Oregon held by the Oregon & California Railroad Co., provides for classification as

"power-site lands" of the revested lands found to be chiefly valuable for water-power sites. The total area classified as power-site lands under the provisions of this act was 141,273 acres on June 30, 1919, there having been no change during the fiscal year.

The act of February 26, 1919 (Public No. 280, 65th Congress), also revested in the United States title to certain lands in Oregon, known as the Coos Bay Wagon Road grant, which has been held by the Southern Oregon Co., and provided for the classification of these lands in the manner prescribed in the act of June 9, 1916, above referred to. No classifications of "power-site lands" have yet been made under this act, although such action has been under consideration.

On July 1, 1918, designation had been made of 764,438 acres of land valuable for water power in Arizona and of 201,000 acres of such land in New Mexico under the provisions of the enabling acts of those States. During the fiscal year cancellations of designations involving 6,355 acres were made in Arizona, reducing the area designated to 758,083 acres; the area designated in New Mexico remained unchanged.

In general, such of the designated lands as were not otherwise withdrawn were also included in power-site reserves under appropriate acts of Congress.

Applications for reclassification.—At the beginning of the year 18 applications for the reclassification of lands included in power-site reserves were awaiting action, and during the year 99 were received, making a total of 117 cases. Action was taken on 101 cases, leaving 16 pending at the end of the year. Of the cases received, over half were from the State of Oregon, and most of these were from the region west of the Cascade Mountains. The remainder of the cases do not apply to any particular region in a materially preponderating degree. The large number of cases in western Oregon is largely attributable to the desires of settlers to acquire certain lands of the former Oregon & California Railroad grant, title to which was revested in the United States under the provisions of the act of June 9, 1916 (39 Stat., 218), and which have been included in power-site reserves.

The following table shows the number of applications for reclassification which have been received each fiscal year since 1910–11

Applications received for reclassification of lands included in power-site reserves.

1910–11	21	1915–16	70
1911–12	32	1916–17	78
1912–13	19	1917–18	90
1913–14	46	1918–19	99
1914–15	49		

It is notable that the number of applications, instead of decreasing from year to year as might be expected with the gradual adjustment of cases of questionable classification, has shown an almost steady

increase. This marks, in large part at least, the increasing manifestation of the demand for a more careful classification of power-site lands. It is to be regretted that action upon these applications has generally been embarrassed by the lack of definite information regarding the power possibilities of lands in power-site reserves. In fact, a similar lack of information has impeded all the Survey's activities in the administration of the water-power resources of the public domain. The investigations of power sites upon the public lands that have been made thus far have been made very predominantly by private interests, and it has been necessary for the Survey to depend largely on information so gathered. It is estimated that in the last 10 years development of the water power on public lands has progressed at a rate that will greatly outstrip their investigation by the Government. Proper administration of the power resources of the public domain requires that the Government shall have sufficient knowledge concerning such resources to be able to direct their development so as to insure the greatest ultimate benefit from them consistent with consideration of the agricultural and other resources of the land. Such a policy urgently demands greater activity in the investigation of the power possibilities of the public lands.

Right of way applications.—Departmental regulations of January 6, 1913, under the act of Congress approved March 4, 1911 (36 Stat., 1235, 1253), and of March 1, 1913, under the act of Congress approved February 15, 1901 (31 Stat., 790), charge the Geological Survey with important administrative duties in connection with applications for rights of way over the public lands for purposes related to the development of water power. Such applications, when received in proper form at the General Land Office, are forwarded to the Survey for consideration of such matters as relative priority of applications, incompatibility of works, relative beneficial utilization of resources, and the engineering and economic features involved in the applications and permits. If the approval of an application is found to be compatible with the public interest, a draft of agreement is prepared, and a report is made to the Secretary of the Interior on the circumstances in the case. This agreement, after execution by the applicant and issuance of the permit by the Secretary of the Interior, defines the conditions under which the power is to be developed, the tenure of the site, and the provisions for the protection of the public interest as regards distribution of output, rates, and service.

During the year favorable reports were made to the Secretary of the Interior on 11 applications for power permits under the act of February 15, 1901, including 3 applications for preliminary and 2 for final permits involving the development of water power and

6 applications for final permits for electrical transmission lines. Favorable reports were also rendered on 11 applications for grants under the act of March 4, 1911, for rights of way for electrical transmission lines.

Several applications involving extensions of time under permits and grants, modifications of stipulations of permittees and grantees, and approvals of transfers of permits and grants have been considered and reported upon to the Secretary. A large amount of correspondence of the Interior Department relative to right of way matters in general has been initiated by the Geological Survey or has been assigned to it for handling.

In pursuance of the Secretary's instructions of August 24, 1916 (45 L. D., 326), 51 permittees under the act of February 15, 1901, and grantees under the act of March 4, 1911, to whom permits and grants have been issued by the Secretary of the Interior since January 1, 1913, were called on for detailed reports of the operations or developments of their power systems during the calendar year 1918. These reports cover the operations of many of the larger power systems of the public-land States and present information which should be of great value in the consideration of the proper working out of Federal administration of water-power development on public lands. The reports show that during 1918, the permittees and grantees generated or transmitted over their systems 3,200,000,000 kilowatt-hours of electric energy. Of this amount 90 per cent was generated by water power and 9 per cent by steam or internal-combustion engines in the systems of the permittees and grantees. The remaining 1 per cent was purchased from outside sources. The average sale price of all energy sold was slightly in excess of 1 cent a kilowatt-hour. Some of the smaller systems which supply the relatively intermittent requirements of small communities received an average of as much as 6 or 7 cents a kilowatt-hour. These reports contain many detailed data concerning the actual operations of power systems which are very valuable in connection with engineering and economic studies relating to power problems.

Some of the permittees and grantees have commented on the multiplicity of reports required by officials of the United States and the States. The suggestion has been made that all these requirements for information should be coordinated and combined in such manner as to reduce to a minimum the burden of preparing reports by public utilities. The labor in the preparation of such reports should be made as small as is consistent with furnishing to authorized officials the information essential for the particular governmental interest represented. In the interest of efficiency this subject is worthy of most careful consideration, and as opportunity is afforded such consideration will be given as being within the general scope of the in-

structions of the Secretary. It was not found to be practicable during the year to inspect any of the power projects of permittees and grantees.

The Survey has continued the accumulation of information regarding power operations affecting public lands under authorization by the Interior Department prior to the issuance of the current regulations and regarding the very numerous power operations upon lands under the jurisdiction of the Interior Department without authorization.

Near the end of the calendar year 1918 it was determined that the annual rentals in force on projects for the development of water power on Interior Department land amounted to $5,763.40. The income from final permits for power development now in force will increase somewhat, because a number of final permittees are under agreement to begin the payment of rentals at different times within the next few years, and others are paying compensation in accordance with a sliding scale, which provides for a gradual increase in the charge from year to year until a maximum is reached at the end of about ten years from the issuance of the permit. The charges for permits and grants for transmission lines amounted to $4,618 a year. The compensation for preliminary permits in force appeared from Survey records to amount to $5,468.05 a year. Thus the total compensation due for permits and grants at that time was at the rate of $15,849.45 a year. The amount of rentals paid to the Interior Department by the permittees and grantees actually operating power systems is equivalent to approximately 3 mills per 1,000 kilowatt-hours generated or transmitted.

In addition to applications for rights of way for hydroelectric development, a large number of applications of other types are referred to the Geological Survey for consideration and report. These embrace applications for rights of way for railroads, under the acts of March 3, 1875 (18 Stat., 482), and March 2, 1899 (30 Stat., 990), affecting public lands and Indian reservations, respectively, on which report is made as to whether or not the construction of the railroad will interfere with power or irrigation development on streams in the vicinity of the right of way; applications for rights of way for irrigation uses, under the act of March 3, 1891 (26 Stat., 1095), on which report is made as to interference with power development, the feasibility of the project, and other features; applications for rights of way across national forests for mining, milling, and municipal purposes, under the act of February 1, 1905 (33 Stat., 628); and a variety of miscellaneous applications for domestic, municipal, mining, and railroad water supply.

Applications for rights of way, fiscal year 1918–19.

	Pending June 30, 1918.	Received, 1918–19.	Acted on, 1918–19.	Pending June 30, 1919.
Railroad: Acts of Congress approved Mar. 3, 1875 (18 Stat., 482), May 14, 1898 (30 Stat., 409), Mar. 2, 1899 (30 Stat., 990), etc.	9	30	32	7
Irrigation: Acts of Congress approved Mar. 3, 1891 (26 Stat., 1095), May 11, 1898 (30 Stat., 404), etc.	7	46	46	7
Power: Acts of Congress approved Feb. 15, 1901 (31 Stat., 790), Mar. 4, 1911 (36 Stat., 1235, 1253), etc	21	23	22	22
Miscellaneous: Acts of Congress approved Jan. 21, 1895 (28 Stat., 635), May 11, 1898 (30 Stat., 404), May 21, 1896 (29 Stat., 127), Jan. 13, 1897 (29 Stat., 404), Feb. 15, 1901 (31 Stat., 790), Feb. 1, 1905 (33 Stat., 628), Mar. 4, 1911 (36 Stat., 1253, 1254), etc.	9	61	68	2
Total number of applications for original consideration	46	160	168	38
Additional applications for reconsideration	15	36	35	16

IRRIGATION.

Irrigation projects.—A new development in connection with irrigation classification work occurs as a result of the irrigation-district law of August 11, 1916 (39 Stat., 506). The first cases under this law were received during the closing months of the year and have not yet been considered. The functions of the Survey with reference to these cases are similar to its functions in connection with Carey Act projects in that reports to the General Land Office are required as to their engineering and economic feasibility. In purpose and effect, however, the law is totally different from the Carey Act. Under the new law the secretary is empowered to approve applications filed by irrigation districts duly organized in any State, and thereafter any unentered public land in the district as well as entered land upon which final certificate has not been issued shall be amendable to the State laws governing the district to the same extent and upon like terms as privately owned lands in the district. The approval of an application by the Secretary in cases of this type is therefore tantamount to a vote by an owner of private land in the district consenting to the district organization and pledging his land for the payment of expenses arising therefrom.

During the year three Carey Act segregation lists were received, and reports were forwarded to the General Land Office in each case. Six cases of this type were submitted by the General Land Office for reconsideration during the year, and supplemental reports were made in each case.

At the beginning of the year 34 cases were pending awaiting reports to the General Land Office under instructions from the Secretary of the Interior of March 15, 1913, relative to irrigation projects whose water rights or shares of stock are presented as evidence of compliance with the requirements of the desert-land act. During the year 41 new cases were received and reports were submitted to the General Land Office in 72 cases, leaving 3 cases pending June 30, 1919. Of the pending cases two are the applications under the act of August 11, 1916 (39 Stat., 506), which have been received and not yet considered.

On June 30, 1918, five cases involving reports as to projects for irrigating land in desert entries were awaiting reconsideration, and during the year three other such cases were received. Seven of these cases have been closed by supplemental report, leaving one unanswered June 30, 1919.

Reservoir withdrawals.—No withdrawals or restorations in connection with irrigation water-storage reservoir-site investigations have been made by the Survey during the year. The following table shows the area of such withdrawals outstanding:

Reservoir withdrawals outstanding June 30, 1919.

	Acres.
Arizona	23,040
Colorado	1,728
Montana	9,080
North Dakota	1,569
Oregon	10,619
Washington	35,943
	81,979

ENLARGED HOMESTEADS.

Classification of lands under the enlarged-homestead acts of February 19, 1909 (35 Stat., 639), June 17, 1910 (36 Stat., 531), June 13, 1912 (37 Stat., 132), March 3, 1915 (38 Stat., 953), March 4, 1915 (38 Stat., 1162), July 3, 1916 (39 Stat., 344), September 5, 1916 (39 Stat., 724), and February 20, 1917 (39 Stat., 925), was continued during the year, sufficient data being obtained to serve as a basis for action in nearly all cases involving lands previously withheld from designation because of reported or suspected irrigation possibilities. The excepted cases in general are those lying within the exterior limits of irrigation projects requiring further investigation.

Action on petitions under the enlarged-homestead acts, fiscal year 1918–19.

State.	Pending June 30, 1918.	Received 1918–19.	Total.	Action taken, 1918–19.					Pending June 30, 1919.	Cases reconsidered.
				All designated.	Part designated.	Refused.	Recalled.	Total.		
Arizona	40	35	75	27	.....	2	2	31	44	14
Arkansas	.....	1	1	.....	.....	.....	.....	.....	1	.....
California	453	172	625	268	5	12	23	308	317	8
Colorado	767	586	1,353	716	8	15	50	789	564	53
Idaho	563	472	1,035	487	18	80	45	630	405	100
Kansas	29	90	119	99	.....	1	4	104	15	12
Minnesota	.....	1	1	.....	.....	.....	.....	.....	1	.....
Montana	521	740	1,261	222	41	56	59	378	883	68
Nebraska	.....	6	6	.....	4	1	.....	5	1	.....
Nevada	37	7	44	.....	.....	2	2	4	40	.....
New Mexico	510	221	731	357	2	9	34	402	329	31
North Dakota	364	125	489	292	20	15	10	337	152	35
Oregon	556	169	725	466	7	59	27	559	166	40
South Dakota	407	123	530	261	15	13	9	298	232	28
Utah	551	197	748	32	3	187	59	281	467	7
Washington	127	104	21	13	2	5	14	34	127	1
Wyoming	490	463	953	608	4	23	11	646	307	37
	5,415	3,512	8,927	3,848	129	480	349	4,806	4,121	434

The general provisions of the acts, which apply in 14 States, permit the entry by one person of 320 acres of "nonmineral, nonirrigable, unreserved, and unappropriated surveyed public lands which do not contain merchantable timber." Entries may be allowed for the surface only of mineral land containing coal, phosphate, nitrate, potash, oil, gas, or asphaltic minerals. As a prerequisite to the allowance of an entry under these acts the land must have been designated by the Secretary of the Interior as not being, in his opinion, "susceptible of successful irrigation at a reasonable cost from any known source of water supply." Under the provisions of sections 6 of the acts of February 19, 1909, and June 17, 1910, applicable in Utah and Idaho only, the Secretary may further designate lands which do not have upon them "such a sufficient supply of water suitable for domestic purposes as would make continuous residence upon the lands possible," and entrymen upon such lands are relieved of the necessity of residence.

Since the enactment of the preference-right amendment to the enlarged-homestead act, on March 4, 1915 (38 Stat., 1162), the entire energy available for enlarged-homestead classification work has been required for considering individual petitions for designation by prospective entrymen. In consequence general designations of large areas are made only in rare instances.

Enlarged-homestead designations, fiscal year 1918–19, in acres.

State.	Outstanding July 1, 1918.	Designations, 1918–19.	Cancellations, 1918–19.	Outstanding June 30, 1919.
Arizona	25,467,643	21,840	.....	25,489,483
California	7,557,873	857,368	.....	8,415,241
Colorado	27,864,474	914,525	640	28,778,359
Idaho:				
Secs. 1–5 and 7	10,062,974	259,925	3,400	10,319,499
Sec. 6	512,837	3,400	.....	516,237
	10,575,811	.....	.....	10,835,736
Kansas	509,834	38,920	.....	548,754
Montana	50,378,065	287,961	120	50,665,906
Nevada	46,304,756	.....	.....	46,304,756
New Mexico	29,988,434	1,531,555	.....	31,519,989
North Dakota	11,631,385	279,986	654	11,910,717
Oregon	18,150,919	788,508	440	18,938,987
South Dakota	15,648,876	252,884	.....	15,901,760
Utah:				
Secs 1–5 and 7	7,501,820	182,375	.....	7,684,195
Sec. 6	1,424,274	.....	.....	1,424,274
	8,926,094	.....	.....	9,108,469
Washington	5,563,938	2,720	.....	5,566,658
Wyoming	21,781,756	3,030,670	.....	24,812,426
	280,349,858	8,452,637	5,254	288,797,241

A set of State maps showing area covered by the designations outstanding June 30, 1919, has been printed.

STOCK-RAISING HOMESTEADS.

The following tables show the status of petitions and the area of land designated as subject to entry under the stock-raising homestead law of December 29, 1916 (39 Stat., 862), which authorizes the

Secretary of the Interior to designate unreserved public lands in any of the public-land States (but not in Alaska) whose surface is chiefly valuable for grazing and raising forage crops and which do not include merchantable timber, are not susceptible of irrigation from any known source of water supply, and are of such character that 640 acres are reasonably required to support a family.

Prior to July 1, 1918, more than 7,500,000 acres had been designated as subject to stock-raising entry in tracts of 640 acres or less; during the year 12,651,226 acres were so designated and designations of 8,320 acres were canceled, leaving 20,181,868 acres designated under the above-mentioned law.

The work has progressed rapidly, a total of 29,176 cases having been finally closed during the year. Of this number more than 22,000 received favorable consideration.

Stock-raising homestead petitions, fiscal year 1918–19.

State.	Pending June 30, 1918.	Received 1918–19.	Total.	Action taken, 1918–19.					Pending June 30, 1919.	Cases reconsidered.
				All designated.	Part designated.	Refused.	Recalled.	Total.		
Arizona	1,111	221	1,332	483	3	336	72	894	438	25
Arkansas	1		1						1	
California	2,268	614	2,882	651		371	109	1,131	1,751	8
Colorado	3,183	1,702	4,885	2,361	15	162	311	2,849	2,036	66
Idaho	2,913	645	3,558	708	24	294	259	1,285	2,273	17
Kansas	109	33	142	74			7	81	61	2
Minnesota		1	1				1	1		
Montana	7,164	1,756	8,920	3,948	11	925	894	5,778	3,142	84
Nebraska	18	67	85	1		2	1	4	81	
Nevada	159	47	206	45		10	19	83	123	
New Mexico	7,277	1,816	9,093	4,838	114	1,743	294	6,989	2,104	132
North Dakota	200	73	273	1	1	22	13	37	236	2
Oklahoma	75	58	133	82		11		95	40	
Oregon	3,202	886	4,088	1,686	39	200	161	2,086	2,002	9
South Dakota	1,102	1,629	2,731	1,211	6	22	26	1,265	1,466	100
Utah	1,323	262	1,585	92		217	46	355	1,230	1
Washington	673	212	885	378	6	59	46	489	396	
Wyoming	3,871	4,226	8,097	5,501	19	170	66	5,756	2,341	69
	34,649	14,248	48,897	22,060	238	4,553	2,325	29,176	19,721	515

Stock-raising homestead designations, fiscal year 1918–19, in acres.

State.	Outstanding July 1, 1918.	Designations, 1918–19.	Cancellations, 1918–19.	Outstanding June 30, 1919.
Arizona		291,120		291,120
Arkansas		240		240
California		365,380		365,380
Colorado	1,432,766	1,250,398	8,200	2,674,964
Idaho		445,389		445,389
Kansas	15,384	42,220		57,604
Montana	55,538	2,346,252		2,401,790
Nebraska	38,648			38,648
Nevada		28,980		28,980
New Mexico	2,188,698	2,894,392		5,083,090
North Dakota	190,797	621		191,418
Oklahoma		22,481		22,481
Oregon		1,041,027	120	1,040,907
South Dakota	1,156,229	626,296		1,782,525
Utah		52,410		52,410
Washington		207,536		207,536
Wyoming	2,460,902	3,036,484		5,497,386
	7,538,962	12,651,226	8,320	20,181,868

PUBLIC WATER RESERVES.

Withdrawals of tracts containing watering places located in regions largely devoid of sources of water supply for stock grazing on surrounding open public range were continued during the year, and many restorations from such withdrawals were also made. These reserves are created under the act of June 25, 1910 (36 Stat., 847), as amended by section 10 of the act of December 29, 1916 (39 Stat., 862), in order that control of the water on the land withdrawn may be retained in the Government. Efforts of private individuals to develop and protect the water supply on such lands from damage and pollution, however, will be encouraged by granting special privileges to such individuals through issuing permits under the act of February 15, 1901 (31 Stat., 790).

Areas amounting to 22,422 acres were included in public water reserves during the year and 1,375 acres were eliminated from such reserves on the basis of information obtained through field examinations by the General Land Office and the Survey.

Public water reserves withdrawn, restored to entry, and outstanding, fiscal year 1918–19, in acres.

State.	Withdrawals outstanding July 1, 1918.	New withdrawals, 1918–19.	Restorations, 1918–19.	Withdrawals outstanding June 30, 1919.
Arizona	13,066	1,080	320	13,826
California	52,474	3,560	.....	56,034
Colorado	480	1,460	40	1,900
Idaho	7,210	.....	170	7,040
Montana	5,264	2,065	45	7,284
Nevada	4,753	80	.....	4,833
New Mexico	2,926	475	40	3,361
Oregon	2,482	9,262	.....	11,744
Utah	34,627	240	.....	34,867
Washington	40	760	.....	800
Wyoming	81,312	3,200	760	83,752
South Dakota	.....	240	.....	240
	204,634	22,422	1,375	225,681

PUBLICATION BRANCH.

DIVISION OF BOOK PUBLICATION.

SECTION OF TEXTS.

During the year 34,948 pages of manuscript were edited and prepared for printing, and proof sheets comprising 3,285 galley proofs and 12,696 page proofs were read and corrected. Indexes were prepared for 25 publications, covering 5,044 pages. The publications of the year are listed and abstracted on pages 23–38.

At the end of the year seven persons were employed in this section. The water-resources branch has continued to render special assistance in preparing copy and reading proof.

SECTION OF ILLUSTRATIONS.

At the beginning of the war period the section of illustrations comprised 15 employees. By the transfer of three employees to the topographic branch for work on military maps and by resignations the force during the year was reduced to 10. As a consequence of this reduction the regular scheduled work has in general been delayed, but the aggregate number of drawings prepared was not less than in some previous years. The number of illustrations prepared was 2,522, comprising 197 miscellaneous maps, 188 photographs, 1,054 diagrams and sections, 943 paleontologic drawings, and 140 miscellaneous illustrations. The illustrations sent to the printer were reproduced by chromolithography, photolithography, halftone engraving, zinc etching, wax engraving, four-color process, and cuts already engraved, a total of 933 subjects. The number of proofs received was 952. At the end of the year material for illustrating 40 reports was on hand.

DIVISION OF DISTRIBUTION.

Editions of 147 new books and pamphlets, 12 reprinted books and pamphlets, 1 new geologic folio, 1 new geologic map, 181 new or revised topographic maps, and 179 reprinted topographic maps, making a total of 521 publications, were received during the year. Many other special pamphlets and forms prepared for administrative use were received and distributed.

The total units of all publications received numbered 558,604 books and pamphlets, 3,873 folios, 95 geologic maps, 945,293 topographic and other maps, a grand total of 1,507,865.

The division distributed 465,826 books, 8,865 folios, and 538,396 maps, a total of 1,013,087, of which 7,964 folios and 325,447 maps were sold. The total amount received and deposited in the Treasury as the result of sales of publications was $22,983.21. The sales of topographic and geologic maps amounted to $22,263.96, of geologic folios to $719.25. The division received and answered 69,897 letters.

DIVISION OF MAP EDITING.

SECTION OF GEOLOGIC MAPS.

Practically no editorial work on geologic folios was done during the year because of the discontinuance of the publication of folios during the war. Toward the end of the year, however, one folio that had been well advanced when work was discontinued was completed and published—Folio 208, Colchester-Macomb, Ill. The Newell (S. Dak.) and Herman-Morris (Minn.) folios were also nearly completed. The draftsmen of the section were employed during the large part of the year in preparing manuscript maps of the United States and of

foreign countries for an atlas of commercial geology. The base maps for Part I of the atlas, which deals with the production of minerals, were transferred to stone, and the geologic data were being prepared for reproduction in colors.

During the year G. W. Stose, the geologist in charge of the section, edited geologically the maps and other illustrations for 36 reports other than folios.

SECTION OF TOPOGRAPHIC MAPS.

At the beginning of the year 143 topographic maps were on hand for publication, and the accessions during the year were 118, making a total of 261 maps. Of these, 2 (Springdale and Maysville, Ohio) were combined in a single map, 180 have been published, 69 are in process of engraving and printing, and 10 have not yet been transmitted to the engraving division. One old map has also been republished in a new edition. Of the maps published (see notices on pp. 38–58), 142 are new maps engraved on copper, 30 are new maps reproduced by photolithography, and 8 (two of them photolithographs) are new combinations of maps otherwise published previously. The following statement shows the comparative status of map editing and map publication on June 30 for the last nine years:

Progress of map publication for nine years ended June 30, 1919.

	1911	1912	1913	1914	1915	1916	1917	1918	1919
Published during the year	86	114	101	102	107	153	95	103	181
In process of engraving and printing	56	65	89	69	87	97	111	121	69
For engraving	95	102	105	114	91	52	19	22	10

The manuscripts edited during the year comprise 83 maps prepared for engraving, 30 maps for photolithography, 4 maps of Army cantonments, 169 maps or sheets for the illustration of 21 Survey reports, and corrections for 129 maps about to be reprinted. The proof read comprises 156 new topographic maps and corrections to 49 old maps. The index maps for 6 circulars of the series 9–323 and for 5 of the State circulars were revised and reprinted.

Four men were employed in this section for nine months and five men for three months.

DIVISION OF ENGRAVING AND PRINTING.

TOPOGRAPHIC MAPS AND FOLIOS.

During the year 140 topographic maps were engraved and printed, including the Maysville and Springdale (Ohio-Ky.) maps combined and printed as one map, the Morning View (Ky.) fractional map combined with and printed as part of the Felicity (Ohio) map, and the Mingo (W. Va.) fractional map printed as part of the Webster Spring (W. Va.) map; 30 new topographic war maps were photo-

lithographed and printed in black and colors; 9 special maps showing Army cantonments were compiled and printed with special texts; and a new map of Rocky Mountain National Park was issued, making a total of 180 new maps printed and delivered. One other map was republished in a new edition.

Corrections were engraved on the plates of 126 maps. Of these maps 104 were intended for reprint editions, 1 was in hand for printing, and 21 were corrected for other purposes. Thirteen photolithographic State maps and 4 photolithographed topographic maps in four colors were corrected and reprinted, and reprint editions of 59 maps in hand at the beginning of the year were completed.

Of the new and reprinted maps 360 different editions, amounting to 945,293 copies, were printed and delivered to the map room. This is an increase of 61 editions and 241,955 copies over the preceding year.

One new geologic folio (Colchester-Macomb, Ill.) was published during the year. The edition of this folio was 3,873 copies. Extra geologic maps of this folio amounting to 140 copies were also delivered.

OTHER GOVERNMENT MAP PRINTING.

The following war work was done for different branches of the War Department and Navy Department and for other branches of the Government: For the General Staff (Committee on Education and Special Training), map of Camp De Lassigny and 14 French mission maps; for the Bureau of Aircraft Production, charts and diplomas for air service radio schools, French map (Commercy), 3 French maps, photographic mosaic of Washington, D. C., and vicinity, and miscellaneous work; for the Department of Military Aeronautics, conventional map signs (British and French), map of Mulberry Island, motor-fuel distillation blank and enlargements of topographic maps; for the office of the Chief of Engineers, 3 French maps (Rethal, Vouziers, Somme-Py), circular map enlarged from three Belgian maps, map of Camp Hancock, Ga., maps of Belgium, and miscellaneous work; for the United States Marine Corps, conventional map signs (British and French); for the Quartermaster Corps, 269 German maps, map of Vailly, France, 5 charts for War Department Document 385, and United States base map; for the Coast Artillery School, Fort Monroe, Va., map of Vailly, France; for the Motor Transport Corps (training branch), instruction charts; for the Chemical Warfare Service (gas-defense division), a large amount of photographic and photolithographic work including editions of 97 diagrams, tracing, charts, etc.; for the Chemical Warfare Service (gas-investigations division), a large amount of photographic and photolithographic work including editions of 817 diagrams, drawings, tracings, etc.; for the United States Lake Survey,

Detroit, Mich., transfers of 5 sheets for progressive military map of the United States; for the Navy Department, diagrams of Curtiss airplane; for the Bureau of Navigation, map showing military camps in the vicinity of Washington for use of naval flyers on Hampton Roads; for the Hydrographic Office, bromide enlargements of 12-sheet map of the Atlantic Ocean; for the Bureau of Construction and Repair, a large amount of photographic and photolithographic work including editions of 276 camouflage designs of ships; for the Department of State, 29 maps of South American countries; for the Council of National Defense, a large amount of photographic and photolithographic work including editions of 434 diagrams, drawings, graphs, etc.; for the United States Food Administration, bromide enlargements of charts and other miscellaneous work; for the United States Fuel Administration, map showing congested manufacturing districts, ruled diagrams, and other miscellaneous work; for the War Trade Board, base map of the world (Mercator projection), editons of diagrams and charts, and other miscellaneous work; for the Central Bureau of Planning and Statistics, a large amount of miscellaneous photographic and photolithographic work; for the Bureau of Mines, under appropriations for war materials investigations, argon-gas investigation, chemical plant No. 4, explosive regulation, and war minerals relief, a large amount of photographic and photolithographic work; for the Bureau of Standards, editions of 381 pages of technical manuscript. On order of the Bureau of Standards, two large position mirrors were ruled in centimeter squares for the use of the Ordnance Department. Miscellaneous war work was also done for the Committee on Training Camp Activities, Department of Labor, United States Shipping Board, National Advisory Committee for Aeronautics, War Industries Board, Service Bureau (Committee on Public Information), Federal Board for Vocational Education, and United States Railroad Administration.

The following war work was done through the topographic branch: Eleven aviation maps; 77 special engraved and photolithographed military maps; map of Camp De Lassigny; plan of destruction; map of Gunpowder Neck (7 sheets); maps of Camp Humphreys, Camp Hancock (4 sheets), Camp Abraham Eustis, Camp Jackson (5 sheets), military post J–18, Mulberry Island, Fort Omaha balloon field (3 sheets); map showing war activities; form (report of military surveys); and other miscellaneous work. For the geologic branch war work was done as follows: Eight maps of South American countries, mineral-reserve maps of Europe (91 sheets), 9 maps of Africa, mineral-reserve maps of Australia and other islands (8 maps), mineral-reserve maps of Latin America (55 maps). Miscellaneous war work was also done for the water-resources branch and the administrative branch.

For the Government Printing Office the following items were printed and delivered: Illustrations for the annual reports of the governor of Alaska, the governor of Hawaii, the Commissioner-General of Immigration, and the Director of National Parks; Census reports, Volume I (Population, general report and analysis), Volume II (Report by States, etc., Alabama to Montana), Volume III (Population, report by States, Nebraska to Wyoming, Alaska, Hawaii, and Porto Rico), Volume V (Agriculture, general report and analysis); reports of the Federal Trade Commission on the fertilizer industry, price of gasoline, packing (Methods of the five packers), and pipe-line transportation of petroleum; Department of Agriculture Bulletin 755; Atlas of American Agriculture, Part I, section 1, Part V, section 1, and Part VIII, section 1; Report on a reconnaissance of the soils, agriculture and other resources of the Kenai Peninsula region of Alaska; Bureau of Mines Bulletin 107; Department of Commerce Special Publication 18; United States Coast Pilot, Sections A and E; American Ephemeris and Nautical Almanac, 1921 and 1922; Geological Survey Bulletins 551, 552, 641–F, 664, 668, 678, 683, 686–B, 686–C, 686–D, 686–E, 686–F, 686–G, 686–H, 686–I, 686–J, 686–K, 686–L, 686–M, 686–N, 686–O, 686–P, 686–Q, 686–R, 686–S, 691–E, 691–F, 691–M, 692–E, 692–G, 710–A, 711–A, Professional Papers 112, 120–H, Water-Supply Papers 427, 428; Mineral Resources 1917, chapters on peat and quicksilver; topographic instructions of the United States Geological Survey. In addition, the following separate illustrations were printed and delivered to the Government Printing Office: For the War Department, Ordnance Pamphlet 216, Orientation for Coast Artillery (Appendix 1 to Part III), conventional map signs for War Document 418 and for report on aerial navigation; for the Navy Department, organization chart—Bureau of Supplies and Accounts; for the Department of State, map of Spitzbergen and Bear Island; for the Alaskan Engineering Commission, plats of three Alaska town sites; for the Department of the Interior, township diagram and plat; for the National Park Service, maps for 8 circulars giving general information regarding national parks, sketch map of Mount Rainier and its glaciers, map showing mountaineering in Rocky Mountain National Park, map showing life zones in Glacier National Park; for the Department of Agriculture, base and outline maps of the United States by counties and States, relief map of United States, maps showing quarantine for Texas fever of cattle, map showing world production, map showing spread of the Mexican cotton boll weevil, and protractor diagrams.

The following work was done for other bureaus and departments: For the General Land Office, 1,242 township plats, 463 mineral plats, plats of 3 town sites, 13 State maps showing enlarged homestead areas, and other miscellaneous work; for the National Park Service,

maps of four national parks, 2 automobile tour maps, 7 automobile guide maps, 2 maps showing proposed enlargements of national parks, automobile wind-shield stickers for eight national parks, fire-warning signs, and other miscellaneous work; for the Department of the Interior, floor plans of new Interior Building, department seal, and miscellaneous work; for the Bureau of Mines, maps of world, charts, diagrams, and other miscellaneous work; for the Reclamation Service, 8 maps of projects, 2 State maps, 17 sheets of the Rio Grande drainage survey, map of Colorado River storage, 5 farm-unit plats, township plats, and diagrams, and miscellaneous work; for the Forest Service, maps of 76 national forests, index maps for districts 1, 2, 3, 4, 5, and 6, 13 proclamation maps of national forests, homestead-entry plats, grazing quadrat sheet, allotment-estimate sheets, triangulation-record cards, statistical-atlas page headings, labels, forms, and other miscellaneous work.

Miscellaneous work was also done for the Interstate Commerce Commission, Office of Indian Affairs, Department of Commerce, Department of Justice, International Boundary Commissions, Bureau of Crop Estimates, Biological Survey, Bureau of Chemistry, Bureau of Entomology, States Relations Service, Weather Bureau, Coast and Geodetic Survey, Bureau of Lighthouses, Smithsonian Institution, Bureau of Foreign and Domestic Commerce, Bureau of Education, and Alaskan Engineering Commission.

This work for various branches of the Government included numerous reprint editions and amounted to about $130,000, for which the appropriation for engraving and printing geologic maps was reimbursed by transfer of credit on the books of the United States Treasury.

Work was also done for the College of Liberal Arts; Northwestern University, Evanston, Ill.; Virginia Geological Survey, Charlottesville, Va.; Iowa Geological Survey, Des Moines, Iowa; and Columbia Planograph Co., Washington, D. C.; and the money received in payment for the work, amounting to $374.60, was turned into the Treasury of the United States to be credited to miscellaneous receipts. On requisition of the Government Printing Office, 299 transfer impressions were made and shipped to contracting printers. Under cooperative agreements, transfer impressions were furnished without charge to the State Geological Surveys of Illinois, Ohio, New York, and West Virginia.

A large amount of miscellaneous work relating to the map publications was also done, including index circulars and lists of geologic folios, topographic maps, and State maps.

Of contract and miscellaneous printing of all kinds, 2,935,543 copies were printed. Including topographic maps and geologic folios a grand total of 3,884,849 copies were printed and delivered during the year, an increase of nearly 20 per cent over the previous year.

PHOTOGRAPHIC LABORATORY.

The output of the photographic laboratory consisted of 19,529 negatives, of which 1,094 were wet, 1,324 dry, 666 paper, and 12,838 field negatives developed; 298 lantern slides; 5,109 negatives made for photolithographers; 4,674 zinc plates; 244 zinc etchings; 89 celluloids; and 52,942 prints, of which 32,240 were maps and diagrams and 20,702 were photographs for illustrations. In addition 961 prints were mounted, and 13 lantern slides and 48 prints were colored, and 24 prints were bleached.

ADMINISTRATIVE BRANCH.

EXECUTIVE DIVISION.

The work of the executive division was of the same general character as during the fiscal year 1918.

Mails, files, and records.—During the year 126,290 pieces of mail, of which 1,797 were registered, were opened and referred. In addition 180,515 letters were received direct by other divisions, making a total of 306,805, an increase of 2.5 per cent compared with 1918.

Of the letters opened in this division, 14,897 contained $24,017.37 remitted for Survey publications, a decrease of 12 per cent in number of letters and a decrease of $3,421.50 in amount compared with last year.

The recording, referring, filing, and mailing of correspondence required the services of 10 clerks. The number of letters mailed through the division was 130,071, a decrease for the year of 9.9 per cent. This number does not include the outgoing registered mail, which numbered 9,705 pieces, nor 384,778 pieces of letter mail sent direct from other divisions. The total for the Survey was therefore 524,554—an increase of 27 per cent for the year.

Personnel.—The roll of Secretary's appointees numbered 967 at the end of the fiscal year, 33 less than at the end of 1918. The total number of changes in the personnel was 1,357, which included 387 appointments, 433 separations, 498 promotions, and 39 miscellaneous changes.

During the year 16,095 days of annual leave and 5,238 days of sick leave were granted, being 71¾ per cent of the amount of annual leave and 23⅓ per cent of the amount of sick leave which it is permissible to grant under the law; 9,239 days of leave without pay were also granted.

Freight and express.—During the year 1,491 pieces of freight and express were handled, of which 545 were outgoing and 946 were incoming.

DIVISION OF ACCOUNTS.

A condensed statement covering the financial transactions of the fiscal year is given below, including disbursements up to August. The unexpended balances of that date largely represent outstanding obligations.

Amount appropriated for and expended by the United States Geological Survey pertaining to the fiscal year ended June 30, 1919.[a]

Title of appropriation.	Appropriation.	Repayments.	Available.	Disbursements.	Balance.
Salaries, office of Director	$31,020.00	.....	$31,020.00	$28,260.50	$2,759.50
Salaries, scientific assistants	29,900.00	.....	29,900.00	29,811.12	88.88
Skilled laborers, etc	15,080.00	.....	15,080.00	15,076.50	3.50
Gaging streams, etc	148,244.10	$32,655.42	180,899.52	179,899.52	1,000.00
Chemical and physical researches	40,000.00	266.88	40,266.88	39,317.61	949.27
Preparation of illustrations	18,280.00	441.21	18,721.21	18,672.07	49.14
Mineral resources of United States	99,414.70	.....	99,414.70	97,498.09	1,916.61
Geologic maps of United States	118,049.00	115,613.20	233,662.20	232,662.20	1,000.00
Books for the library	2,000.00	.....	2,000.00	1,771.19	228.81
Topographic surveys [b]	216,415.60	472,481.64	688,897.24	683,872.77	5,024.47
Geologic surveys	347,073.50	6,896.26	353,969.76	348,144.63	5,825.13
Mineral resources of Alaska	75,000.00	.....	75,000.00	62,009.02	12,990.98
Enlarged and stock-raising homesteads	197,268.60	.....	197,268.60	195,843.30	1,425.30
	1,337,745.50	628,354.61	1,966,100.11	1,932,838.52	[c]33,261.59

[a] In addition to these appropriations $100,000 for Survey publications was contained in the appropriation for printing and binding but not disbursed by Survey officials.

[b] Includes appropriation of $74,219.60 for surveying national forests, which is combined with appropriation for topographic surveys in current appropriation bill.

[c] The larger part of this balance will be used to pay outstanding obligations.

Classification of expenditures by the United States Geological Survey pertaining to the fiscal year ended June 30, 1919.

Appropriation.	Total.	Salaries and wages.	Transportation of persons.	Transportation of things.	Provisions; subsistence and support of persons.	Forage; subsistence and support of animals.
Salaries, office of the Director	$28,260.50	$28,260.50	.....	.....	.....	.....
Salaries, scientific assistants	29,811.12	29,811.12	.....	.....	.....	.....
Skilled laborers, etc	15,076.50	15,076.50	.....	.....	.....	.....
Gaging streams, etc	179,899.52	141,996.87	$7,598.25	$872.15	$9,341.96	$219.57
Chemical and physical researches	39,317.61	29,892.30	1,499.43	84.96	2,221.09	82.18
Preparation of illustrations	18,672.07	18,099.00	.....	.....	.....	.....
Mineral resources of United States	97,498.09	90,834.83	1,180.05	85.64	1,329.22	1.00
Geologic maps of United States	232,662.20	146,987.16	134.09	51.10	105.85	.....
Books for the library	1,771.19	.....	.....	1.80	.....	.....
Topographic surveys	[a] 683,872.77	322,083.41	10,639.33	2,189.95	136,002.97	16,343.95
Geologic surveys	348,144.63	289,806.87	9,993.20	501.59	22,358.08	3,374.59
Mineral resources of Alaska	62,009.02	44,187.91	5,231.75	1,142.20	4,991.14	212.34
Enlarged and stock-raising homesteads	195,843.30	129,406.94	9,659.09	478.52	29,393.34	630.49
	1,932,838.52	1,286,443.41	45,935.19	5,407.91	205,743.65	20,864.12

[a] Includes expenditures made from appropriation for surveying national forests, which is combined with topographic surveys in current appropriations.

Classification of expenditures by the United States Geological Survey pertaining to the fiscal year ended June 30, 1919—Continued.

Appropriation.	Communication service.	Printing, engraving, lithographing, etc.	Fuel; furnishing heat, light, power, etc.	Special and miscellaneous service.	Materials; miscellaneous supplies, etc.	Stationery, drafting, etc., supplies.
Gaging streams, etc	$979.91	$242.65	$97.73	$2,376.63	$1,129.79	$2,214.62
Chemical and physical researches	43.80	66.91	33.77	1,340.95	341.78	782.84
Preparation of illustrations	.05	6.85	.....	301.57	.75	101.64
Mineral resources of United States	1,842.81	157.26	12.36	391.40	15.73	687.08
Geologic maps of United States	27.64	750.00	247.40	3,573.62	3,879.22	48,541.97
Books for the library	2.82	.....	.....	.....	.....	10.75
Topographic surveys	450.01	8,080.07	785.13	65,010.82	6,869.50	4,281.51
Geologic surveys	745.14	943.97	26.90	6,266.37	294.88	1,168.52
Mineral resources of Alaska	137.28	75.60	449.60	2,072.73	271.30	331.21
Enlarged and stock-raising homesteads	536.97	10.30	.....	1,570.29	13.55	863.86
	4,766.43	10,333.61	1,652.89	82,904.38	12,816.50	58,984.00

Appropriation.	Equipment (including live stock).	Rent.	Maintenance, operation, and repair of passenger-carrying vehicles.	Purchase of motor-propelled passenger-carrying vehicles.	Purchase of horse-drawn passenger-carrying vehicles.
Gaging streams, etc	$4,278.63	$1,628.50	$4,405.16	$865.41	$1,651.69
Chemical and physical researches	1,667.44	.....	905.16	.....	355.00
Preparation of illustrations	162.21	.....	.....	.....	.....
Mineral resources of United States	942.17	.....	.....	.....	18.54
Geologic maps of United States	28,364.15	.....	.....	.....	.....
Books for the library	1,755.82	.....	.....	.....	.....
Topographic surveys	17,136.18	455.10	59,963.45	.....	33,581.39
Geologic surveys	2,110.61	10.00	6,971.86	670.21	2,901.84
Mineral resources of Alaska	2,323.96	480.00	.....	.....	102.00
Enlarged and stock-raising homesteads	46.45	110.68	22,036.52	935.20	151.10
	58,787.62	2,684.28	94,282.15	2,470.82	38,761.56

DIVISION OF SCIENTIFIC AND TECHNICAL EQUIPMENT.

The cost of the work and material used in the division of scientific equipment during the year was $23,287.24.

In addition, work amounting to $1,500 was done by the instrument section for the War Department, and work amounting to $1,300 was done on the development of the airplane camera.

LIBRARY.

The accessions of books, pamphlets, and maps numbered 13,057 items, which were recorded in the catalogues. The recorded loans were 7,959 books and 913 maps, not including those used by 9,372 readers who consulted the library in person. The catalogue was increased by the addition of 8,091 cards. In accordance with the cooperative cataloguing arrangement 393 title entries were furnished to the Library of Congress for printing, the proof reading for which involved 76 galleys.

The books collated and prepared for the binder numbered 411. The letters and other papers translated from foreign languages for other divisions of the Survey numbered 149.

The bibliography of North American geology for 1917 was published as Bulletin 684. The bibliography for 1918 was completed and submitted in April for publication as Bulletin 698. The cumulated bibliography of North American geology has progressed so far that it will probably be ready for publication before the end of the fiscal year 1919–20.

It may be stated with confidence that the library contains practically all the important scientific and technical publications treating of the subjects included in the Survey's work, as well as the necessary guides, bibliographic aids, and reference books. By reason of its unusual resources it renders a unique service both to the scientific and technical force in Washington and, by correspondence, to investigators in all parts of the country.

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