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U.S. GEOLOGICAL SURVEY

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DURING the fiscal year 1937 the Geological Survey continued its systematic work in investigating, mapping, and reporting on the geology, the mineral and water resources, and the physical features of the United States. The results of this work are basic in all conservational activities, as those who plan and direct the conservation policies toward the wise development and use of the Nation's resources must first have the facts about the quantity, quality, distribution, and availability of those resources and adequate maps with which to pursue and record further studies. Through its technical supervision of prospecting, mining, and producing operations on public and Indian lands under permits, leases, and licenses, the Survey was directly engaged in the practical application of conservation policies.

During the year the aggregate expenditures for which the Geological Survey was responsible amounted to about $4,222,000, as compared with about $4,620,000 during the preceding year. These aggregates were made up of the regularly appropriated funds, the cooperative funds from States, counties, and municipalities, the funds transferred from other departments of the Government for types of work falling within the Survey's field, and the emergency funds derived chiefly from the Public Works Administration and devoted largely to mapping of various types, to river-utilization surveys of power and storage resources, to conservation work on public lands, and in a lesser degree to the study of mineral resources.

Although there was a decline from the preceding year in aggregate funds available, the fiscal situation has nevertheless improved, because the Congress, in view of the decreasing availability of emergency funds, had increased the regular appropriation to $2,807,000, from the $2,285,000 of the preceding year.

As a part of our informal service to the public, more than 4,500 tests of mineral and rock samples were made and more than 2,200 chemical analyses were completed.

More than 14,500 square miles of new area was surveyed in the field topographically. This work will yield 102 contoured topographic maps of areas in 36 States and in Puerto Rico. In addition, by the aid of aerial photography, 4,780 square miles was surveyed in 5 States for the production of planimetric maps without contours.

Fifty-seven book publications of the Survey's regular series, aggregating nearly 6,000 pages of printed matter, dealing with geology, mineral resources, and water supplies were issued during the year, and about 673,000 copies of 296 topographic and other maps were printed. The geologic map of Texas was completed.

There were 59 geologic parties in the field in 33 States. The field investigations on several continuing projects were completed, and work was begun on new projects including geologic studies of areas in Idaho, Arizona, and in the Big Horn Basin in Wyoming and the geologic aspects of the Ohio River flood.

Measurements of stream flow were maintained at 3,379 stream-gaging stations. All the States, the District of Columbia, and Hawaii are affected by this work. Drought and flood studies were continued during the year.

The work on underground waters, so important in the drought-stricken areas, was continued, much of it in cooperation with the States, and 75 reports on this topic were released for public use.

In the land-classification and mineral-leasing activities of the Survey more than 9,000 formal findings of technical fact were made regarding the mineral resources, water power, or storage possibilities of public land, and the Government's ownership of great reserves of coal, oil and gas, potash, phosphate, and other minerals was safeguarded. Technical supervision was given to more than 9,000 properties containing oil and gas and more than 600 containing coal, and 100 containing other minerals. On Indian lands more than 5,300 oil and gas leases were supervised, as well as more than 100 properties containing coal, asphalt, and lead and zinc.

GENERAL SUMMARY OF THE YEAR'S ACTIVITIES

Geologic work.—Fifty-nine field parties were active during the year, and work was done in 33 States. Work was continued throughout the year in metal-mining districts of Colorado, Idaho, and New Mexico and in the oil fields of Kansas and Michigan. Cooperative work was also done in Arizona, Florida, Mississippi, and Virginia. The geologic map of Texas was completed. Physiographic and geologic studies were continued in the Yosemite and Sequoia National Parks, Calif., Zion National Park, Utah, and Glacier National Park, Mont., in cooperation with the National Park Service. Geologic examinations of areas in the Carolinas, Georgia, and Alabama were made for the Forest Service, and of dam and reservoir sites for the Office of Indian Affairs and the War Department. Work on many projects was completed in 1937, and work was begun on new projects including studies of the areal and economic geology of the Irwin quadrangle, Idaho, the Pearce quadrangle, Ariz., and the Big Horn Basin, Wyo.,

and of the geologic aspects of the Ohio River flood. The determination and compilation of the physical properties of rocks, as part of the "borderland" field between geology and chemistry and physics, received increasing attention. More than 4,500 tests of mineral and rock samples were made, including 1,587 chemical analyses in connection with the Geological Survey's projects and 1,570 tests for persons not officially connected with the Survey. Many tests were made of activable bleaching clays, two deposits of which are now in commercial production, largely as a result of study and tests made in the Survey's laboratory. Temperature measurements of wells were made in two States. The section of geophysical prospecting continued work on projects in hand and made new field studies related to ores and ground water in Nevada and oil and gas in Michigan. It also continued laboratory studies of the construction and operation of geophysical apparatus.

Explorations in Alaska.—In the field season of 1936 seven field projects were carried on in Alaska. Of these projects, four were principally concerned with geologic investigations relating to the mineral resources of the Territory, two were primarily topographic, and one was a general survey of recent mining developments in the more important camps. In addition, an assay laboratory was maintained at College, Alaska. The general collection of statistics regarding the production of mineral commodities was continued. For the field season of 1937, three field projects had been started before the end of the fiscal year, and two additional field projects were to be undertaken as soon as practicable. All these field projects will be continued throughout the open season as late as conditions permit.

Topographic mapping.—The area covered by new topographic surveys, resurveys, and revision amounted to 14,502 square miles, representing 102 topographic maps with contours. The topographic mapping was done in 36 States and in Puerto Rico. The area covered by planimetric maps without contours, resulting from aerial photography, covered 4,780 square miles in five States. In addition, aerial photographs were used as bases for topographic mapping in 26 quadrangles. Stereoscopic plotting apparatus, utilizing single-lens aerial photographs, as a practical demonstration of the use of such equipment in connection with topographic mapping, is being extensively applied in the mapping of the Tennessee River Basin in cooperation with the Tennessee Valley Authority and in special areas in Virginia, in cooperation with the Conservation and Development Commission of Virginia, Geological Survey. The transportation map of the United States, in sections, which is being made for the Bureau of Public Roads was continued with increased output. The maps of Delaware, in two sections; Washington, in nine sections; Rhode Island, in one section; Connecticut, in one section; and South Carolina, in five sections, were published. The maps of Massachusetts , in three sections; New York, in seven sections; and Maryland, in three sections, are in course of publication.

Investigations of water resources.—The water-resources branch collected and made available for publication stream-flow records at 3,379 river-measurement stations on rivers in the 48 States, the District of Columbia, and the Territory of Hawaii, thus obtaining authentic information on the behavior of streams in drought in flood, and under normal conditions—information that is invaluable for planning of projects for use or control of the surface water supply. It investigated underground water supplies in 22 States and in Guam and Hawaii and obtained basic information on the occurrence, quantity, and quality of underground water supplies, which is essential for the development, conservation, and use of ground water upon which a large part of the population of the country must depend. Drought studies have been continued. Investigations of stream-flow and silt movement of streams in eight projects of the Soil Conservation Service and similar

studies on the Colorado River have also been continued. The annual report on the capacity of water wheels in water-power plants of 100 horsepower or more in the United States on January 1, 1937, was released in April 1937. Engineers of the branch had general supervision of operation under permits and licenses of the Federal Power Commission in connection with 150 projects. Investigations of the water problems along the international boundary between the United States and Canada were continued for the State Department. The collection of information on recent outstanding floods was continued. Partial or complete analyses were made of 1,754 samples of water from surface and underground sources with reference to the suitability of the waters for industrial and agricultural use and for domestic use (not related to questions of health).

Classifying and leasing public land.—The Conservation Branch made 9,036 formal findings of technical fact involving the mineral resources, water power, or storage possibilities of public lands; added 100,699 acres to outstanding water-power reserves and eliminated 17,507 acres therefrom; defined the "known geologic structure" of 2 producing oil and gas fields amounting to 9,354 acres; completed 1,261 miles of river-utilization surveys and 155 square miles of reservoir surveys in public-land States, and made geologic and geophysical studies of formation materials and conditions at 61 dam sites; supervised activities and operations under 166 power projects licensed by the Federal Power Commission and 172 permits and grants from the Interior Department; supervised on public lands 9,052 oil and gas holdings involving 4,112 productive wells and 657 coal properties, 39 potash properties, 44 sodium properties, 18 sulphur properties, 11 phosphate properties and 1 oil-shale property; supervised on naval petroleum reserves 22 leaseholds involving 538 productive oil and gas wells; and on Indian lands 5,342 leaseholds involving 4,397 oil and gas wells, 40 lead and zinc properties, 108 coal properties and 1 asphalt property; assisted hundreds of oil and gas permittees and operators in preparation of unit plans of development and operation; formulated the revised Oil and Gas Operating Regulations, effective November 1, 1936.

Publications.—The publications of the year consisted of 57 reports in the regular series, making a total of 5,760 pages; 96 new or revised topographic and other maps; 199 reprinted topographic and other maps; and several pamphlets for administrative use. Among the book publications were reports on the mineral resources of the region around Boulder Dam, the Bayard area, New Mexico, and the Butler and Zelienople quadrangles, Pennsylvania; fuel resources of Pike County, Ky., the San Juan Basin, N. Mex., and areas in Alaska, Arkansas, Montana, and Oklahoma; spirit leveling in Connecticut and Massachusetts; records of water levels and artesian pressure in observation wells in the United States in 1935; records of wells on the Snake River Plain, Idaho; ground-water resources of the Florida Peninsula, the Elizabeth City area, North Carolina, and of the San Antonio, area and Duval, Kleberg, Medina, and Uvalde Counties, Tex.; and several stratigraphic and paleontologic papers, notably a comprehensive report on the Tertiary floras of Alaska by the outstanding authority on the subject. Besides these printed reports 30 brief papers were issued in mimeographed form as memoranda for the press.

The engraving and printing division printed more than 673,000 copies of maps and did repay work amounting to about $220,000 for 68 other units of the Federal and State Governments.

NOTE.—Detailed tabular statements are given at the end of the report.

GEOLOGIC BRANCH

SUMMARY

Fifty-nine parties were active in the field during the year and work was done in 33 States. Work was continued throughout the year on metal-mining districts in Colorado, Idaho, and New Mexico, and in the oil fields of Kansas and Michigan. Cooperative projects were also conducted in Arizona, Florida, Mississippi, and Virginia. The geologic map of Texas, embodying the results of many years of work by the Federal and State surveys and by oil companies and private geologists, was completed and was available for distribution early in July 1937. The section of geologic map editing also aided the State surveys in the preparation and proofreading of geologic maps of California, Washington, and Iowa. Physiographic and geologic studies were continued in the Yosemite and Sequoia National Parks, Calif., Zion National Park, Utah, and Glacier National Park, Mont., in cooperation with the National Park Service, and geologic examinations of selected areas in the Carolinas, Georgia, and Alabama were made for the Forest Service. Dam and reservoir sites were examined for the Office of Indian Affairs and the War Department, and information was furnished on request to several other Federal organizations.

New projects begun in 1937 included studies of the areal and economic geology of the Irwin quadrangle, Idaho, the Pearce quadrangle, Arizona, and the Big Horn Basin, Wyo., and of the geologic aspects of the Ohio River flood.

More attention given to the determination and compilation of the physical properties of rocks, as part of the "borderland" field between geology, chemistry, and physics, and correlations between the physical properties of minerals and their chemical composition, many of which were completed during the year, will make the future identification of these minerals more rapid and more exact. More than 4,500 tests of mineral and rock samples were made, including 1,587 chemical analyses in connection with the Geological Survey's projects and 1,570 tests for persons not officially connected with the Survey. Many tests were made of activable bleaching clays, two deposits of which are now in commercial production, largely as a result of study and tests made in the Survey's laboratory. Temperature measurements of wells were made in two States.

The section of geophysical prospecting, transferred from the Bureau of Mines to the Geological Survey on July 1, 1936, continued work on projects in hand and made new field studies related to ores and ground water in Nevada and oil and gas in Michigan. It also continued laboratory studies that may lead to reduced cost in the construction and operation of geophysical apparatus.

WORK OF THE YEAR BY STATES

Alabama.—Geologic mapping was continued in the Russellville iron-ore district in Franklin, Colbert, and Lauderdale Counties, and geologic examinations were made of some other deposits of brown iron ore in the eastern part of the State and of some manganese deposits in Blount and Etowah Counties. Reports on the brown iron ore in the Russellville district and on iron ore in the Red Mountain formation in northeastern Alabama were in progress. A paper on Foraminifera of Choctaw Bluff was completed for Survey publication. Work on gold in Alabama is mentioned under "Southern Appalachians." Examinations were made for the Forest Service of proposed additions to the Black Warrior National Forest and Akmulgee division and the Talladega unit of the Talladega National Forest, and a report was prepared for the Forest Service on proposed additions to the Chattahoochee National Forest in Georgia and Alabama.

Arizona.—A field study of the geology and ore deposits of portions of the Benson and Pearce quadrangles, including the Gleeson, Courtland, Black Diamond, and Pearce mining districts, was begun. The report on the geology and ore deposits of the Ajo quadrangle was completed for Survey publication, and a paper on the physiography of the Ajo region was submitted for publication by the Geological Society of America. Progress was made on a report on the geology and mineral resources of the Tucson quadrangle and on a report on detailed mapping of the ore deposits of the Tombstone district, in cooperation with the Arizona Bureau of Mines.

Arkansas.—The report on the geology and ore deposits of the southwestern Arkansas quicksilver district was transmitted for Survey publication. The report of the western portion of the Arkansas coal field was issued as Bulletin 847–E. Reports on the fauna and stratigraphy of the Morrow group of Arkansas and Oklahoma and on recent developments in the carbonate ores of the Batesville manganese district are in preparation for official publication. Papers on the mineral taeniolite from Magnet Cove and on Pennsylvanian sedimentation in the Arkansas coal basin are in preparation for publication in some scientific magazine, and one on the lead and zinc ore-bearing formations of northern Arkansas was submitted for inclusion in the volume on the ore deposits of the Mississippi Valley to be published by the National Research Council.

California.—A comprehensive report on the general geology, oil resources, physiography, paleontology, stratigraphy, and economic phases of the Kettleman Hills and a report on the geology and ore deposits of the Grass Valley region were nearing completion for Survey publication. Field studies were made of the diatom-bearing deposits of the Temblor formation in Kern County, and a paper on comparison of diatom floras of the Temblor formation of California and the Calvert formation of Maryland and Virginia was in preparation. Investigations of the geology of the San Andreas rift; of the Death Valley region; and of the structure, stratigraphy, and oil resources of the lower Tertiary strata in Reef Ridge, in the Kettleman Plains and Dudley no. 2 quadrangle in the Coalinga region, were continued. Oil centers in California were visited to obtain data in connection with a study of source of beds of petroleum carried on in cooperation with the American Petroleum Institute. Studies of the geomorphology of the Sequoia National Park and adjoining areas in Inyo National Forest and of the northern portion of Yosemite Valley were made in cooperation with the National Park Service, and a report giving an outline of the geology of the Sequoia National Park was in preparation. Reports on Pliocene diatoms from the Kettleman Hills and on lower Pliocene mollusks and echinoids from the Los Angeles Basin and their inferred environment have been completed. Reports are in preparation on the siliceous rocks of the Monterey formation, the geology of the Palos Verdes

Hills, and the geomorphology of the San Joaquin Basin. A paper on the geologic history of Mount Whitney was submitted for outside publication. Papers in preparation for outside publication cover vein filling at Nevada City; calcium carbonate content of California Cretaceous and Tertiary sediments; significance of wet, lean, and dry gas to absence or presence of petroleum; and Nevada City-North San Juan granodiorite.

Colorado.—In continuation of the cooperative program carried on with the State of Colorado and the Colorado metal mining fund in investigations of the mining regions of the State, studies were continued of the Ouray, Red Mountain, and Sneffels-Camp Bird districts in the San Juan region and of districts in the La Plata Mountain region; in the mineral belt of the Front Range, including mapping in the vicinity of Boulder, Nederland, Central City, Ward, Idaho Springs, Jamestown, Gold Hill, and in the Cripple Creek district; in the Mosquito Range, the Sugar Loaf-St. Kevin district, and the Butte mine and other mines in the vicinity of the London fault. Studies of the geology and ore deposits of the Chattanooga district and of the Kokomo-Robinson area were begun. The report on the Snowmass region is now in press as Bulletin 884. A report on the ore deposits in the vicinity of the London fault was transmitted for Survey publication. A geologic map of the Leadville district and a geologic map of the Front Range mineral belt, both with brief explanatory text, have been prepared and will be published in advance of the comprehensive reports on these districts. A paper on the Laramide igneous sequence and differentiation in the Front Range will be published by the Geological Society of America, and one on the geology of the Neglected mine, La Plata district, by the American Institute of Mining and Metallurgical Engineers. A preliminary report entitled "Resurvey of the La Plata District" was published in volume 13, no. 9, of the Proceedings of the Colorado Scientific Society, and one on the mode of igneous intrusion in the La Plata Mountains was prepared for the section of volcanology of the American Geophysical Union. A paper on the petrologic results of a study of the minerals from the Tertiary volcanic rocks of the San Juan region was also completed for outside publication. A report on the geology of the Pine River dam site was prepared for the Reclamation Service. Geologic mapping was done in a portion of the Yampa coal field, in the Elkhead Creek, Pilot Knob, Daton Peak, and Mount Harris quadrangles.

Delaware.—See Maryland (Chesapeake & Delaware Canal).

District of Columbia.—A geologic map of the District of Columbia, with descriptive text, is in preparation for Survey publication.

Florida.—An investigation of the physical geography of Florida was made in cooperation with the Florida Geological Survey. A report on the fauna of the Alum Bluff group of Florida was completed for publication and the report on phosphate investigations in Florida, is nearing completion for official publication. A paper on mollusks of the Tampa and Suwannee limestones of Florida was transmitted to the Florida Geological Survey, and a description of seven new species and one new subspecies of mollusks from the Choctawhatchee formation of Florida was prepared for publication in some outside journal. A paper on Government prospecting for phosphate in Florida will be published by the American Institute of Minng and Metallurgical Engineers.

Georgia.—A detailed geologic study of the geology and mineral resources of the Pine Log quadrangle, including manganese ores, ocher, limonite, and barite, was begun. A report on the Coastal Plain of Georgia is being prepared in cooperation with the Georgia Division of Mines, Mining, and Geology, Department of Natural Resources. A paper on some gold deposits of Georgia was prepared for the committee on processes of ore deposition, National Research Council.

Idaho.—In cooperation with the Idaho Bureau of Mines, investigations of the geology and ore deposits were made in the Atlanta-Rocky Bar mining district, the Florence mining district, the Coeur d'Alene dry belt, and Kootenai County, and a study of the placer deposits of central Idaho was continued. The paleontology and stratigraphy of the Carboniferous formations of south-central Idaho were studied. The report on the Edwardsburg-Thunder Mountain district was sent to the Idaho Bureau of Mines and Geology for publication. Reports on the Atlanta, Warren, Florence, and Murray mining districts and on the Boise Basin were nearing completion at the end of the year, and one on the geology and mineral resources of an area around Freedom was begun. Papers on the significance of amygdules in Columbia River lava, "Modern Forty-Niners", the influence of structure on deposition in the Boise Basin, the Clark Fork-Sandpoint porphyry belt, and the genetic features of the Idaho batholith were prepared for publication outside of the Survey, and one on bedding veins near Murray was prepared for the volume on ore deposition to be published by the National Research Council. Studies of the glacial geology and physiography of portions of eastern Idaho and of the geology and ore deposits of the Borah Peak quadrangle were continued. Mapping in the Irwin quadrangle was begun, and progress was made on reports on the geology and ore deposits of south-central Idaho, on Idaho mining districts, and on the geology and mineral resources of the Paradise and Ammon quadrangles, in southeastern Idaho.

Illinois.—A geologic investigation was made in the southern part of Illinois and Indiana included in the flood area in the Ohio Valley. A report on geologic factors in the interpretation of fluorspar reserves in the Illinois-Kentucky field, was published by the Geological Survey as Bulletin 886–B. One of the Cave in Rock fluorspar district, prepared in cooperation with the Illinois Geological Survey Division, was transmitted to that organization for publication. A paper on the origin of bedding replacement deposits of the Illinois fluorspar field was published in Economic Geology.

Work on the late David White's report on the Pottsville flora of the Eastern Interior Basin, mainly in Illinois, was continued. Preparation of a paper on the Fusulinidae of the Pennsylvanian formations of Illinois, for publication by the State, was continued.

Indiana.—A report to be known as part 3 of the flora of the New Albany shale of Indiana and Kentucky and one on new crinoid genera from the Mississippian of Indiana were in preparation. The Ohio Valley investigation and the report on the Pottsville flora of the Eastern Interior Basin are mentioned under Illinois.

Kansas.—In cooperation with the Geological Survey of Kansas, an investigation of the rocks generally designated the "Mississippi lime" that are found in deep wells in the oil and gas fields in southeastern Kansas was continued. A report on the geology and coal resources of the southeastern Kansas coal field in Crawford, Cherokee, and Labette Counties and one on Pennsylvanian invertebrate faunas were transmitted to the Kansas Geological Survey. Some oil centers in Kansas, Oklahoma, and Texas were visited to collect data in connection with a comprehensive report on source beds of petroleum. Studies of the lead and zinc deposits of southeastern Kansas included in the Tri-State district are mentioned under Oklahoma.

Kentucky.—See Indiana (New Albany shale) and Illinois (Ohio Valley investigation and report on the Pottsville flora).

Maine.—A paper on Graftonite from Greenwood, Maine, was published in the American Mineralogist.

Maryland.—A report on the Upper Cretaceous deposits of the Chesapeake & Delaware Canal of Maryland and Delaware was completed for publication by the Maryland Geological Survey. Examinations of the geology of the Savage

River dam sites were made for the district engineer of the War Department. In informal cooperation with the Maryland Geological Survey, geologic examinations were made in portions of Frederick County, and the geology of the Westminster quadrangle was reviewed. A paper on *Crassatellites* from the St. Marys formation was submitted for outside publication.

Massachusetts.—In connection with a general study of the granites of New England, investigations were made of areas around Chelmsford, Westford, and Graniteville.

Michigan.—A resistivity survey in some of the oil districts near Lansing was made by members of the geophysical section in cooperation with the State geologist, division of geology, Department of Conservation of the State of Michigan. Studies of Devonian fossils and stratigraphy of Michigan were continued.

Mississippi.—Studies of the Upper Cretaceous deposits of northern Mississippi in connection with a revision of the geologic map and a report on the stratigraphy of the State were in progress. A report on the geology of the Jackson area was in preparation for Survey publication. Examinations were made in connection with the drilling of a deep test well (State of Mississippi fee no. 2 well) for oil and gas by the State on State-owned land near Jackson, and a report on cores and cuttings from the well was prepared for the Mississippi Mineral Lease Commission, Jackson. A report on the well was also prepared for the Mississippi Geological Survey. A report on the gas reserves and probable life of the Jackson gas field was made to the Public Works Administration. A paper on the Prairie Bluff chalk and Owl Creek formation was prepared for publication by the American Association of Petroleum Geologists.

Missouri.—Progress was made on an official report on the stratigraphy and fauna of the Louisiana limestone and on a paper for outside publication on the Warsaw fauna (Mississippian) of the Joplin district.

Montana.—Geologic mapping of the geology and mineral resources of the Little Rocky Mountains and adjoining regions in Phillips and Blaine Counties was continued, and an investigation made of the geology of the Fort Belknap Indian Reservation. General reconnaissance studies of the physiography and glacial geology of portions of western Montana, northwestern Wyoming, and eastern Idaho were continued, and in cooperation with the National Park Service an investigation of the geologic features of Glacier National Park was made and a report prepared for the Park Service. The study of the Fort Union and associated formations of North Dakota, Montana, and Wyoming was continued. A study of scarps and other evidences of Pleistocene and Recent faults in southwestern Montana was in progress. The report on the geology and ore deposits of the Libby quadrangle was nearly completed, and one on the structure and stratigraphy of the Black Hills rim, Montana and Wyoming, was in progress. The report on the geology and mineral resources of north-central Chouteau, western Hill, and eastern Liberty Counties was issued as Bulletin 847–F. Work on a paper on suggested correlations of the Lance and Fort Union formations in Montana, North Dakota, and South Dakota was continued. Papers on the following subjects were submitted for outside publication: Quartz monzonite and related rocks of the Libby quadrangle; a new locality for Middle Cambrian fossils near Noxon; helvite from the Butte district; amphibolization of sills and dikes in the Libby quadrangle; asymmetric distribution of stream terraces in southeastern Montana; and fossil plants from the Colgate sandstone and adjacent strata.

Nevada.—Geologic field mapping was completed and reports were in progress on the Comstock lode at Virginia City and on the general geology and ore deposits of the Hawthorne and Tonapah quadrangles. Geophysical studies were made at Mineral Hill, Spring Valley, Caliente, Delamar, Hawthorne, and Comstock.

Preparation of a report on the Basin Ranges was continued. An abstract of a paper on the Slumbering Hills was published in Economic Geology, and a paper on the geology of the Searchlight district, Clark County, was transmitted to the Nevada State Bureau of Mines for publication. Other papers were prepared on early Jurassic orogeny in west-central Nevada; Triassic and Jurassic rocks of the Hawthorne and Tonopah quadrangles; and recent fault scarps in the western part of the Great Basin, Nevada and California, for the Geological Society of America; and on the Pennsylvanian-Permian boundary in southern Nevada, for the American Association of Petroleum Geologists.

New Hampshire.—In connection with a study of the granites of the New England States, investigations were conducted at Concord.

New Jersey.—Papers on bentonite in the Upper Cretaceous of New Jersey and on the stratigraphic significance of *Kummelia*, a new Eocene bivalve genus from New Jersey, were submitted for publication in outside periodicals.

New Mexico.—Study of the geology and ore deposits of the Little Hatchet Mountains, in cooperation with the New Mexico Bureau of Mines, was continued. An area in Rio Arriba County not previously mapped, on the east side of the San Juan structural basin, including land-grant and Indian lands, was studied with particular reference to coal and oil resources, including the coal-bearing Cretaceous rocks of the Lumberton-Monero area. Official reports covering these recent investigations, together with earlier investigations in this basin and on the geology and potash resources of the Potash Mines area, were in progress. A report on the geology of the Zuni Dam was made for the Office of Indian Affairs. A paper on the geologic significance of a geothermal gradient curve for the Dooley No. 7 well will be published by the American Association of Petroleum Geologists.

New York.—Reports on the structure and gas possibilities of the Oriskany sandstone in Steuben, Yates, and parts of adjacent counties, and on Pleistocene diatoms from Long Island were completed for Survey publication. Progress was made on a report on talc in the Gouverneur district, field work for which was done under Public Works allotment in 1934. Other papers were in preparation on the geology of the Clove and Millbrook quadrangles for Survey publication, on the structural petrology of these quadrangles for outside publication, and a paper on fossil plants inclosed in pyrite nodules from the Tully (Devonian) limestone, also for outside publication.

North Carolina.—A report for Survey publication on Mollusca from the Miocene and lower Pliocene of Virginia and North Carolina, with notes on the stratigraphy, was advanced; and one on Foraminifera, diatoms, and mollusks from test wells near Elizabeth City was completed. Papers were submitted for outside publication on a new subspecies of *Pecten* from the upper Miocene of North Carolina; sphalerite from a pegmatite near Spruce Pine; and the molluscan fauna of the Pliocene Croatan sand of North Carolina. Others were in preparation on Pleistocene fossils from a well at Hatteras and Miocene diatoms from Hamilton Wharf.

North Dakota.—For work on the Fort Union and associated formations, see Montana. Progress was made in the compilation of material for a geologic and topographic map of the State. The report on the geology and coal resources of the Minot area was in preparation.

Ohio.—Several places along the Ohio River were visited in connection with a geologic investigation of the flood area in the Ohio Valley. A paper on Devono-Carboniferous stratigraphy and faunas from Ohio and Pennsylvania was in preparation. Deep-well drilling is reported under Pennsylvania.

Oklahoma.—An investigation was begun of the geologic structure, stratigraphy, and petroleum possibilities of an area adjoining Black Knob Ridge in and near the west end of the Ouachita Mountains. Field and office work on an investigation of the subsurface geology and oil and gas resources of Osage County was

continued, and a report covering Tps. 22 and 23 N., Rs. 10 and 11 E., was completed for Survey publication. The report on the geology and mineral resources of the Howe-Wilburton district was completed for publication as Bulletin 874–D. A report on the geology and fuel resources of the McAlester district was issued as Bulletin 874–A, and one on the Quinton-Scipio district is in press as Bulletin 874–C. Reports were in progress on the stratigraphy and fauna of the Morrow formation, the stratigraphy and Mississippian faunas of the Wyandotte quadrangle, the fauna of the Moorefield formation, and the flora of the coal beds of eastern Oklahoma. Work in the Missouri, Kansas, and Oklahoma lead and zinc areas, including detailed areal mapping, studies of mines and stratigraphy, and structure contour mapping, was continued. Papers on the Black Knob Ridge and on the Verden sandstone, an exposed shoestring sand of Permian age, were prepared for the American Association of Petroleum Geologists. An abstract of a paper on the stratigraphy of the pre-Carboniferous rocks of Black Knob Ridge was published in the Digest of the Tulsa Geological Society. Papers on the origin and distribution of the Bartlesville and Burbank shoestring oil sands in parts of Oklahoma and Kansas and on new shoestring oil fields expected in Osage County, Okla., and Cowley and Butler Counties, Kans., were submitted to the American Association of Petroleum Geologists for publication, and one on physical characteristics of the Bartlesville and Burbank sands in northeastern Oklahoma and southeastern Kansas was published in the bulletin of the American Association of Petroleum Geologists. Work on source beds of petroleum is mentioned under Kansas.

Pennsylvania.—Reports are in preparation on the geology and mineral resources of the Honeybrook and Phoenixville quadrangles and, in cooperation with the Pennsylvania Geological Survey, on the York and Hanover quadrangles. Studies of the regional metamorphism in the lower Kittanning coal beds of western Pennsylvania were continued. Studies were also made of the stratigraphy and flora of the Pocono formation of West Virginia and Pennsylvania; the structure of the northern anthracite coal basin; and deep-well drilling in the Appalachian region. A paper on the structure of the Honeybrook uplift will be published by the Geological Society of America.

South Carolina.—A paper on massive low-fluorine topaz at the Brewer mine was submitted to the American Mineralogist, and one on an extraordinary topaz replacement body in the Brewer mine was submitted to the American Geophysical Union for publication. A paper on Pliocene and Pleistocene mollusks from the Intracoastal Waterway in South Carolina was prepared for publication, and one on the Pleistocene Horry clay and Pamlico formation near Myrtle Beach was submitted to the Washington Academy of Sciences. (See also Southern Appalachians.)

Southern Appalachians.—The report on gold deposits of the southern Appalachians, including areas in Virginia, North Carolina, South Carolina, Georgia, and Alabama, was completed for Survey publication.

Tennessee.—A report on limestone for concrete aggregate for a dam near Chattanooga was prepared for the Tennessee Valley Authority.

Texas.—Studies of the structure, stratigraphy, and fossils of the Navarro group; the faunas of the Rio Grande embayment of Texas and adjacent regions in Mexico; the geology of the Sierra Diablo region, west Texas; and the stratigraphy, geomorphology, and structure of the southern Guadelupe Mountains were continued. A geologic map of Texas was issued. The report on the brown iron ores of east Texas was transmitted for Survey publication, and reports on the geology and ore deposits of the region around Terlingua and of the Shafter silver district were completed. Reports on new fusulinids from the Cisco group (Pennsylvanian) of the Brazos River region, on Guadalupe faunas, a revision of

Professional Paper 58, and on water possibilities in the El Paso district as determined by geophysical methods were in preparation. A correlation chart of the Cretaceous formations of the Atlantic and Gulf Coastal Plain and west Texas was completed for the National Research Council. Papers were prepared for outside publication on structural features of the quicksilver lodes of the Terlingua region, for the committee on processes of ore deposition of the National Research Council; braunite from Mason County, for the American Mineralogist; a sphenolith in the Terlingua district, for the American Geophysical Union; a microscopic study of geothite and hematite in the brown iron ores of east Texas, for the American Mineralogist; and an abstract on Permian rocks of the southern Guadalupe Mountains, for the Digest of the Tulsa Geological Society. Work on source beds of petroleum is reported under Kansas.

Utah.—Geologic mapping of the greater part of the Strawberry Valley quadrangle for the purpose of classifying land as to oil shale, coal, oil, gas, and phosphate, and a study of the stratigraphy was begun. Investigations of the coal resources and oil and gas possibilities of the Hanksville-Caineville district and detailed studies of the structure, igneous rocks, mineral resources, and physiography of the Henry Mountains were continued. Geologic studies of the Marysvale district were continued, and a preliminary report on the alunite deposits of the region was submitted for Survey publication. A general geologic reconnaissance of the plateau country of southern Utah, including Zion Canyon, was in progress. A report on the geology of the area between the Green and Colorado Rivers in Grand and San Juan Counties was completed for Survey publication. The report on the geology and mineral resources of the Randolph quadrangle, Utah and Wyoming, is nearing completion. Reports on the geology of the Green River Desert-Cataract Canyon region; the structure of southeastern Utah; the Cretaceous-Eocene boundary in cental Utah; and iron ores of Bull Valley were in preparation.

Vermont.—Progress was made on the study of the metamorphic rocks in east-central Vermont, in cooperation with the Geological Society of America. Granites of Vermont were studied in connection with the general investigation of granites of the New England States.

Virginia.—The report on the titanium deposits in Nelson and Amherst Counties was nearly completed. Geologic work was done in the Galax and Independence quadrangles and adjoining portions of the Max Meadows and Speedwell quadrangles in connection with the cooperative report on the geology of the Gossan Lead, to be published by the Virginia Geological Survey. For work on gold deposits, see Southern Appalachians.

Washington.—Investigation of the areal geology, mineral resources, and mines of the Metaline quadrangle, Pend Oreille County, was continued. A paper on inesite from Quinault was submitted for outside publication.

West Virginia.—Studies of the flora of the Pocono formation of West Virginia and of the Pottsville floras along the New River were in progress. Deep-well drilling is mentioned under Pennsylvania.

Wyoming.—Areal and structural geologic mapping of portions of Park and Hot Springs Counties on the west side of the Big Horn Basin, with particular reference to coal and petroleum resources, and a study of the coal, oil, and gas resources of portions of the northeast side of the Big Horn Basin in Big Horn County, Wyo., and Carbon County, Mont., were in progress. Further investigations of the Tertiary rocks of the Green River and Bridger Basins and Fossil syncline and of the geology and mineral resources of the Afton quadrangle were begun. Reports on the geology and oil and coal resources of the Cody-Pitchfork area, the geology of the northeastern part of Big Horn Basin, and the geology of the Shoshone area, Park County, were in preparation. Work on the Randolph quadrangle is men-

tioned under Utah; on the Black Hills rim, on the Fort Union and associated formations, and on the physiography and glacial geology, under Montana.

General studies.—General investigations included studies of types and ranks of coal; source beds of petroleum; salt-dome cap rock; Foraminifera of the Cretaceous formations of the Gulf coastal region; Globigerinidae; the genus *Ceratopea;* fossils from the Eocene of the Gulf Province; borderland problems of geology, physics, and chemistry; clay minerals; deep-sea cores collected in 1936 across the North Atlantic Ocean; and a core sample from the deep-sea bottom southeast of New York City.

WORK IN CHEMISTRY AND PHYSICS

Work in chemistry and physics applied to geology is designated geochemistry and geophysics. Much of the chemical work in the Survey consists necessarily of analyses to determine the composition of the rocks, ores, and minerals involved in projects under study by geologists, and the remainder deals with the particular problems of geochemistry. These problems are to determine the abundance and distribution of different chemical elements in the crust of the earth, to explain the origin of natural products, including gases and ores, to classify rocks and minerals, and to describe the decomposition of rocks under weathering agencies. The physical work deals with the physical properties of minerals or of strata in place, such as their thermal or electrical conductivity, their temperature, their porosity, grain size, radioactivity, and compressibility.

The discovery of isotopes—that is, elements of similar chemical properties but of different physical properties—has considerably enlarged the field for chemical and physical study, particularly as related to geology. The results may affect the estimation of geologic time based on the transformation of one element into another, as such estimates require that the particular isotopes undergoing change be determined rather than the total quantities of the elements involved. This field is being developed as rapidly as possible. The use of X-rays, likewise, is now required to explain the real atomic structure of minerals, and hence their physical properties and chemical behavior.

Among materials analyzed in the laboratory during the year were clays from California and other States, alunite from Utah, oil from New Mexico, mercury ore from Kansas, silver ore from Idaho, phosphate rock from California, ocean-bottom samples from the North Atlantic, garnet from North Carolina, alkali brine from Wyoming, and silicate rocks and limestone from many different States. Complete analyses were also made of the minerals actinolite, allanite, biotite, feldspar, graftonite, halloysite, prehnite, rhodochrosite, samarskite, and sodalite. Several drill cores were examined and well cuttings logged. Spectrographic tests were made on different minerals and ores. Crystallographic measurements were made of a number of unusual minerals.

Altogether 4,576 examinations or tests of minerals and rock samples were made. These included tests and identifications of 1,570 specimens for persons not officially connected with the Survey; 1,587 chemical analyses made for geologists and 615 similar analyses made in connection with studies of methods of analysis and geochemical investigations; and 804 tests relating to core samples, well cuttings, and similar materials.

Special mineralogic work included the analysis of several varieties of zinc carbonate (smithsonite). "Fairy stones" from Virginia were investigated; only the altered crystals are usable commercially, as ornaments. The investigation of the stability relations of sodium and ammonium borates was continued with reference to their geologic occurrence. Many samples of garnet, lepidolite, and spinel were purified and prepared for analysis, 16 rocks and minerals from Guam were identified, and 20 crystals of quartz from Arkansas were measured and rare faces and unusual combinations determined.

Among the more important items of work in physics were the testing of activable bleaching clays in several States and geothermal surveys of wells in Oregon and southeastern Illinois. The investigation of bleaching clays has led to a rationalization of that industry. At least two deposits previously extensively surveyed by numerous tests are now in commercial production, and other deposits have been found which will eventually effect a more economical use of the raw materials available.

Dam sites in Oregon were surveyed by electrical conductivity methods.

The geothermal surveys in the lava beds of Oregon revealed the possibility of water-bearing beds of unusual thickness. From the data of existing geothermal surveys, it was estimated roughly that a temperature of 1,000° C. (1,832° F.) would be found at a depth of about 30 miles (48 kilometers) in the crust of the earth.

Many correlations of the physical properties of minerals with their chemical composition were completed during the year, which will make future determinations more rapid and more exact.

The work in chemistry and physics is mainly confined to laboratory investigations. However, field trips were made in New York, Pennsylvania, Virginia, North Carolina, South Carolina, Georgia, Tennessee, Ohio, Illinois, Utah, Wyoming, and Oregon, and papers were presented at regular meetings of the American Chemical Society, the Society of Economic Geologists, the American Geophysical Union, Geological and Mineralogical Societies in Ohio, the American Institute of Mining Engineers, the Virginia Academy of Sciences, and the American Association of Petroleum Geologists.

The following papers were completed during the year:

Fahey, J. J. Determination of mercurous chloride and mercury in mercury ores: Ind. Eng. Chemistry, analytical ed.

Fahey, J. J., with J. J. Glass. Graftonite from Greenwood, Maine: Am. Mineralogist.

Milton, Charles. Contributions to the petrology of the Franklin Furnace quadrangle, New Jersey: Jour. Geology.

Milton, Charles. Open hearth slags (preliminary paper): Am. Inst. Min. Met. Eng. 19th Open Hearth Proc.

Murata, K. J. Hydrogen ion concentration and the formation of copper complexes: Washington Acad. Sci. Jour.

Nutting, P. G. Study of bleach-clay solubility: Am. Assoc. Petroleum Geologists Bull.

Schaller, W. T. Lithium: Industrial Minerals, vol. 2, Am. Inst. Min. Met. Eng.

Schaller, W. T. Borates: Idem.

Schaller, W. T. Crystallography of valentinite and andorite from Oregon: Am. Mineralogist.

Stevens, R. E. Bibliography of reagents for potassium, rubidium, and cesium: Am. Chem. Soc. Jour.

Stevens, R. E., with F. L. Hess, Rare alkali biotite from Kings Mountain, N. C.: Am. Mineralogist.

Stevens, R. E., with J. T. Pardee and J. J. Glass, Low-fluorine topaz from Brewer mine, N. C.: Am. Mineralogist.

Van Orstrand, C. E. Temperatures in the lava beds of east-central and south-central Oregon: Am. Jour. Sci.; abstract: Washington Acad. Sci. Jour.

Van Orstrand, C. E. On the estimation of temperatures at moderate depths in the crust of the earth: Am. Geophys. Union Trans.; abstract, with additional notes: Science Service.

Wells, R. C., with R. E. Stevens. The analysis of pollucite: Ind. and Eng. Chemistry (read at spring meeting of Am. Chem. Soc., Chapel Hill, N. C.).

ALASKAN BRANCH

The work of the Geological Survey in Alaska is directed primarily toward aiding in the development of the mineral resources of the Territory and involves field examinations of the various factors that pertain to these resources, and laboratory and office studies by which the field observations are analyzed and the results made available to the public through reports, maps, and other media. The product of this work is used extensively by Government organizations engaged in other special fields of investigation within Alaska, such as the Forest Service, the Alaska Road Commission, and the Biological Survey. The Survey's maps of Alaska are indispensable in any enterprise concerned with the development of the Territory.

Manuscripts and publications.—During the year seven reports and five maps, including two new editions and two reprints, and four memoranda for the press have been published. Nine reports including maps, one separate map, and reprints of four maps are in course of publication. In addition three manuscript

reports, including maps, are in various stages of preparation for publication. At the end of the year one manuscript report and three maps were partly completed.

Work of the year.—In addition to the routine duties of serving as a central station, seven projects involving new field investigations were carried on during the season of 1936. These field projects included four that were directed primarily to the geologic phases of the investigation of the Territory's mineral resources, two that were primarily topographic, and one that was a general study of recent mining developments in the principal producing camps of the Territory. The areas in which the principal new geologic projects were undertaken were the Glacier Bay district, in the northwestern part of southeastern Alaska; the Alaska Range region, including especially portions of the valleys of the Slana, Tok, and Robertson Rivers; the region adjacent to the Alaska Railroad, including some of the mining camps as remote from that general tract as the Nuka Bay district, in the extreme southern part of Kenai Peninsula, or the quicksilver showings in the Kuskokwim River Valley near Sleitmut; and the mining developments in the Eagle, Fortymile, and Circle districts, in the Yukon region not far from the international boundary. The general study included visits to many of the more important mining centers from southeastern Alaska to western Seward Peninsula, where such diverse deposits as gold placers, tungsten lodes, and tin placers were examined. The topographic projects included semidetailed mapping of extensive areas on Admiralty Island, in southeastern Alaska, and reconnaissance and exploratory mapping in the Alaska Range region at the head of the Copper River, including portions of the valleys of the Robertson and Gerstle Rivers and areas adjacent to the Richardson Highway in the valley of the Delta River and Donnelly Dome.

Two projects not directly involving new field work were the maintenance of a testing laboratory at College, Alaska, where mineral specimens sent in by prospectors can be identified or can be assayed and the results made available for the information of the general public, and the annual statistical canvass of the production of mineral commodities.

In the field season of 1936 the late passage of the Interior Department Appropriation Act for 1937 prevented full utilization of the open season, so that several of the parties were forced to delay beginning effective work until nearly the first of July. Similar conditions existed in 1937. As a consequence, for the field season of 1937 only three parties had been started prior to June 30, though others were organized as soon as practicable after funds became available. Two of the projects are concerned primarily with topographic mapping and one with geologic investigations. One of the topographic projects is in the Copper River region north of the highway between Slana and Nabesna and is planned to cover the tract east of Batzulnetas and north of the Nabesna River, in continuation of the mapping that has been in progress for the last 3 years in this general region. The other topographic project includes detailed mapping of the more productive portions of the known platinum-bearing areas in the vicinity of Goodnews Bay, near the mouth of the Kuskokwim River, followed by reconnaissance mapping of more remote parts of the district continguous to those areas. The geologic project involves study of the known platinum-bearing areas adjacent to Goodnews Bay, with the view of determining the geologic facts as to the origin and character of the mineralization by which the valuable metals were introduced into the country rock, the processes that have subsequently acted on these deposits so as to produce workable placers, the character of the platinum minerals, and the distribution and extent of the deposits that may warrant commercial exploitation.

Among the additional field projects authorized to be undertaken are a geologic examination of the northern and western part of Admiralty Island, in southeastern Alaska, an area that is now yielding gold from its lodes and that may contain

significant deposits of nickel-bearing ores, and a general study of recent mineral developments in the larger, more accessible, mining camps throughout the Territory.

TOPOGRAPHIC BRANCH

GENERAL OFFICE WORK

Necessary office work incidental to the field work of the topographic branch consisted in the inking, inspection, and editing of the completed topograhic field sheets prior to their submission for reproduction and the computation and adjustment of the results of control field work.

In addition to the routine adjustment of primary control, there has been in progress a general adjustment of both horizontal and vertical control to agree with the standard datums of the United States.

During the year 157 new topographic maps were edited and transmitted for engraving. Editing was also completed on 753 miscellaneous maps, making a total of 910, and 1,848 proofs of maps in course of publication were read.

On June 30, 322 new maps were in preparation for reproduction and 239 were in process of engraving and printing.

In addition to the work incidental to the field work of the branch the compilation of planimetric maps from aerial photographs amounted to 2,765 square miles.

For the conservation branch of the Survey the work of inking, assembling, and preparing for publication was done on 78 maps of river surveys. Twelve such maps were completed and transmitted for lithography during the year.

For the Tennessee Valley Authority the work of inspection and preparing for lithography was done on 450 maps and 561 proofs were read.

For the Bureau of Public Roads the work of preparing the Transportation Map of the United States was continued. Compilation and inking were in progress on 48 sheets, 10 of which were completed. Proofreading and checking was done on 31 sheets. Maps of 5 States, comprising 18 sheets, were published.

FIELD SURVEYS

Abbreviations for projects used below: Federal Emergency Administration of Public Works, "P. W."; Tennessee Valley Authority, "T. V. A." Cooperation with States was continued in about the same amount as in recent years. Topographic surveys were accomplished in 36 States and in Puerto Rico. The mapping of Los Angeles County, Calif., on a large scale was completed.

The status of topographic surveys shows that the United States is now 47.4 percent mapped, the year's increment amounting to 0.3 percent.

Alabama.—In preparation for geologic mapping, Greasy Cove project completed.

Arizona.—At the request of the Office of Indian Affairs, Silver Bell No. 3 15′ quadrangle completed. Payson No. 4 15′ quadrangle continued at the request of the Forest Service. In preparation for geologic mapping, Aravaipa No. 2 15′ quadrangle begun.

Arkansas.—In cooperation with the Geological Survey of Arkansas, Blakemore 15′ quadrangle begun. Poteau Mountain No. 1 15′ quadrangle begun at the request of the Forest Service. Benton No. 4 15′ quadrangle (P. W.) begun.

California.—In cooperation with the State engineer of California, Tobias Peak 30′ quadrangle and Avenal 15′ quadrangle completed. In cooperation with the county surveyor of Los Angeles County, Crystal Lake, Mount Baden-Powell, Swarthout, and Mount Waterman 6′ quadrangles completed. Kramer No. 1, Kramer No. 2, and Kramer No. 4 15′ quadrangles (P. W.) completed. In preparation for geologic mapping, Downieville No. 1 15′ quadrangle begun.

Colorado.—East Denver 2c and East Denver 3b 7½′ quadrangles completed. Mapping without contours from aerial photographs completed for West Denver 4a 7½′ quadrangle and continued for West Denver 1d 7½′ quadrangle in cooperation with the city of Denver. In cooperation with the Colorado Metal Mining Fund, Ward-Sunset mining area begun. In preparation for geologic mapping, Platoro mining area and Summitville mining area completed and Gold Hill area begun. Chattanooga mining area (east), Chattanooga mining area (west), Chattanooga mining area (Ophir and vicinity), Chattanooga mining area (Alta Basin and vicinity) and Chattanooga mining area (Hanson Peak and vicinity) completed (P. W.). At the request of the Forest Service, Bardine No. 2 15′ quadrangle begun. Great Sand Dunes National Monument begun for the National Park Service.

Florida.—St. Augustine 15′ quadrangle (P. W.) completed.

Georgia.—For the Forest Service, Spring Place 15′ quadrangle begun. East Ridge 7½′ quadrangle continued, and Fort Oglethorpe and Coosa Bald 7½′ quadrangles (T. V. A.) begun.

Idaho.—For the Forest Service, Boehls Butte 15′ quadrangle and Newport 30′ quadrangle completed. At the request of the Office of Indian Affairs, Pocatello No. 2 15′ quadrangle continued. Logan No. 3 and Yellow Pine No. 2 15′ quadrangles (P. W.) continued. In preparation for geologic mapping, Wallace special area begun.

Illinois.—Ashmore 15′ quadrangle (P. W.) completed. Lena and New Douglas 15′ quadrangles continued, and Oilfield, Alto Pass, and Monticello 15′ quadrangles begun in cooperation with the Department of Registration and Education of Illinois, Geological Survey.

Louisiana.—The Louisiana Board of State Engineers cooperating, mapping without contours from aerial photographs completed for 7½′ quadrangles within De Ridder, Juanita, Lees Mill, Starks, and Mystic 15′ quadrangles.

Maine.—For the Forest Service, Gorham 15′ quadrangle completed.

Massachusetts.—In cooperation with the Department of Public Works, Division of Waterways, Blue Hills, Norwood, Mansfield, Brockton, Onset, Woods Hole, 7½′ Falmouth, Marion, 7½′ New Bedford, Apponagansett, Sconticut Point, Northfield, Millers Falls, and 7½′ Middleboro 7½′ quadrangles completed and Warwick No. 1, Warwick No. 4, Middleboro No. 1, and Middleboro No. 3 7½′ quadrangles begun.

Michigan.—In cooperation with the State Highway Department of Michigan, Smiths Creek and Goodells 7½′ quadrangles begun and mapping without contours from aerial photographs completed for Marine City, Algonac No. 2, Algonac No. 3, Algonac No. 4, Lake Orion, Romeo, Ray Center, Richmond, Dundee

No. 1, Dundee No. 4, Grosse Pointe No. 2, Grosse Pointe No. 3, Smiths Creek, Goodells, Adair, Rattle Run, Davisburg, Milford No. 1, Wixom, Monroe No. 1, Monroe No. 2, Monroe No. 3, Monroe No. 4, New Haven, Waldenburg, Mount Clemens No. 3, Selfridge Field, Pontiac No. 1, Pontiac No. 2, Pontiac No. 3, Pontiac No. 4, Port Huron, St. Clair, Romulus No. 1, Romulus No. 2, Romulus No. 3, Romulus No. 4, Washington, 7½′ Rochester, Rochester No. 3, Rochester No. 4, Ortonville, Oxford, South Lyon No. 1, South Lyon No. 2, Redford, Wayne No. 2, Wayne No. 3, Wayne No. 4, Wyandotte No. 2, Wyandotte No. 3, Ypsilanti No. 1, Ypsilanti No. 4, and Estral Beach 7½′ quadrangles and begun for Detroit No. 1, Detroit No. 2, Detroit No. 3, and Detroit No. 4 7½′ quadrangles.

Mississippi.—In preparation for geologic mapping, Terry 15′ quadrangle completed.

Missouri.—In cooperation with the Geological Survey and Water Resources of Missouri, Bradleyville, Elmer, Edgar Springs, Fielden, Franks, Hannibal, Springfield 3 S. ½ 15′ quadrangles and Tiffin, Springfield 3b, and Warsaw 2c 7½′ quadrangles completed; Big Piney, Bolivar No. 2, Fordland, Gatewood, Long Lane, Middlebrook, Protem, Richland, Springfield No. 4, Topaz, Vienna, Warsaw No. 3, and Warsaw No. 4 15′ quadrangles continued; Bolivar No. 1, Cabool, Cedar Gap, Doniphan, Exeter, Knoblick, Louisiana No. 4, Macomb, Mountain, Noel, and Raymondville 15′ quadrangles and De Soto SW. ¼, Manchester NW. ¼ and Springfield 4b 7½′ quadrangles begun. Warsaw 3b 7½′ quadrangle (P. W.) completed.

Montana.—Silvertip 30′ quadrangle (P. W.) completed.

Nebraska.—For the National Park Service, Scotts Bluff National Monument completed.

Nevada.—For the Forest Service, Mountain City 15′ quadrangle completed. In preparation for geologic mapping, Mineral Hill No. 4 15′ quadrangle begun.

New Hampshire.—For the Forest Service, Gorham 15′ quadrangle completed.

New Mexico.—In preparation for geologic mapping, Taos 30′ quadrangle completed. At the request of the National Park Service, Bandelier National Monument completed. Jemez No. 1 15′ quadrangle begun for the Forest Service.

New York.—Poughkeepsie and West Point 15′ quadrangles and Tarrytown No. 1 7½′ quadrangle completed in cooperation with the Department of Public Works of New York. Binghamton No. 4 and Saratoga No. 2 7½′ quadrangles (P. W.) completed.

North Carolina.—Blowing Rock 15′ quadrangle (P. W.) completed. Hayesville 7½′ quadrangle (T. V. A.) completed and Peachtree and Andrews 7½′ quadrangles (T. V. A.) begun.

North Dakota.—In preparation for geologic mapping, Lake Upsilon 15′ quadrangle completed. McVille 15′ quadrangle (P. W.) completed.

Oklahoma.—At the request of the Forest Service, Cache 15′ quadrangle and Cache No. 2 7½′ quadrangle completed.

Oregon.—In preparation for geologic mapping, Troutdale 15′ quadrangle completed. For the Forest Service, Mapleton 15′ quadrangle continued.

Pennsylvania.—In cooperation with the Department of Internal Affairs of Pennsylvania, Topographic and Geologic Survey, Mattawana, Marienville, and Delaware Water Gap 15′ quadrangles completed and Slatington and Coburn 15′ quadrangles begun.

Puerto Rico.—In cooperation with the Commissioner of the Department of the Interior of Puerto Rico, San German, Puerto Real, and Sabana Grande 7½′ quadrangles completed, Moca and Aguadilla 7½′ quadrangles begun.

South Carolina.—In preparation for geologic mapping, Nixonville and Myrtle Beach 15′ quadrangles completed.

Tennessee.—Oswald Dome 7½′ quadrangle (T. V. A.) completed and East Ridge, Charleston, Wauhatchie, Calhoun, East Chattanooga, Fort Oglethorpe, Hooker, 7½′ Chattanooga, Goodfield, Riceville, Parksville, Caney Creek, and Benton 7½′ quadrangles (T. V. A.) begun. For the Forest Service, Spring Place 15′ quadrangle begun. Mapping without contours from aerial photographs completed for Lyles, Texas Hollow, Nunnelly, and Littlelot 7½′ quadrangles (T. V. A.) completed.

Texas.—In preparation for geologic mapping, Tyler No. 4 15′ quadrangle completed. Tyler No. 1 15′ quadrangle (P. W.) begun.

Utah.—In preparation for geologic mapping, the revision and extension of Cottonwood quadrangle completed. At the request of the National Park Service, Cedar Breaks National Monument completed. For the Forest Service, Delano Peak No. 2 15′ quadrangle begun.

Vermont.—In cooperation with the State geologist of Vermont. Barnet 15′ quadrangle continued.

Virginia.—Gerrardstown and Capon Bridge 15′ quadrangles completed and Middletown and Stephens City 15′ quadrangles begun in cooperation with the Conservation and Development Commission of Virginia, Geological Survey.

Washington.—In cooperation with the Director of the Department of Conservation and Development, Union Gap and Hog Ranch Buttes 15′ quadrangles completed. For the Forest Service, Newport 30′ quadrangle completed and Pomeroy 30′ quadrangle begun. Marcus 30′ quadrangle (P. W.) completed.

West Virginia.—Culture revision begun for Wellsville 15′ quadrangle (P. W.).

Wisconsin.—Arkansaw 15′ quadrangle (P. W.) completed.

Wyoming.—Cokeville 30′ quadrangle (P. W.) completed and La Barge 30′ quadrangle (P. W.) continued. For the Forest Service, Leckie No. 1 15′ quadrangle begun.

WATER-RESOURCES BRANCH

The importance of water and of systematic records related to the quantity, chemical quality, and availability of both surface and ground waters becomes greater each year. The growth of the country in population and industry, with consequent increases in demands for water, and especially the continued series of dry years that included the disastrous and widespread droughts of 1934 and 1936, and the recent disastrous floods in different parts of the country, have impressed on the people the controlling importance of water in our surface streams and in underground basins in relation to many of man's activities. The information collected by the Geological Survey is used extensively by many Federal, State, and private agencies. The Public Works Administration, the National Resources Committee, and related activities have found the Survey records and information with respect to water to be invaluable in studies of projects of all classes and in all sections of the country.

Reliable information with respect to supplies of water, both on the surface and in the ground, and to their fluctuations with variations in rainfall is essential to orderly, sound, and economic development along many lines, as in domestic water supplies, irrigation, flood protection, control of pollution, recreational uses, and water-power development.

The investigations by the branch are conducted largely in cooperation with Federal bureaus; State, county, municipal, and other governmental agencies; and permittees and licensees of the Federal Power Commission. A major part of this cooperation is set forth below.

Federal bureaus.—Investigations of ground and surface water and of the quality of water were conducted for the following Federal bureaus:

Department of Agriculture:
- Bureau of Biological Survey.
- Bureau of Plant Industry.
- Soil Conservation Service.
- Weather Bureau.

Department of the Interior:
- Office of Indian Affairs.
- Bureau of Mines.
- Bureau of Reclamation.
- Division of Grazing.
- National Park Service.
- Division of Territories and Island Possessions.

Department of Justice; Bureau of Prisons.
Department of State.
Federal Power Commission.
National Resources Committee.
Resettlement Administration.
Tennessee Valley Authority.
War Department:
- Office of Chief of Engineers.
- Mississippi River Commission.
- Schofield Barracks.

States.—Amounts aggregating approximately $630,000 were made available by States and municipalities for cooperative investigations of surface water, ground water, and quality of water. In addition to the data obtained as a result of this cooperation, other data having an estimated value of over $140,000 were furnished by individuals and other organizations.

Permittees and licensees of the Federal Power Commission.—At the request of the Federal Power Commission, 30 engineers of the branch have been designated as representatives of the Commission to perform such field work as may be assigned to them by the Commission. The operation of about 290 gaging stations was conducted by the branch or was performed by permittees and licensees under the supervision of the branch in connection with 115 projects of the Federal Power Commission. Engineers of the branch have had general supervision of operation under permits and licenses of the Federal Power Commission in connection with 150 projects.

Division of Surface Water.—The division of surface water conducts investigations of surface water, which consist of the measurement of

the flow of rivers in the 48 States, the District of Columbia, and Hawaii at selected gaging stations where the volume of water is measured and records of stage and other data are collected. In this work 45 States, the Territory of Hawaii, several Federal bureaus and several individuals cooperated in the maintenance of the 3,379 regular gaging stations that were in operation at the end of the year. Records for about 108 additional gaging stations were received from Federal bureaus and from individuals. There were 47,398 regular and miscellaneous discharge measurements made during the year.

Division of Ground Water.—The division of ground water investigates the waters that lie below the surface of the zone of saturation (from which wells and springs are supplied); the source, occurrence, quantity, and head of these waters; their conservation; their availability and adequacy for domestic, industrial, irrigation, and public supplies and as watering places for livestock and desert travelers; and the methods of constructing wells and recovering water from them and of improving springs. Each year surveys are made of selected areas where problems of water supply are urgent, and the results are prepared and released to the public. Each year a water-supply paper is published that gives the current records of water levels or artesian pressure in observation wells in different sections of the country. During the fiscal year 75 technical reports or papers relating to ground water or reservoir sites were released to the public. Work was done in 30 States and in Guam and in Hawaii. Nearly all the work was done in cooperation with Federal, State, Territorial, or local governmental agencies.

Division of Quality of Water.—The division of quality of water analyzes water from surface and underground sources with reference to the suitability of the waters for industrial and agricultural uses and for domestic use (not related to questions of health), so far as use is affected by the dissolved mineral matter. The partial or complete analysis of 1,754 samples of water was completed during the year. Close cooperation was continued with the division of ground water in the study of problems relating to quality of ground water and the preparation of the parts of ground-water reports that involve consideration of the chemical character of the waters.

Division of Power Resources.—The work of the division of power resources comprised the compilation and publication of the annual report on the capacity of water wheels in water-power plants in the United States of 100 horsepower or more on January 1, 1937. The report was released in April. The report on the capacity of water wheels January 1, 1938, will be prepared and published by the Federal Power Commission. The compilation and publication of the monthly and annual reports of the production of electricity for public use and the consumption of fuel in generating the electricity reported, which

had been done by the power-resources division from 1919 to 1936, were transferred to the Federal Power Commission on July 1, 1936. A study is being made of the records of power production from 1920 to 1935. These studies are based on the records compiled by the Geological Survey and published by the Federal Power Commission as Power Series No. 6 of the National Power Survey.

Division of Water Utilization.—The division of water utilization investigates problems affecting the utilization and control of the waters of streams, makes studies for the interpretation of records of stream flow, and performs administrative work relating to supervision and investigation of these problems and to activities conducted by the field organization of this branch pertaining to power projects of the Federal Power Commission and of the Interior Department. The division supervised and coordinated the collection by the district offices of the division of surface water of special stage and discharge information relative to the outstanding floods of March 1936 in the Northeastern States and to notable floods in Texas. The division assembled these flood data, together with data for other recent notable floods, and prepared reports thereon for publication as water-supply papers. The reports that were completed during the year are listed below:

Water-Supply Paper 796–B. Flood on the Republican and Kansas Rivers in May and June 1935, by Robert Follansbee and J. B. Spiegel.

Water-Supply Paper 796–C. The New Year's flood of 1934 in La Cañada Valley, California, by H. C. Troxell and J. Q. Peterson.

Water-Supply Paper 798. Floods of March 1936, Part 1, New England rivers.

Water-Supply Paper 799. Floods of March 1936, Part 2, Hudson River to Susquehanna River region.

Water-Supply Paper 800. Floods of March 1936, Part 3, Potomac, James, and upper Ohio Rivers.

Water-Supply Paper 816. Major floods in Texas in 1936, by Tate Dalrymple and others.

The Division has been active during the year in investigations of water problems along the international boundary between the United States and Canada for the State Department and also in the collection of information on recent outstanding floods in the Ohio and Mississippi Valleys.

CONSERVATION BRANCH

The work of the Conservation Branch involves surveys and investigations precedent to an inventory of the water and mineral resources of the public domain, supervision of private operations for development of power and production of minerals from public and Indian lands, and supplying information and advice to numerous land-administrative agencies of the Government.

The first of these activities remained nearly at a standstill for lack of funds for field explorations, but a small increase of appropriation

permitted better and quicker service to be given to land-administrative agencies, there being a decrease of 33 percent in cases pending at the end of the year, though the annual volume of work had increased 23 percent.

An increase in appropriations for mineral-lease supervision permitted reasonably prompt action to be taken on proposed plans for cooperative or unit development of oil fields and somewhat better supervision of production operations. At the end of the year 1,343 plans of development and operation had been received and only 42 of these were awaiting original technical consideration in the branch. The volume of work under field supervision, which has regularly shown an annual increment, again advanced materially. On public land alone 85 operating properties were added to the total number under supervision, production increased between 5 and 10 percent, and revenue increased to about $6,300,000. The funds available have never been adequate for supervision of these vast operations, and during this year, as in other years, revenue far in excess of the appropriation has been lost because of inability to make timely inspection of field properties and make sure that operations are so conducted as to accomplish the greatest ultimate production and effective current beneficial use of the mineral resources involved.

In addition to their regular activities members of the Branch were engaged on related projects under the auspices of the Public Works Administration. Useful conservation work was thus accomplished, employees who otherwise must have been furloughed for lack of funds were continued in service, and emergency employment was given to many engineers, clerks, and laborers.

MINERAL CLASSIFICATION DIVISION

The work of the Mineral Classification Division, restricted largely to office procedure, although less than in previous years, was delayed in part by lack of geologic information due to scanty field investigations. The activities of the Division were directed in considerable part to determining the areas subject to inclusion in plans for unit or cooperative development submitted by holders of Government oil and gas prospecting permits and leases.

In the aid of mineral classification pertinent information relating to the occurrence of carbon dioxide gas in California, New Mexico, and Utah; of coal in Montana, New Mexico, Utah, and Wyoming; of oil and gas in Alabama, Arkansas, Colorado, Florida, Kansas, Louisiana, Mississippi, Montana, New Mexico, Oklahoma, South Dakota, Utah, and Wyoming; and of phosphate in Wyoming was obtained either by the personnel of the Mineral Classification Division or through the geologic branch.

In the routine work of the Division, 8,937 cases requiring technical consideration were disposed of during the fiscal year.

In addition to the preceding work, revisions of the definitions of the known geologic structure of two producing oil and gas fields were prepared and promulgated as follows:

Definitions of Known Geologic Structure, Fiscal Year 1937

State	Field	Date promulgated	Acres
New Mexico	Eaves	Apr. 10, 1937	8,074
Wyoming	Rex Lake	Apr. 5, 1937	1,280

The aggregate area of the outstanding definitions of the known geologic structure of oil and gas fields on June 30, 1937, amounted to 1,155,253 acres in California, Colorado, Montana, New Mexico, North Dakota, Oklahoma, Utah, and Wyoming.

WATER AND POWER DIVISION

The work of obtaining basic information as to the water-power resources and storage possibilities of public lands and of making it available for use in the administration of public-land laws and by Federal and other agencies engaged in planning, constructing, and operating water-power projects was continued in the field, being made possible by the extended availability of Public Works funds. River-utilization surveys covering 1,261 miles of important streams and tributaries were made in 11 public-land States. Surveys of reservoir and dam sites embracing an area of 155 square miles were also completed. Supplemental geologic and geophysical studies of foundation materials and conditions were made at 61 dam sites.

Office activities included action resulting in the addition of 100,699 acres to outstanding water-power reserves in 12 public-land States and the elimination of 17,507 acres from such reserves in 7 States, with a net increase of the total reserved area in 22 States to 6,583,439 acres. The elimination of 260 acres from reservoir-site reserves left a net total of 133,444 acres withdrawn. One restoration of lands withdrawn under the act of October 2, 1888, was also made. Field supervision of power projects for the Federal Power Commission involved investigations and reports on 9 projects, supervision of construction and operation on 148 projects, and studies of cost accounting on 9 projects. Field supervision of power projects holding permits and grants from the Interior Department involved 172 projects, making a total of 320 projects for the Interior Department and the Federal Power Commission.

Statistics compiled by the division show that the holders and users of rights of way granted by the Secretary of the Interior for power

purposes had, for the calendar year 1936, an aggregate installed capacity of 4,852,841 horsepower, including 3,300,704 horsepower at hydraulic plants and 1,552,137 horsepower at fuel plants, and an aggregate energy generation of 11,468,380,623 kilowatt-hours, which is an increase of 44 percent over the production in the next preceding year. The energy generated by water power increased 3,118,916,918 kilowatt-hours, or about 45 percent, and that generated by fuel increased 388,074,113 kilowatt-hours, or about 38 percent. Revenues accrued to the Government from these grants aggregated $236,211 from 1912 to 1936, and $12,814 additional has been assessed for the calendar year 1937. Payments for unauthorized occupancy of public lands by power projects prior to the issuance of license therefor by the Federal Power Commission amount to $101,633 additional.

MINING AND OIL- AND GAS-LEASING DIVISIONS

The work of the mining and oil- and gas-leasing divisions consists of inspectional and regulatory supervision of mineral prospecting and development on public lands, Indian lands, and naval petroleum reserves.

The mining division is charged with supervision of all operations for the discovery and development on public lands of deposits of coal, phosphate, sodium potassium, and oil shale; in New Mexico and Louisiana of sulphur; on certain land grants of gold, silver, and mercury; and on restricted allotted and tribal Indian lands of all minerals except oil and gas. This supervisory and regulatory work during the fiscal year was accomplished through six field offices in Colorado, Montana, New Mexico, Oklahoma, and Utah, and through a cooperative agreement approved May 4, 1935, with the Department of Mines, Territory of Alaska.

The work of the Oil and Gas Leasing Division includes inspectional and regulatory supervision of all operations for the discovery and development of petroleum and natural gas on public lands of the United States, on naval petroleum reserves, and on all Indian lands subject to departmental jurisdiction, both tribal and allotted, except the Osage Reservation, Okla. The work was accomplished in the fiscal year 1937 through the agency of 13 field offices and sub-offices at Taft, Calif.; Roswell and Farmington, N. Mex.; Tulsa and Oklahoma City, Okla.; Wichita Falls, Tex.; Denver, Colo.; Casper, Midwest, and Thermopolis, Wyo.; Billings and Shelby, Mont.; and Salt Lake City, Utah.

Public lands.—The number of public-land properties under supervision of the Oil and Gas Leasing Division increased 8.6 percent, to a total of 9,052, involving 12,485,167.59 acres in 17 States and Alaska.

With the aid of funds allotted by the Public Works Administration the Division was enabled to continue important conservational and

remedial measures through the proper plugging and conditioning of many old abandoned wells. The results of this work are outlined more fully under the heading "Public Works projects."

A substantial part of the time of the personnel of the Division was devoted to assisting oil and gas permittees in fulfilling departmental requirements for the submission of unit or cooperative plans of operation and development involving permit acreage, and to reviewing and revising the engineering and royalty features of such plans after their submission. At the end of the fiscal year 1937 a total of 1,343 plans of unit or cooperative development for oil or gas pools, fields, or areas involving public land had been filed with the Geological Survey, of which 47 had been given final approval by the Secretary of the Interior, 1,145 had been rejected, withdrawn, or suspended, 201 had been reviewed and returned to their proponents for revision and consummation, and 161 were pending final action, including 42 which were awaiting technical consideration in the Conservation Branch.

The Oil and Gas Leasing Division formulated the revised oil and gas operating regulations, effective November 1, 1936, which established a uniform basis of regulation for the development and production of the oil and gas resources on reserved and unreserved public lands of the United States, including naval petroleum reserves, and on all restricted Indian lands, tribal and allotted, except those of the Osage Indian Reservation.

Drilling activity on public lands during the fiscal year 1937 included the commencement of 333 new wells and the completion of 344 wells, of which 257 were rated as productive of oil and gas and 87 as barren. The total number of wells under supervision on June 30, 1937, was 7,934 in 17 States and Alaska, including 4,112 capable of oil or gas production. The production of petroleum, natural gas, and natural gasoline from public lands in 1937 was substantially greater than in other recent years, and the revenues accrued therefrom were materially increased.

Coal properties under supervision in 14 States and Alaska decreased 37, to 657; potash properties in 8 States decreased 56, to 39 in 3 States; sodium properties in 9 States increased 4, to 44; sulphur properties in 1 State decreased 8, to 18; phosphate properties increased 2, to 11; and the oil-shale lease remained at 1 in 1 State. The total number of properties under supervision was 770, a decrease of 95, substantially all of which were inactive. The reduction in coal properties resulted indirectly from the Secretary's instructions of January 24, 1934, and that in potash properties from the Secretary's orders 799, 817, 854, and 914, all of which tended to slow down the issuance of new permits and leases. In prospecting for the above-named minerals 16 bore holes were drilled during the year.

Accidents to employees working in mines under departmental leases are generally fewer than in competitive mines not on Government lands, and it is gratifying to note that of the 33 awards made to coal mines or to operators by the Joseph A. Holmes Safety Association for the calendar year 1936 two were made to departmental lessees. The use of safety appliances and safety clothing is increasing generally throughout mines on Government lands.

Indian lands.—The Secretary's order 1112, approved September 4, 1936, which relates to oil and gas operations and which constitutes a new cooperative agreement between the Geological Survey and the Office of Indian Affairs, extended the cooperative technical supervision and the royalty-accounting duties of the Geological Survey to embrace all tribal and restricted allotted lands within the limits of all Indian reservations except the Osage Nation. Oil and gas supervision involved 5,342 leaseholds, 4,463 wells, and aggregate bonus, royalty, and rental accruals estimated at $2,665,000 for Indian beneficiaries in 10 States and 30 different tribes. The cooperative duties involved royalty accounting, appraisals of bonuses, royalty offers, and pollution damages, assistance to lessees of Indian land on operating problems and in the preparation of unit plans of development, and assistance to agency officials and tribal councils on technical phases of leasehold development and administration.

Mining supervision involved 40 lead and zinc leaseholds in the Quapaw Reservation, Okla., with aggregate royalty accruals of $568,299.94, an increase of 57.54 percent from the preceding year; 57 coal leaseholds involving Choctaw, Chickasaw, and Five Tribes lands in Oklahoma, with an aggregate production decreased from 568,725.92 tons in 1936 to 527,579.75 tons in 1937; and revenue accruals from royalties, bonuses, and sale of coal lands amounting to $89,308.31; one asphalt lease involving segregated Choctaw and Chickasaw lands in Oklahoma; and 51 properties in other States, 18 of which are agency mines. It included also special investigations of 18 properties for minerals other than fuels.

Naval petroleum reserves.—On behalf of the Navy Department supervision was continued during the fiscal year over operations for the production of oil and gas within Naval Petroleum Reserves Nos. 1 and 2, in California, and for the conservation of shut-in production within Naval Petroleum Reserve No. 3, in Wyoming. Production from 538 wells on the reserves aggregated 3,567,213.54 barrels of petroleum, 2,816,073,000 cubic feet of natural gas, and 11,076,165,000 gallons of natural gasoline and had an aggregate royalty value of $787,906.64.

PUBLIC WORKS PROJECTS

Under the supervision of the conservation-branch personnel, aggregate expenditures of $165,286.47 were made during the fiscal year 1937 from funds allotted by the Administrator of Public Works for field investigation in conservation work pertinent to branch functions. On 11 projects $109,423.36 was expended for river-utilization surveys of power and storage resources of important streams in 11 States. On 12 projects $55,863.11 was expended in 9 States in the plugging and abandonment or conditioning for use as a source of water of numerous wells drilled for oil and gas on public lands and theretofore improperly abandoned or merely deserted; in extinguishing or controlling coal-outcrop fires and in filling, bulkheading, or otherwise safeguarding abandoned mines or prospective openings on public and Indian lands; and in surface studies of coal occurrence and subsurface studies of oil and gas occurrence in Indian lands in Oklahoma.

SUMMARY OF FIELD ACTIVITIES, BY STATES

Alabama.—Investigated oil and gas prospecting operations throughout the State in aid of mineral classification. Examined 1 tract in Franklin County for purposes of mineral classification. Supervised 1 coal lease.

Alaska.—Supervised 1 power project, 144 prospecting permits for oil and gas, and 2 leases, 2 licenses, and 9 prospecting permits for coal.

Arizona.—Completed 162 miles of river-utilization surveys on Black Creek, the Little Colorado River, and the Rio Puerco, and surveyed in detail 44 square miles in the Cottonwood Wash, Leroux Wash, Lyman, and Zuñi reservoir and dam sites. Made geologic studies of foundation materials and conditions at 6 dam sites. Supervised 25 power projects, 72 prospecting permits for oil and gas, and 3 for coal, 6 for sodium, and 5 for potash on public land, and 4 coal mines on Indian land.

Arkansas.—Investigated oil and gas prospecting operations in northeastern and northwestern Arkansas in aid of mineral classification. Supervised 1 power project and 9 prospecting permits for oil and gas.

California.—Investigated occurrence of carbon dioxide gas in Brawley area, Imperial County. Completed 140 miles of river-utilization surveys on the Carson (including East and West Forks). Trinity, and Yuba (including Middle North and South Forks) Rivers and tributaries, and surveyed in detail 24 square miles in the Beno, Steiner Flat, Trinity Center, Fairview, and Bullards Bar reservoir and dam sites and the Silver Queen, Washington, Governor Stevens, and Spaulding dam sites. Supervised 89 power projects, 223 leases and 1232 prospecting permits for oil and gas on public land and 22 leases on Naval Petroleum reserves, 4 prospecting permits for coal and 23 for sodium, and 1 sodium lease and 2 potash leases.

Colorado.—Completed structural and stratigraphic investigations in the South Park area, Park County. In cooperation with the geologic branch made a reconnaissance investigation of land in southeastern Archuleta County. Completed 111 miles of river-utilization surveys on Buzzard Creek, the Gunnison River, the Little Snake River, Troublesome Creek, and the Yampa River and tributaries; and surveyed in detail 5 square miles in the Buzzard Creek, Columbus

Mountain, and East Fork reservoir sites and the Black Mountain, Middle Fork, North Fork, Stonewall, Three Forks, Walker, and Yampa Nos. 1, 2, 3, and 4 dam sites. Made geologic studies of foundation materials and conditions at 11 dam sites. Supervised 12 power projects, 32 leases, and 691 prospecting permits for oil and gas on public land and 5 oil and gas leases on Indian land; 90 leases, 13 licenses, 38 permits, and 9 awarded lease applications for coal, and 1 sodium lease on public land; and 2 Indian agency coal mines. Dug out and re-covered 2 coal-mine and outcrop fires in Rio Blanco County, under Public Works allotments.

Florida.—Investigated oil and gas prospecting operations throughout the State, including inspection of two drilling operations in Hillsborough County and one each in Lake and Nassau Counties.

Idaho.—Completed 90 miles of river utilization surveys on the North Fork of the Coeur d'Alene and Weiser Rivers and tributaries; and surveyed in detail the Leland Glen reservoir and dam site and the Bumble Bee, Evanville, Hultman Creek, Spion Kap, Teddy Creek, Brown, Lost Valley, and Squaw Flats dam sites. Supervised 32 power projects, 74 prospecting permits for oil and gas, 1 lease and 17 permits for coal, and 2 phosphate leases.

Kansas.—Investigated oil and gas prospecting operations in western Kansas in aid of mineral classification. Supervised 3 leases and 18 prospecting permits for oil and gas.

Louisiana.—Investigated oil and gas prospecting operations throughout the State in aid of mineral classification. Supervised 17 leases and 2 prospecting permits for oil and gas.

Mississippi.—Investigated oil and gas prospecting operations throughout the State in aid of mineral classification and examined 1 tract each in Attala, Choctaw, Leake, Montgomery, and Webster Counties.

Montana.—Examined land in the Rattlesnake Butte area, Petroleum County, for mineral classification. In cooperation with the geologic branch initiated structural and stratigraphic investigations in the Little Rocky Mountains area, Phillips and Fergus Counties. Completed 173 miles of river-utilization surveys on the Middle, North, and South Forks of the Flathead River and tributaries and surveyed in detail 14 square miles in the Glacier View and Big Prairie reservoir and dam sites. Supervised 38 power projects; 117 leases and 859 prospecting permits for oil and gas on public land; and 99 leases, 32 permits, and 45 licenses for coal; 7 phosphate leases; 47 oil and gas leases, 2 Indian agency coal mines, and 26 coal and 3 silver-lead-gold leases on Indian land; continued important conservation measures through the plugging and conditioning of abandoned oil wells under Public Works allotments.

Nevada.—Completed 17 miles of river surveys on the Carson River (including East Fork) and Marys River and made detailed surveys of the Heenan Lake, Silver King Nos. 1 and 2, Silver Queen, Soda Springs, Chalk Basin, and Hanks Creek dam sites. Supervised 24 power projects, 81 prospecting permits for oil and gas, 4 coal permits, 1 phosphate lease, 6 sodium permits, and 7 potash permits.

New Mexico.—Continued an areal, stratigraphic, and subsurface structural investigation in Lea County. In cooperation with the geologic branch initiated an investigation of coal and oil resources of the Lumbarton and Monero districts Rio Arriba County. Completed 158 miles of river utilization surveys on the Pecos River, Rio Chama, and San Juan River; surveyed Dead Man's Wash in connection with erosion studies; surveyed 16 square miles in Los Osteros, Cañon de Chama, El Vado, and Lower Abiquiu reservoir and dam sites; and made detailed surveys of the Tecolote and Los Osteros No. 2 dam sites. Made geologic studies of foundation materials and conditions at 5 dam sites and of Dead Man's Wash erosion area; continued operations in connection with plugging oil wells and reconditioning water wells under Public Works allotment. Supervised 3 power

projects; 193 leases and 1,862 prospecting permits for oil and gas on public land; 5 oil and gas leases on Indian land; 24 leases and 23 prospecting permits for coal; 9 prospecting permits for sodium; 9 leases and 70 prospecting permits for potash; and 44 sulphur permits. Supervised on Indian land 73 agency coal mines.

North Dakota.—Supervised 1 lease and 25 prospecting permits for oil and gas; 67 leases, 1 permit, and 18 licenses for coal; and 1 permit for sodium.

Oklahoma.—Investigated oil and gas operations in western Oklahoma for purposes of mineral classification. Supervised 3 power projects, 15 leases, and 93 prospecting permits for oil and gas on public land and 5,252 oil and gas leases on Indian land. Supervised on segregated tribal and restricted allotted Indian lands 33 leases, 21 permits, and 1 temporary mining permit for coal; 1 asphalt lease and 2 right-of-way leases; supervised on Quapaw Indian lands 40 zinc-lead leases.

Oregon.—Completed 131 miles of river-utilization surveys on the Applegate River, Chewaucan River, Deep Creek, Grave Creek, Hood River and tributaries, Nehalem River, and South Umpqua River; and surveyed in detail 5 square miles in the Lower Applegate and Paisley reservoir sites and the Alternate, Cranberry, State, Grave Creek, Elsie, Days Creeks, Shovely and Tiller dam sites. Made geologic and geophysical studies of foundation materials and conditions at 14 dam sites. Supervised 43 power projects, 134 prospecting permits for oil and gas, 1 lease and 4 prospecting permits for coal, 2 sodium permits, 3 potash permits, and 1 oil-shale lease.

South Dakota.—Initiated an areal and structural investigation in Butte and Harding Counties for purposes of mineral classification. Supervised 50 prospecting permits for oil and gas and 6 oil and gas leases on Indian land; 5 leases, 3 permits, and 1 license for coal on public land.

Utah.—Examined land in the Diamond Fork area, Utah County, for purposes of mineral classification. Investigated occurrence of carbon dioxide gas in the Farnham area, Carbon County. Continued stratigraphic and structural investigations in Washington County. In cooperation with the geologic branch initiated a structural and stratigraphic investigation of the Henry Mountains area, Emery, Garfield, and Wayne Counties, and of the Strawberry Valley quadrangle, Utah and Wasatch Counties. Completed 109 miles of river-utilization surveys on the Bear River, Sevier River, and Willard Creek and surveyed in detail 27 square miles in the Otter Creek and Piute reservoir and dam sites. Made geologic studies of foundation materials and conditions at one dam site; continued operations in connection with plugging oil wells and reconditioning water wells under Public Works allotment. Supervised 17 power projects; 25 leases and 884 prospecting permits for oil and gas on public land and 1 oil and gas lease on Indian land; 48 leases, 57 permits, and 2 licenses for coal; 11 sodium permits, 31 potash permits, and 1 phosphate lease.

Washington.—Completed 98 miles of river-utilization surveys on the Cispus, Cowlitz, Sauk, and Toutle Rivers and surveyed in detail 11 square miles in the Mossy Rock and Sauk reservoir sites and the Green River dam site. Made geologic and geophysical studies of foundation materials and conditions at 21 dam sites. Supervised 21 power projects, 12 prospecting permits for oil and gas, 1 lease and 14 permits for coal, 1 sodium permit; 3 silver-gold leases and 4 tungsten leases on Indian lands.

Wisconsin.—Supervised 1 power project.

Wyoming.—Examined land in the West Dewey area, Weston County, and the Smith Creek area, Carbon County, for purposes of mineral classification. In cooperation with the geologic branch continued phosphate investigations in northern Lincoln County; and structural and stratigraphic investigations in the Cody, Pitchfork, and Shoshone districts, Park County, and the east side of the

Big Horn Basin, Big Horn County. Through the geologic branch examined land in the Cottonwood Creek area, Park County, for purposes of mineral classification. Completed 72 miles of river-utilization surveys on the Bear River and Savery Creek and surveyed in detail 9 square miles in the Yellow Creek reservoir site and the Needles and Lower and Upper Savery Creek dam sites. Made geologic studies of foundation materials and conditions at 2 dam sites. Supervised 10 power projects, 477 leases and 1,707 prospecting permits for oil and gas on public land, 24 oil and gas leases on Indian lands, 56 leases, 60 permits, and 22 licenses for coal, 2 prospecting permits for sodium, and 1 permit for potash. Performed technical supervision at Emergency Conservation Camp 858, established for conserving coal deposits.

WORK ON PUBLICATIONS

Texts.—The book publications of the year numbered 57 and contained 5,760 pages. Besides these publications 30 brief papers in mimeographed form were issued as memoranda for the press. During the year 38,785 pages of manuscript were edited and prepared for printing, 1,397 galley proofs were read, and 6,385 page proofs were revised. Indexes were prepared for 39 publications, covering 6,310 pages. Copy and proof or stencils for 580 pages of multigraph or mimeograph matter were read. During the year 22 foreign letters, in German, French, Spanish, Italian, and Portuguese were translated.

Illustrations.—The section of illustrations prepared 2,213 drawings and photographs, transmitted 1,154 illustrations to accompany 44 reports, received and examined 569 proofs, and examined 82 edition prints.

Geologic map editing and drafting.—The geologic map of Texas, scale 1:500,000 was completed and published. This map is in four parts, each 50 by 40 inches, and is printed in 23 colors, with 108 map units represented by patterns. This map was prepared and drafted, the proof read, and the color printing directed in this section. A total of 213 illustrations, comprising geologic maps, sections, and diagrams, were drawn in the section, and illustrations for 27 papers were edited. Proofs of 18 geologic maps and sections were read.

Distribution.—A total of 353 publications, comprising 57 new books and pamphlets, 96 new or revised topographic and other maps, 199 reprinted topographic and other maps, and 1 geologic map, were received during the year. Several special pamphlets and forms for administrative use were also delivered and distributed. The total units of all publications received numbered 140,802 books and pamphlets and 673,590 topographic and other maps, a grand total of 814,392. The division distributed 101,827 books and pamphlets, 3,413 geologic folios, and 746,820 maps, a grand total of 852,060, of which 3,051 folios and 645,123 maps were sold. The net proceeds (gross collections less copying fees and amounts refunded) from the sales of publications were $37,963.17, including $37,136.32 for topo-

graphic and geologic maps and $826.85 for geologic folios. In addition to this $10,308.74 was repaid by other establishments of the Federal Government at whose request maps or folios were furnished. The total receipts, therefore, were $48,271.91.

Engraving and printing.—During the year 70 newly engraved topographic maps including 4 revised maps, were printed, and 26 special maps, making a total of 96 new maps printed and delivered. Of the newly engraved maps 45 were completed under the Public Works allotment. Corrections were engraved on the plates of 413 maps. Reprint editions of 184 engraved topographic maps and 15 photolithographed State and other maps were printed and delivered. In addition, 81 new topographic maps had been engraved and were in press June 30, including 56 under Public Works allotment, and the engraving of 161 other new topographic maps was in hand, including 93 under Public Works allotment. One new geologic map was printed, the edition amounting to 4,550 copies. Of new and reprinted maps, 296 different editions, amounting to 673,590 copies, were delivered.

A large amount of work was done for 68 other units of the Government and State governments, and the charges for it amounted to about $220,000, for which the appropriation for engraving and printing geologic and topographic maps was reimbursed.

Transfer impressions numbering 386 were made during the year and the amount turned over to miscellaneous receipts was $179.90.

Of topographic maps, geologic maps, and contract and miscellaneous work of all kinds, a grand total of 3,441,687 copies were printed and delivered.

The photographic laboratory made 16,111 negatives (including 5,408 wet plates for photolithographs, 585 wet plates for photographic prints, 35 paper negatives, 3,010 dry plates, 471 lantern slides, 406 half-tone negatives, and 6,196 field negatives), 23,518 prints (including 2,093 maps and diagrams, 21,010 photographs for illustrations and records, and 415 bromide enlargements), 4,674 zinc plates, 400 intaglio etchings, and 11 celluloid prints and mounted 5,165 prints.

LIBRARY

The library served nearly 10,000 readers during the year, about half of them not members of the Geological Survey. The total number of books, pamphlets, and serial parts circulated amounted to more than 46,000 items. Books borrowed from other libraries for the use of the Geological Survey numbered 1,249, and 1,310 books were loaned to other libraries. Loans to members of the Survey and to other individuals privileged to borrow books increased from 7,299 to 8,537. Nearly 19,000 new books, pamphlets, and serial parts and more than 1,500 maps and charts were received during the year, and more than 10,000 new cards were filed in the catalog.

The most satisfactory feature of the year was the authorization for binding of 1,784 volumes at a cost of approximately $7,000, but the library's urgent needs for binding remain at 17,000 volumes, as of the accessions during the last 2 years many paper-covered volumes are in immediate need of binding.

The bibliography of North American geology for 1935–36 was delivered to the editor in April and is in press as Bulletin 892. The volume contains 4,716 entries, as compared to 3,836 entries in the volume for 1933–34.

During the year some 1,600 Geological Survey reports were transferred from the library to the division of distribution.

APPROPRIATIONS AND EXPENDITURES

The appropriation made directly for the work of the Geological Survey for the fiscal year 1937 included 10 items, amounting to $2,807,817, of which $76,804.88 remained unobligated on June 30, 1937. In addition, $5,000 was allotted from appropriations for the Interior Department for miscellaneous supplies.

Classifications of Obligations Incurred by the United States Geological Survey During the Fiscal Year Ended June 30, 1937

	Salaries	Topographic surveys	Geologic surveys	Alaskan mineral resources	Gaging streams
Salaries of permanent employees	$140,385.69	$591,058.35	$421,393.25	$41,405.87	$848,714.56
Wages of temporary employees		561,957.06	25,796.99	3,800.91	212,918.69
Supplies and materials		13,258.64	6,515.84	629.91	36,107.14
Dead storage of passenger-carrying vehicles		21.31			19.59
Other storage and pasturage of animals		966.15	322.78		175.94
Communication services		1,275.29	339.20	5.56	5,143.60
Travel expenses		114,400.23	29,460.78	10,660.38	112,945.93
Hire, maintenance, repair, and operation of passenger-carrying vehicles		1,182.98	2,045.67		10,521.96
Transportation of things		5,025.27	2,042.60	357.80	8,903.35
Hire, maintenance, repair, and operation of freight-carrying vehicles		53,337.07	6,840.50		33,089.11
Printing and binding		136,352.61	4,451.81	85.99	4,897.80
Furnishing of heat, light, power, water, and electricity					174.90
Rents		39.41	221.13	600.00	3,037.16
Repairs and alterations		7,073.36	3,962.12	156.96	35,488.48
Special and miscellaneous current expenses		78.95	72.70		30.00
Purchase of passenger-carrying vehicles		1,065.93	2,407.80		11,784.77
Purchase of freight-carrying vehicles		1,135.02	4,842.03		13,905.55
Purchase of scientific instruments and parts		70,109.38	5,006.75		40,604.72
Other equipment		14,600.34	3,985.34	1,993.48	34,523.22
Structures and parts					21,221.93
Miscellaneous refunds, adjustments and transfers		104,796.54	463.99	25.00	156,544.29
Total	140,385.69	1,677,733.89	520,171.28	59,721.86	1,590,743.69

Classifications of Obligations Incurred by the United States Geological Survey During the Fiscal Year Ended June 30, 1937—Continued

	Classification of lands	Printing and binding	Preparation of illustrations	Geologic and topographic maps	Mineral leasing	Total
Salaries of permanent employees	$83,284.20		$21,105.10	$240,780.92	$332,646.52	$2,720,774.46
Wages of temporary employees	2,379.95			68.53	55,533.38	862,455.51
Supplies and materials	1,070.42		256.24	59,808.30	3,491.24	121,137.73
Dead storage of passenger-carrying vehicles					55.00	95.90
Other storage and pasturage of animals	132.80				22.00	1,619.67
Communication services	122.03			15.31	2,708.72	9,609.71
Travel expenses	6,402.61			105.22	22,839.65	296,814.80
Hire, maintenance, repair, and operation of passenger-carrying vehicles	1,158.94				12,147.29	27,056.84
Transportation of things	187.25			480.79	2,825.25	19,822.31
Hire, maintenance, repair, and operation of freight-carrying vehicles	871.49				1,750.56	95,879.73
Printing and binding	657.32	$117,000.00	127.99		743.51	264,317.03
Furnishing of heat, light, power, water, and electricity					3,972.35	4,147.25
Rents					1,173.65	5,071.35
Repairs and alterations	193.43			10,152.89	20,049.89	77,077.13
Special and miscellaneous current expenses					89.31	270.96
Purchase of passenger-carrying vehicles	610.03				11,730.56	27,599.09
Purchase of freight-carrying vehicles						19,882.60
Purchase of scientific instruments and parts	695.15			16.88	516.89	116,949.77
Other equipment	1,688.91			13,774.52	20,039.42	90,605.23
Structures and parts						21,221.93
Miscellaneous refunds, adjustments and transfers	150.94			918.13	555.00	263,453.89
Total	99,605.47	117,000.00	21,489.33	326,121.49	492,890.19	5,045,862.89

In addition to the above amounts, there was expended directly by cooperating agencies $64,151.82 for topographic surveys and $403,570.02 for stream gaging.

APPENDIX

Topographic and planimetric mapping by the Geological Survey in the United States, Puerto Rico, and Hawaii, to June 30, 1937

State	Total area mapped during fiscal year 1937 (square miles)										Types of standard surveys with contours, fiscal year 1937 (square miles)			Total area mapped to June 30, 1937 (square miles)	Percentage of total area of State mapped to June 30, 1937	Control, fiscal year 1937		
	Planimetric [1] on scale of 1 to—		For engraved publication with contour intervals from 5 to 100 feet on scale of 1 to—													Spirit levels (miles)	Transit traverse (miles)	Triangulation stations occupied
	24,000	31,680	12,000	15,840	24,000	25,000	30,000	31,680	62,500	125,000	Revision [2]	Resurvey [3]	New survey [4]					
Alabama					[5] 86							86		21,983	42.3	70	135	
Arizona									442			65	377	60,919	53.4	505	4	44
Arkansas									428			299	129	23,760	44.6	178	222	4
California					68				1,062	214	239	159	946	134,507	85.0	240		13
Colorado		49	[5] 101		[5] 18			160	64			207	136	57,120	55.0	99		22
Connecticut														4,965	100.0			
Delaware														2,370	100.0			
District of Columbia														70	100.0			
Florida									229				229	6,373	10.9			
Georgia					33				226			259		25,202	42.5	215	5	31
Idaho					[5] 12				538	44		12	582	35,643	42.5	213		29
Illinois									448			64	384	40,365	71.2	551	48	
Indiana														4,287	11.8	114	150	
Iowa														13,710	24.4	17	75	
Kansas														64,446	78.4			
Kentucky														27,358	67.4		50	
Louisiana		928												11,330	23.4	[6] 552	[6] 1,875	
Maine									14			14		21,876	66.2			
Maryland														12,327	100.0		143	
Massachusetts								704				704		8,266	100.0	615		
Michigan		2,054						61					61	14,894	25.7	315		
Minnesota														8,890	10.5	12	60	
Mississippi									253				253	7,511	16.0	96	115	
Missouri								88	2,377			755	1,710	52,579	75.7	[6] 9,934	[6] 9,247	
Montana										805			805	45,942	31.3	242		11
Nebraska				4								4		27,931	36.0	118	676	
Nevada									267				267	54,991	49.7	307		26
New Hampshire									201			201		9,302	100.0	89		
New Jersey														8,224	100.0			
New Mexico								49	48	89		97	89	45,069	36.8	102		12
New York								21	293		16	298		49,204	100.0	84		
North Carolina	295				[7] 127				44			171		19,040	36.3	256	28	18
North Dakota									152				152	14,534	20.5		60	
Ohio														41,040	100.0		62	
Oklahoma									245				245	42,172	60.2	98	112	
Oregon									49					39,125	40.5			
Pennsylvania									516		49	130	386	40,162	89.0	29		
Rhode Island														1,248	100.0			
South Carolina									311				311	15,278	49.3	[6] 3,834	[6] 3,244	
South Dakota					[7] 182									19,887	25.6	31	16	
Tennessee	1,454								5			187		23,633	56.2	36		
Texas				15		41			372				372	90,295	34.0	290	297	
Utah									160		41		175	20,955	24.7	55		
Vermont									13				13	8,752	91.5			
Virginia									402			402		37,897	88.9	127	499	
Washington									375	1,261			1,636	41,532	60.1	248	148	37
West Virginia									20		20			24,170	100.0			
Wisconsin									54				54	19,808	35.3	6	27	
Wyoming									124	587			711	34,081	34.8	113		
Total	1,749	3,031	101	19	526	41		1,083	9,732	3,000	365	4,114	10,023	1,435,023	47.4	19,791	17,298	247
Hawaii							[8] 146				29		117	6,435	100.0			
Puerto Rico														271	7.9	159	5	

[1] Prepared from aerial photographs with field examination and showing culture, drainage, and woodland, but no contours. Reproduction by 3-color photolithography (advance sheet).
[2] Revision mostly of culture only.
[3] Resurveys in large part cover areas previously surveyed on a smaller scale.
[4] New surveys cover areas not heretofore mapped.
[5] Reproduction by 2-color photolithography (advance sheet).
[6] Includes surveys administered and supervised by the Geological Survey and executed by emergency relief personnel but not previously reported.
[7] Reproduction by 3-color photolithography (advance sheet).
[8] Contour interval 5 meters.

Summary of Outstanding Mineral Withdrawals and Classifications

June 30, 1937, in acres

State	Coal		Oil		Oil shale		Phosphate		Potash
	Withdrawn	Classified as coal land	Withdrawn	Classified as oil land	Withdrawn	Classified as oil-shale land	Withdrawn	Classified as phosphate land	Withdrawn
Alaska		56,993							
Arizona	139,415								
Arkansas		61,160							
California	17,603	8,720	1,178,392						90,324
Colorado	4,142,233	3,082,272	215,370		1,172,778	952,239			
Florida							66,796	120	
Idaho	11,520	4,603					276,239	270,036	
Louisiana			466,990	4,233					
Montana	6,259,193	[1] 9,373,884	1,336,697	67,651			280,089	3,833	
Nevada	83,673								39,422
New Mexico	4,119,616	984,829							9,282,160
North Dakota	5,954,364	11,178,286	84,894						
Oregon	4,361	18,887							
South Dakota		250,093							
Utah	3,404,043	1,267,697	[2] 1,344,473		2,737,274	2,703,755	277,344	2,937	
Washington	691,801	141,444							
Wyoming	2,143,991	[3] 6,847,235	541,777		2,079,897	425,214	989,133	25,293	
Total	26,971,813	33,276,103	5,168,593	71,884	5,989,949	4,081,208	1,889,601	302,219	9,411,906

[1] Includes 3,151 acres of coal land reserved for use of the United States (coal reserve no. 1).
[2] Includes 13,578 acres withdrawn as helium reserve.
[3] Includes 2,078 acres of coal land reserved for use of the United States (coal reserve no. 2).

General Summary of Cases Involving Land Classification

Class of cases	Record for fiscal year 1936–37						Record since receipt of first case	
	Pending prior to July 1, 1936	Received during fiscal year	Total	Acted on during fiscal year	Pending June 30, 1937	Gain or loss during fiscal year	Received	Acted on
Mineral leasing laws:								
Permit applications	9	302	311	294	17	−8	62,353	62,336
Lease applications	209	1,837	2,046	1,635	411	−202	4,318	3,907
Committee cases	13	289	302	290	12	+1	13,157	13,145
Concurrence	21	1,537	1,558	1,494	64	−43		
Interference (surface rights)	10	90	100	90	10			
Unit operation plans	595	547	1,142	981	161	+434	1,343	1,182
Cases involved in unit plans	2,528	783	3,311	2,345	966	+1,562	4,042	3,076
Development (drilling operations, etc.)	5	56	61	59	2	+3	17,579	17,577
Mineral classification:								
Oil and gas (including "349")	130	1,402	1,532	1,268	264	−134	29,943	29,679
Water and power:								
Federal Power Commission:								
Preliminary permits	5	48	53	41	12	−7	446	434
Determinations under sec. 24	19	36	55	52	3	+16	628	625
Classification	1	6	7	4	3	−2	557	554
Rights-of-way	15	138	153	123	30	−15	7,326	7,296
Irrigation project reports	2		2	2		+2	944	944
General information:								
General Land Office (coops., etc.)	9	376	385	358	27	−18		
Indian Office							9,549	9,549
Total	3,571	7,447	[1] 11,018	9,036	1,982	+1,589		

[1] Includes all cases pending at beginning of fiscal year.

Mineral Production from Public Lands and Revenues accrued therefrom, Fiscal Year 1937

State	Petroleum (barrels)	Natural gas (M cubic feet)	Gasoline (gallons)	Coal (short tons)	Potassium (short tons)	Sodium (short tons)	Phosphate (short tons)	Accrued revenues
Alaska				134,115				$7,181.55
Alabama				70,326				7,032.64
California	18,773,946	39,758,420	68,320,426	73		68,439		3,468,274.98
Colorado	1,156,234	2,679,558	88,858	597,299		1,499		162,905.43
Idaho				1,136			23,359	2,557.95
Louisiana	204,630	1,457,774	17,706					64,950.70
Montana	473,719	2,391,952		359,698			2,745	105,657.39
Nevada								160.00
New Mexico	5,632,723	16,397,193	1,059,270	46,012	449,584	5,932		652,676.03
North Dakota				477,472				29,656.85
Oklahoma	121,769		262,395					20,516.90
Oregon				27				206.75
South Dakota				2,832				508.84
Utah	611	107,794	11,856	1,329,040				133,999.44
Washington				27,788				2,778.86
Wyoming	10,488,279	15,652,570	27,961,659	1,175,385				1,601,671.80
Total	36,877,412	78,445,261	97,722,170	4,221,203	449,584	75,870	26,104	6,260,277.27
Total 1936	34,371,038	75,016,349	95,291,995	4,062,189	378,601	57,610	50,732	5,172,768.84

Figures for oil, gas, and gasoline from Louisiana, New Mexico, and Oklahoma are for 11 months ended May 31, 1937.

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