

# GEOLOGICAL SURVEY

(WALTER C. MENDENHALL, Director)

During the fiscal year 1934-35, although directly appropriated funds for the support of the Survey's regular activities have been at a low ebb (see details in later pages), these have been augmented by substantial allocations for closely related work made by the Public Works Administration.

As a consequence the year has been a busy and productive one. More than 46,000 square miles of mapping has been done, including a beginning in Puerto Rico; 1,900 linear miles of streams with potential power values have been surveyed; about 700,000 individual maps have been distributed, many of them to cooperating States and new Government agencies; approximately \$40,000 has been received directly from sales of Survey publications; studies of a number of the long-neglected mineral deposits of the Eastern and Southern States have been made; it has been possible to repair and put in good condition approximately 500 of the nearly 3,000 river-measurement stations distributed over the United States; special drought studies have been carried out; Alaskan mapping and mineral-resources investigations have continued at a nearly normal rate; many abandoned wells and mines on public and Indian lands that were actual or potential menaces to safety or to mineral or water supplies were repaired; substantial progress was made in the preparation of numerous unit plans of development of oil and gas fields under the mineral leasing acts—a valuable conservation measure; and supervision, although inadequate, was maintained over nearly 15,000 oil and gas and other mineral properties on public and Indian lands and naval reserves.

Effective cooperative relations have been maintained with a large number of States in geologic work, study of water supplies, and topographic mapping. Similar relations have existed with a number of the older and newer agencies of Government, the special capacities of the technical staffs of the Survey being thus made available in numerous governmental activities, including those of the Petroleum Administrative Board, the National Resources Board, the Bureau of Public Roads, the Tennessee Valley Authority, the Office of Indian Affairs, and many others.

There is an insistent Nation-wide and thoroughly logical demand for greatly increased activity in topographic mapping because of the

now publicly recognized need for maps as bases for so many public and private activities. Urban and rural development, road locations, land, census, and soil problems, crop-control programs, irrigation, park and forest administration—all need these maps acutely. This national need should be met by provision for speeding up the mapping program.

A growing Survey problem, now very inadequately financed, is that of the administration of the mineral leasing laws. The Government's effective management as lessor of its mineral estate is jeopardized by inadequate skilled staff and the resulting inadequate inspection and control of leased properties. This situation needs prompt correction. Losses far in excess of the cost of adequate inspection and management are threatened by insufficient provision for this work.

The mineral industry depends upon and demands many more, and prompter issue, of the scientifically sound and impartial reports of the Geological Survey upon the active and potentially active mining districts of the Nation. Wherever available, these reports are guides in the development of ore bodies and in the search for extensions and for new deposits. More adequate provision is needed for this work and for the publication of results.

Finally, several of the administrative services of the Survey, necessary to its technical activities, have been reduced to the point of near inadequacy as a result of the reductions of recent years in the financial support for the regular services, especially the scientific and technical services of Government. Correction of this situation is one of the present acute needs.

Dr. David White, a member of the staff of the Geological Survey since 1886 and its chief geologist from 1912 to 1922, died February 7, 1935, at the age of 73. In his death geologic science lost one who had been a recognized leader on this continent for more than a generation. Though he was primarily a paleobotanist and the American authority in this field, his activities embraced many branches of geology as well as administration. Dr. White's career is a striking example of the type of leadership at the service of the American people in the scientific establishments at Washington. Recognized and honored the world over as a scientist of the highest standing, whose research and administrative work had direct practical applications of great value; repeatedly offered by commercial organizations salaries several times greater than the Government paid him—he nevertheless remained in the service throughout his career and devoted his rare abilities and his limitless industry to the Government and the people of the United States.

## GENERAL SUMMARY OF THE YEAR'S ACTIVITIES

*Geologic work.*—Field parties of the geologic branch were actively at work in the beginning of the fiscal year on mineral-resources and land-classification surveys in 19 States east of the Rocky Mountains for which funds had been allocated by the Public Works Administration. One of the more important projects thus carried on was a report on the mineral resources of the region tributary to Boulder Dam, prepared as an aid in the study of possible markets for Boulder Dam power. Other projects included studies of the quicksilver deposits in Texas and Arkansas, the gold deposits of the southern Appalachian region, the clays of several Southern States, and the iron ores of northeastern Texas. Work was continued throughout the year on the metal-mining districts of Colorado, Idaho, and New Mexico in cooperation with the States, and some assistance was given to the Arizona Bureau of Mines in a survey of the Tombstone district. A resurvey of the Comstock lode in Nevada was begun near the end of the year. Stratigraphic and structural surveys of the San Andreas rift and Death Valley, Calif., were resumed, and field projects were carried on in Illinois and Kentucky, in the Coastal Plain area of Louisiana, Mississippi, and North Carolina, in eastern Pennsylvania, and in the Wasatch Plateau, Utah. Temperatures in deep wells were measured in several oil fields. Areas of forest lands, mostly in the Appalachian region, were geologically examined for the Forest Service. A comprehensive review of the geology and occurrence of petroleum in the United States was prepared for a subcommittee of the House Committee on Interstate and Foreign Commerce.

*Explorations in Alaska.*—In the field season of 1934, 7 field projects were carried on in Alaska, 2 of which were primarily topographic and 5 primarily geologic. This work was financed in part by grants from the Public Works Administration. The usual general survey of recent mining developments and the collection of mineral statistics were continued. Six field projects for the season of 1935 had been started at the end of the fiscal year and will be continued throughout the open season. Compilation of base maps from aerial photographs taken in 1928 and 1929 by the Navy Department was continued throughout the year, the work being done in Juneau, Alaska, with an enlarged staff.

*Topographic mapping.*—A notable increase was made in the area covered by new topographic surveys, resurveys, and revision, the total being 30,924 square miles representing over 200 topographic maps with contours. The topographic mapping included all States. There was also a considerable increase in the area covered by planimetric maps without contours resulting from aerial photography, which covered 15,721 square miles in 9 States. In addition, aerial photographs were used as bases for topographic mapping in 42 quadrangles. Successful experiments were undertaken with single-lens aerial photographs with a wide-angle lens at high altitudes. The sectional transportation map of the United States being made for the Bureau of Public Roads was continued with increased output. The map of Iowa, the first State issued, consists of eight sections. These transportation maps on a scale of about 4 miles to 1 inch show all kinds of transportation routes in a variety of colors.

*Investigations of water resources.*—The water-resources branch collected and made available for publication stream-flow records at more than 3,000 river-measurement stations on rivers large and small, obtaining thus authentic information on the behavior of streams in drought, in flood, and in normal conditions—information which is invaluable for intelligent planning of projects

for use or control of the water supply. This work included the construction of many new stations on the larger rivers of the country and the complete rehabilitation of more than 500 existing stations. It investigated underground water supplies in 32 States and in the Territory of 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. In collaboration with the Mississippi Valley Committee of the Public Works Administration the branch made a comprehensive study of floods in the United States with reference to magnitude and frequency and an investigation of the relation of rainfall and run-off in the United States. A report on the flood study was sent to the printer near the end of the year, and a report on the rainfall and run-off study was nearly completed. A broad study was made of the great droughts of 1930-34, with an extensive compilation of information about the drought and a comparison with notable droughts of earlier years. An investigation had been made of the stream flow and silt movement of streams in eight projects of the Soil Conservation Service, and similar studies on the Colorado River. The completion of a program of well drilling at Salt Lake City, Utah, based upon the recommendations of the Geological Survey, provided a large additional supply of water for the city and averted a serious shortage. A report on the geology and ground-water resources of the Island of Oahu disclosed large supplies of underground water that are available to the city of Honolulu. Investigations conducted in the hydrologic laboratory demonstrated the law of flow of ground water for pressure gradients as low as 1 inch to the mile, which is of practical importance because natural gradients are very low.

*Classifying and leasing public land.*—The conservation branch made 11,434 formal findings of technical fact involving the mineral resources, water power or storage possibilities, and agricultural or grazing utility of public lands; classified 885,535 acres of withdrawn land as to coal and 267,684 acres of withdrawn land as to oil shale; added 72,793 acres to outstanding water-power reserves and eliminated 408,157 acres therefrom; added 12,450 acres to public water reserves and eliminated 460 acres therefrom; designated 35,450 acres as enterable under the stock-raising homestead law and canceled prior designations of 16,945,535 acres thereunder; designated 1,894 acres as enterable under the Enlarged Homestead Act and canceled prior designations of 25,947,994 acres thereunder; defined the "known geologic structure" of three producing oil and gas fields; completed 1,900 miles of stream-utilization surveys in public-land States; supervised operations or activities under 152 power projects licensed by the Federal Power Commission; supervised on public land 8,394 oil and gas holdings involving 3,699 productive wells, 758 coal properties, 204 potash properties, 45 sodium properties, 26 sulphur properties, 8 phosphate properties, and 1 oil-shale property; on naval petroleum reserves 24 leaseholds involving 529 productive oil and gas wells; and on Indian lands 4,812 leaseholds involving 4,477 oil and gas wells, 36 lead and zinc properties, 39 coal properties, 1 asphalt property, and 1 lime phosphate property; assisted hundreds of oil and gas permittees and operators in the preparation of unit plans of development; participated extensively in the organization and preliminary work of the departmental Division of Grazing; and initiated and fostered legislation looking to material change in the oil and gas provisions of the Federal mineral-leasing law.

*Publications.*—The publications of the year comprised 35 pamphlets in the regular series, covering a total of 3,509 pages; 86 new or revised topographic

and other maps; and 139 reprinted topographic and other maps. Among the notable book publications were professional papers on the Breckenridge mining district, Colorado, and copper deposits of the Ducktown type in the Appalachian States; bulletins on the quicksilver deposits of southwestern Oregon, the Book Cliffs coal field in Colorado, the geology of Big Horn County and the Crow Reservation, Mont., and the coal in a part of the San Juan Basin, N. Mex.; a paper on the industrial utility of public water supplies in the United States; and a review of the petroleum industry in the United States, 1934. Besides these publications, 36 brief papers, some of them containing simple maps, were issued in mimeographed form as memoranda for the press.

The engraving division printed more than 581,000 copies of maps and folios and, in addition, did repay work amounting to about \$190,000 for over 60 other Government units and State Governments.

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

## GEOLOGIC BRANCH

### SUMMARY

Field parties of the geologic branch were actively at work in the beginning of the fiscal year on mineral-resources and land-classification surveys in 19 States east of the Rocky Mountains for which funds had been allocated by the Public Works Administration. Summary reports giving the results of work on most of these projects have been prepared, and several of them have already been published. Among the more important of these is a report on the mineral resources of the region tributary to Boulder Dam, prepared as an aid in the study of possible markets for Boulder Dam power. Public Works funds were made available through the Bureau of Reclamation, and the preliminary report was published by that Bureau.

Other valuable results made possible through Public Works aid include studies of the quicksilver deposits of the Terlingua district of southern Texas, the recently discovered quicksilver area of southern Arkansas, the gold deposits of the southern Appalachian region, the clays of several of the Southern States, and the iron ores of northeastern Texas.

Work was continued throughout the year on the metal-mining districts of Colorado, Idaho, and New Mexico in cooperation with the States, and some assistance was given to the Arizona Bureau of Mines in a survey of the Tombstone district. A resurvey of the Comstock lode, in Nevada, was begun near the end of the year.

Stratigraphic and structural surveys of the San Andreas rift and Death Valley, Calif., were resumed, and minor field projects were carried on in Illinois and Kentucky, in the Coastal Plain area of Louisiana, Mississippi, and North Carolina, in eastern Pennsylvania, and in the Wasatch Plateau, Utah. Temperatures in deep wells

were measured in several oil fields, and certain areas of forest lands, mostly in the Appalachian region, were geologically examined for the Forest Service.

A comprehensive review and summary of the geology and occurrence of petroleum in the United States was prepared during the year by members of the Survey staff for a subcommittee of the House Committee on Interstate and Foreign Commerce, acting under the chairmanship of Representative William P. Cole, Jr., of Maryland. This summary and review, covering more than 200 pages, with 130 illustrations, chiefly maps, constitutes the greater part of part 2 of the hearings held under House Resolution 441, Seventy-third Congress. The situation in each of the petroleum-producing States is summarized in this volume, and an estimate of the reserves in the known fields is assembled. Important among the papers included are those on the early history of the use and development of petroleum and on its origin. They were written by Dr. David White, principal geologist of the Survey and world authority in this field.

### WORK OF THE YEAR, BY STATES

*Alabama.*—Funds from the Public Works Administration were available through Federal projects 157, 158, and 161 for the continuation in 1935 of several projects on the mineral resources of Alabama begun in the fiscal year 1934, and further funds were made available through Federal projects 183 and 189. The work was done under the supervision of Survey geologists and consisted of the mapping and examination of mines in the Woodstock iron-ore area; geologic mapping and prospecting in the Russellville brown iron ore district; further studies of some of the gold areas of the State, with detailed mapping in some of the most representative and accessible gold-mining districts; investigation of bleaching and other high-grade clays in Clarke and Choctaw Counties as a continuation of studies in Mississippi, in the Cretaceous and Tertiary areas, and in northwestern Alabama; and investigations of manganiferous iron ore in Cleburne and Cherokee Counties and adjoining portions of Georgia. A paper on the geology of the Hog Mountain gold district was published by the American Institute of Mining and Metallurgical Engineers. A report on tin deposits of Alabama was issued as a press memorandum. A preliminary report on the gold deposits of the State has been prepared for publication by the Alabama Geological Survey. Reports on the clay investigations are nearing completion and will be issued by the Geological Survey.

*Arizona.*—Progress was made on reports on the geology and ore deposits of the Ajo copper district, the geology of the Tucson quadrangle, and manganese deposits near Artillery Peak. A paper on strontium deposits of southeastern California and western Arizona was published by the American Institute of Mining and Metallurgical Engineers. A geologic survey of the Tombstone mining district is being made in cooperation with the Arizona Bureau of Mines. Work near Boulder Dam is mentioned under California.

*Arkansas.*—The field studies of the coal and gas resources of the western portion of the Arkansas coal field of Sebastian, Franklin, Crawford, Logan, and Scott Counties (Federal project 163) were completed, and a report on the geology and mineral resources of the area was prepared for publication as a

Survey bulletin. A map showing geologic structure, gas fields, and coal outcrops of the same area will be issued as a preliminary report. Geologic mapping of the quicksilver district of Pike, Clark, and adjoining counties, as a part of Federal projects 163 and 184, was completed. Publications resulting from this investigation are "Mine developments in the Arkansas quicksilver district to June 1, 1934," and "Investigation of the Arkansas quicksilver district by the United States Geological Survey", which were transmitted to the Arkansas Geological Survey; "Quicksilver deposits near Little Missouri River, southwest Arkansas", published by the American Institute of Mining and Metallurgical Engineers; "Quicksilver deposits near Little Missouri River and near Antoine Creek", issued as a press memorandum. Exploratory drilling and geologic mapping in Saline, Pulaski, and Garland Counties were done to determine the extent of bauxite deposits (Federal projects 163 and 185).

Papers on the fossil flora of the Wedington sandstone member of the Fayetteville shale and the carbon ratio in a part of the Arkansas-Oklahoma coal field were transmitted to the American Association of Petroleum Geologists for publication, and a report on cyclical sedimentation and the stratigraphy of the Boyd shale, Morrow group, near Fayetteville, was submitted to the Journal of the Washington Academy of Sciences.

*California.*—Reports on the Kettleman Hills oil and gas field, the geology and mineral resources of the San Pedro Hills, the geomorphology of the San Joaquin Basin, the Grass Valley mining district, chrome in northern California, and the origin of the borate deposits of Kramer were in preparation during the year. Geologic investigations in the southern part of the Death Valley region and of the San Andreas rift and Cajon Pass region were continued. Grants from the Geological Society of America financed a study of the calcium carbonate content of fine-grained clastic sediments in California, a survey of the Nevada City mining district, and a study of Miocene diatomaceous deposits. A paper on the relation of salinity to the calcium carbonate content of marine sediments will be published by the Geological Survey, and one on the organic content of sediments from several American oil-producing areas has been issued by the American Petroleum Institute.

A preliminary report on mineral resources in the region tributary to Boulder Dam, the work for which was done by geologists of the Survey by funds allotted by the Public Works Administration to the Bureau of Reclamation, was published by that Bureau in November 1934; a more complete report has been prepared for publication as a Survey bulletin. Under a Public Works allotment (Federal project 153), the drafting of the geologic map of California was continued in cooperation with the State. Routine seismologic and meteorologic observations were continued at the volcanologic station at Mineral, though the volcanologist in charge was furloughed part of the time on account of reduction of funds. On June 30, 1935, this station was closed, and the building, which is in a national forest, was transferred to the Forest Service.

*Colorado.*—Cooperation was continued with the Geological Survey Board of Colorado and the Colorado Metal Mining Fund in investigations of the mining regions of the State. Further field studies were made in the Ouray and Red Mountain districts of the San Juan region, the Nederland tungsten district, the Alma district, and the Gold Hill and Ward mining districts of the Front Range, and a study of the geology and mineral resources of the La Plata Mountain region of southwestern Colorado, with special reference to mining geology, was begun. Reports are in preparation on the ore deposits of the Front Range, the Snowmass area, the Jamestown, Alma, and Ouray districts, the Nederland tungsten district, and the Paleozoic stratigraphy. A paper

on the Cripple Creek district was published by the Colorado Scientific Society, and one on the Tincup mining district, in Gunnison County, will be published by the same society. Preliminary papers resulting from these investigations on geology and ore deposits of the Cripple Creek district, ore deposits of the Mosquito and Sawatch Ranges, geologic guidance to the development of the San Juan ore deposits, and the ore deposits of Clear Creek, Gilpin, and Boulder Counties were offered for publication in the Colorado number of the Engineering and Mining Journal. A paper on reconnaissance observations of the Upper Cretaceous rocks north of the Arkansas River in eastern Colorado was submitted to the American Association of Petroleum Geologists.

*Florida.*—Prospecting for phosphate on reserved public lands in Polk, Marion, and Citrus Counties for the purpose of classifying the land was continued by a party under the supervision of a Survey geologist, financed through Federal projects 164 and 188. Field work in connection with the project was completed at the end of the fiscal year. Explorations for bleaching and other high-grade clays (as a part of Federal project 164) were made in Jackson, Alachua, Gadsden, Jefferson, Marion, Holmes, Leon, Madison, and Washington Counties. A preliminary report on the clay studies will be issued by the Geological Survey as a press memorandum. A paper on the Tampa limestone is in preparation, and one on the Choctawhatchee gastropods and scaphopods from the Alaqu Creek Valley, a cooperative project, was transmitted to the Florida Geological Survey.

*Georgia.*—Detailed mapping of various operating mines in the Dahlonega and other gold-bearing areas in Georgia, begun during the fiscal year 1934 under allotment of funds from Public Works Administration (Federal projects 158 and 165), was completed, and five short articles on gold deposits of Georgia were published in the monthly bulletin of the State Department of Forestry and Geological Development and later combined and issued by the Division of Geology as Information Circular 4. By additional funds (Federal project 183) a study of gold districts in Cherokee, Dawson, Lumpkin, and White Counties was made. A short paper on the Battle Branch mine, near Auraria, will probably be published in Economic Geology. As a part of Federal project 165 a study was made of the kyanite and vermiculite deposits of northern Georgia, and a report of the investigation was transmitted to the State geologist for publication. Explorations for bleaching clays were conducted in various parts of the State (Federal projects 165 and 189), and reports have been prepared for publication by the State and the United States Geological Survey. Manganese ore deposits at Cartersville and near Toccoa, Iron City, and Union Point were examined, the results to be incorporated in a paper on manganese deposits of the crystalline belt from Georgia to Maine. At the request of the Forest Service, lands were examined and reports made on proposed additions to the Broad River National Forest.

*Hawaii.*—Because of greatly reduced funds the work of the section of volcanology, with headquarters at Hawaii National Park, was curtailed, and the two employees were furloughed for half a year each. With the cooperation of the Volcano Research Association the routine of the observatory was maintained, the Volcano Letter issued, and seismologic studies of Kilauea continued.

*Idaho.*—Cooperation with the Idaho Bureau of Mines was continued in the Boise Basin, Thunder Mountain, Edwardsburg, and Yellow Pine districts and in a study of the gold-bearing gravel in the vicinity of Grangeville, along the Salmon River, and in the Florence district. Reports were also in preparation on the general geology of south-central Idaho and on the Idaho mining dis-

tricts. A press memorandum on the Elk City mining district was issued, and a bulletin on the geology and ore deposits of the Bayhorse quadrangle was completed for Survey publication. Papers resulting from cooperative work published by the Idaho Bureau of Mines include a preliminary report on the geology and ore deposits in the eastern part of the Yellow Pine district (Pamphlet 43) and a report on the Pearl-Horseshoe Bend gold belt (Pamphlet 41). A report on the geology and mineral resources of the Ammon and Paradise Valley quadrangles was in preparation.

*Illinois.*—The fluor spar deposits of the Cave-in-Rock and Rosiclare districts, southeastern Illinois, were investigated by geologic mapping and geophysical studies, and a preliminary paper dealing with the geology of southern Illinois and the fluor spar deposits was transmitted to the Illinois Geological Survey. This work was done under Federal project 166 and was continued until the funds allotted were exhausted. Further studies in the region were resumed near the end of the fiscal year in cooperation with the Illinois Geological Survey. Work was continued on the monograph of the Pottsville flora of the Eastern Interior Basin, mainly in Illinois but including adjoining portions of Indiana, western Kentucky, and southeastern Iowa, which is being prepared in cooperation with the Illinois Geological Survey.

*Kansas.*—Field examinations of the stratigraphy, structure, and coal resources of southeastern Kansas in Cherokee County and parts of Labette and Crawford Counties, under Federal project 167, were completed, and a report on the geology and mineral resources of the southeastern Kansas coal field was prepared for publication as a Survey bulletin. A contour map with text, of the base of the Cherokee shale in the zinc-lead district of southeastern Kansas will be issued by the Geological Survey as a press memorandum, and a map showing structure of the southeastern coal fields of the Kansas zinc-lead districts will be published by the Kansas Geological Survey. Stratigraphic mapping and studies of lead and zinc mines were made in the Kansas part of the Tri-State lead and zinc area.

*Kentucky.*—A report on the coal deposits of Pike County, giving the results of investigations in 1934 and the early part of 1935 by a party under the supervision of a Survey geologist working under Federal project 168, was completed for publication as a Survey bulletin. The studies of the fluor spar area in Kentucky under Federal project 168 consisted of geologic and geophysical mapping in the vicinity of Marion. Papers on the New Providence shale in the vicinity of Junction City and on a new crinoid genus from the Mississippian of Ohio and Kentucky are in preparation. A report was made to the Forest Service on proposed additions to the Cumberland Purchase unit in the southeastern part of the State. Work on the Pottsville flora is mentioned under Illinois.

*Maryland.*—Studies of the structural materials of Maryland, chiefly sand and gravel, continued by Public Works funds (Federal project 169), covered areas in Prince Georges, Montgomery, Anne Arundel, Charles, Howard, Cecil, Harford, and Baltimore Counties.

*Mississippi.*—A report giving the results of an investigation of the bleaching clays of Mississippi made in 1934 from Public Works funds (Federal project 171) has been prepared.

*Missouri.*—In connection with the investigation of the Tri-State lead and zinc district (Federal project 172) stratigraphic sections were studied in the lead and zinc areas of Jasper and Newton Counties, and detailed mapping of mines was done in the Waco and Joplin areas. Reports on these districts were prepared for the Missouri Geological Survey.

*Montana.*—Work was done on papers on the physiography and glacial geology of western Montana, the glacial geology and physiography of Glacier National Park, the geology and ore deposits of the Libby quadrangle, the geology and mineral resources of north-central Chouteau, western Hill, and eastern Liberty Counties, and fossil plants from the Fort Union and associated formations. Reports on the coal resources of McCone County and on phosphate near Maxville were completed for Survey publication.

*Nevada.*—Further field studies were made in the Tonopah and Hawthorne quadrangles, partly through a grant from the Geological Society of America, and a study of recent faults in the western part of the Great Basin was made through a grant from the same society. A resurvey of the Comstock lode was begun in June 1935. A detailed report on the geology and mineral resources of the Tonopah and Hawthorne quadrangles and reports on the Tonopah, Tuscarora, Gold Range, Searchlight, and Delamar mining districts were in progress. A set of mine maps of the Tonopah district was placed in open files in the San Francisco, Salt Lake City, Reno, and Washington offices of the Geological Survey. A report on the underground geology of the Tonopah mining district will be published by the Nevada Bureau of Mines; and a paper on a pregranodiorite dike in granodiorite, Paradise Range, by the American Geophysical Union. Work near Boulder Dam is mentioned under California.

*New Mexico.*—Cooperation with the New Mexico Bureau of Mines was continued in an investigation of the Eureka and Sylvanite mining districts and geologic mapping of the Little Hatchet Range, in Hidalgo and Grant Counties. A report on the Bayard area of the Central district was completed for Survey publication, and one on the Virginia mining district was sent to the New Mexico Bureau of Mines for publication. Both these reports were products of cooperative investigations. Office work was continued on the manuscript on the geology and ore deposits of the Magdalena mining district. A paper on igneous assimilation and associated metamorphism in the Virginia mining district was transmitted to the American Mineralogist, and one on hydrothermal leaching in the Virginia mining district to Economic Geology. A report on the structure and igneous geology of the Mount Taylor volcanic field was completed for Survey publication. A paper on logs of the Government core tests for potash in New Mexico and Texas was sent to the Texas Bureau of Economic Geology, and one on the Permian formations of the Pecos Valley of New Mexico and Texas was submitted to the American Association of Petroleum Geologists.

*New York.*—Field studies of the stratigraphy, structure, and gas resources of south-central New York, including portions of Seneca, Livingston, Ontario, Schuyler, Chemung, Steuben, Yates, Allegany, and Cattaraugus Counties, were continued under Federal projects 173 and 187. A preliminary report on the structure and gas possibilities of the Watkins quadrangle will be issued as a press memorandum. A study of the talc deposit of St. Lawrence County was made as a part of Federal project 173.

*North Carolina.*—Investigations of gold-bearing regions in the slate and granite areas of the western part of North Carolina, extending from the South Carolina border to Guilford County, were completed under funds from the Public Works Administration (Federal project 174). A preliminary report covering these investigations was issued as a press memorandum. Additional funds were received through Federal project 183 for the completion of detailed examinations of mines and prospects and mapping the geology of the gold-bearing regions of the State. Detailed work was done in Union and Stanly

Counties. Reports on the Uharie and Sauratown purchase units were made for the Forest Service.

*North Dakota.*—The mapping of the coal resources of the Minot district, in McHenry, Ward, McLean, Mercer, and Sheridan Counties, under a Public Works Works allotment (Federal project 159), was completed, and a preliminary map of the area was issued. A detailed report on the geology and coal resources of the area will be published later as a Survey bulletin.

*Oklahoma.*—With Public Works funds field mapping was continued on the coal and gas resources in Pittsburg, Haskell, and Latimer Counties (Federal project 175) and a survey of wells in the Quinton gas pool was made (Federal project 186). A report on the Quinton-Scipio district, covering the gas field of Pittsburg County, has been completed, and a preliminary map of the geology and structure of the area has been prepared for publication. Federal project 160 provided for a study of the Lehigh district, in Coal and Atoka Counties, field work on which was completed. This area has also been covered by a report intended for publication as a Survey bulletin, and a geologic map of the region has been prepared for advance publication. Under Federal project 63-M the mapping of the Osage and adjoining Indian lands, with special attention to the subsurface structure, was continued, and a report on the subsurface geology of Osage County was prepared. The Tri-State lead and zinc project, in Kansas, Missouri, and Oklahoma, provided for by Public Works funds (Federal projects 167, 172, and 175) begun in 1934, was continued during the entire year. The work in Oklahoma included stratigraphic and areal mapping, with detailed study of the principal mines in the Picher and Miami districts, northeastern Oklahoma. Geologic studies were continued in the Ouachita Mountains, and reports are in preparation on the Moorefield fauna, the fauna of the Sycamore limestone, and the geology and mineral resources of the Howe-Wilburton district. Work on the origin and environment of source sediments is mentioned under California.

*Oregon.*—Preparation of a report on the metalliferous deposits of the Cascade Range was continued, and a paper was prepared on Miocene plants from Idaho, Oregon, and Washington for publication in the *Journal of Paleontology*.

*Pennsylvania.*—Some additional field data were collected in the Hanover and York quadrangles in connection with a report on the geology of these quadrangles prepared in cooperation with the Pennsylvania Geological Survey. A brief paper on Appalachian structure in the York-Hanover area will be published by the Geological Society of America. A manuscript describing the Paleozoic and Quaternary sedimentary rocks and the geologic structure of the New Cumberland quadrangle was transmitted to the Pennsylvania Geological Survey for inclusion in a State bulletin. A field study of the structure of the Reading-Boyertown Hills area was made, and a paper was prepared on "The highlands near Reading, Pa., an erosion remnant of a great overthrust sheet", for publication by the Geological Society of America. Revision of the geologic report on the Honeybrook and Phoenixville quadrangles was under way, and the study of the progressive regional metamorphism of the Lower Kittanning coal bed of western Pennsylvania was continued.

*South Carolina.*—The survey of the geology and gold deposits of South Carolina, begun in 1934 with Public Works funds (Federal Projects 158 and 176), covered areas in Lancaster, Chesterfield, York, Union, and McCormick Counties, and later funds through Federal Project 183 were devoted to detailed mapping in the Haile and Brewer mine areas, in Chesterfield and Lancaster Counties. The results of the earlier examination have been given in a press memorandum entitled "Preliminary report on gold deposits in North Carolina

and South Carolina." Public Works funds (Federal projects 176 and 189) provided for a preliminary survey of bleaching-clay deposits of South Carolina, on which a report has been completed. A report on the geologic aspects of the Santee-Cooper hydroelectric project was prepared for the Public Works Administration. Examinations of manganese near McCormick and from Columbia to Gaffney were made in connection with the general study of manganese of the crystalline rocks of the Piedmont area. Areas in the Long Cane and Enoree purchase units were examined and a report made to the Forest Service.

*Tennessee.*—A report on clay deposits of Tennessee, as a result of recent field studies made with Public Works funds (Federal project 177), was completed, and a report on zinc, lead, and barite materials is in preparation.

*Texas.*—The Public Works Administration financed several studies of the mineral resources of Texas (Federal project 178). Surveys of the Shafter silver district and the Terlingua quicksilver district were completed, and preliminary reports on both districts were sent to the Texas Bureau of Economic Geology. More detailed reports on these areas will be published by the United States Geological Survey. A study of the iron ores of northeastern Texas, lying largely in Cass, Marion, and Morris Counties, was completed and a progress report on the investigation was issued by the Texas Bureau of Economic Geology; a final report is in preparation for publication by the Survey. A study of the stratigraphy and structure, with special attention to oil, gas, and coal, in parts of north-central Texas, including areas in Young, Stevens, Throckmorton, Coleman, and Brown Counties, has been completed, and a report will be transmitted to the Texas Bureau of Economic Geology. A report on the clay resources of the San Antonio area was prepared.

The geology of the Guadalupe Peak quadrangle and the Cambro-Ordovician of the Central Mineral Region were studied through grants from the Geological Society of America. A report on the geology of the Monument and Marathon quadrangles was submitted for Survey publication. Papers on potash in Texas and an unconformity in the late Paleozoic of trans-Pecos Texas were sent to the State Bureau of Economic Geology. Further studies were in progress on the fossils of the Navarro formation of Texas (in cooperation with the Texas Bureau), the geology of the Guadalupe Mountains, and the Eocene faunas of the Gulf region. A paper on upper Mississippian rocks of trans-Pecos Texas was sent to American Association of Petroleum Geologists for publication. Work on source rocks of petroleum is mentioned under California.

*Utah.*—Office work was continued on reports on the geology and structure of southeastern Utah; the geology of the area between Green and Colorado Rivers in Grand and San Juan Counties; the structure, stratigraphy, and coal resources of the western part of the Wasatch Plateau; and stratigraphic relations of the Wasatch formation in central Utah. A manuscript on the San Juan country, a geographic and geologic reconnaissance of southeastern Utah, was submitted for publication as a professional paper.

*Vermont.*—A report on the addition to the Green Mountain National Forest was made for the Forest Service.

*Virginia.*—Studies of the lead, zinc, gold, and other minerals of Smyth, Wythe, and Carroll Counties, southwestern Virginia, made through Public Works Administration funds, beginning in 1934, were continued. Preliminary reports on these investigations published by the Virginia Geological Survey include papers on the zinc belt, the copper and iron deposits, and the gold deposits. Examinations of the gold regions of the Piedmont area (Federal

projects 158 and 183) will be covered by a paper also to be published by the Virginia Geological Survey. Manganese deposits were examined near Lynchburg and Galax. Examinations were made of the Clinch River purchase area and of the Mountain Lake forest-reserve tract for the Forest Service. A paper on the titanium deposits of the State is in preparation.

*Washington.*—Fossil plants were collected from the Latah formation in the vicinity of Spokane, and a paper entitled "Leaves and fruits from Miocene strata in Idaho, Oregon, and Washington", was submitted for publication in the *Journal of Paleontology*.

*West Virginia.*—The results of investigation of the manganese deposits of eastern West Virginia (Federal project 169) have been included in a report submitted to the West Virginia Geological and Economic Survey.

*Wyoming.*—A detailed report with geologic map on the mineral resources and structure of the Afton quadrangle is in preparation, and a paper on anticlines between the Hiawatha gas field and Baggs was sent to the American Association of Petroleum Geologists.

## WORK IN CHEMISTRY AND PHYSICS

The chemical work consists largely of routine analyses and tests of ores, rocks, and minerals collected on account of their bearing on geologic problems, such as the mapping and valuation of mineral deposits and the origin and method of deposition of ores. Many tests are also made of mineral specimens submitted by correspondents of the Survey. Individual minerals are analyzed and technically described, the age of minerals and rocks is determined by special chemical analyses, and new methods of analysis are devised and tested for the purpose of obtaining more accurate results.

Among materials analyzed in the laboratory during the year were a geode of hematite containing gas, liquid, and solid inclusions; samarskite from Connecticut, which checked in age with two other minerals previously analyzed from the same locality; jarosite from Texas; chromite from California; alunite from Utah; pollucite from South Dakota; pyroxene from Virginia; cerite from Colorado; rutile from Virginia; over 56 igneous rocks, a great variety of clays, ores, sediments, and several new minerals. A new deposit of natural alkali in Ward County, Tex., identified and described in the Survey laboratory, was put into production during the year. The production of natural alkali has steadily increased during recent years.

During the year 4,236 examinations or tests of minerals and rock samples were made. These included 926 specimens tested or identified for persons not officially connected with the Survey. There were 1,682 chemical analyses made for geologists or in aid of general geologic projects, and 685 similar analyses were made in connection with studies of methods of analysis and geochemical investigations relating to the formation and alteration of minerals under natural conditions. The remaining 943 tests related to potash cores, well cuttings, and similar samples.

Among the more important items of work in physics were the testing of more than 1,500 samples of clay with reference to their effectiveness in bleaching oil and the best methods of treating them for that purpose; and the observations of temperature in deep wells in Pennsylvania, West Virginia, Alabama, Mississippi, Louisiana, Utah, and California. Several classes of geologic data were subjected to mathematical discussion.

## ALASKAN BRANCH

The Geological Survey's work in Alaska is concerned primarily with the investigation of the mineral resources of the Territory and comprises field examination of the various factors that pertain to the character, distribution, and development of these resources, and laboratory and office studies by which these field observations are analyzed and the results made available to the public through reports, maps, and other media. In addition to the funds regularly appropriated by Congress for this work, funds from the Public Works Administration were granted to supplement those for a general project (Federal project 162) and to enable the Geological Survey to carry on special mapping work (Federal project 69). Cooperation was also continued with the Alaska Railroad, the expense of which was borne mainly by the railroad. The work of the branch, in addition to serving the prime purpose of assisting the mining industry, is utilized extensively by Government organizations having to do with other special fields of investigation within the Territory, such as the Forest Service, the Alaska Road Commission, and the Biological Survey. The Geological Survey's maps of Alaska are indispensable in any enterprises concerned with the development of the Territory.

*Manuscripts and publications.*—During the year 4 reports and 2 maps have been published. In addition, 11 manuscript reports (including maps) and 4 separate manuscript maps have been completed by their authors and are in various stages of critical review, proof, or preparation for publication. A reprint of one map previously published is in press. At the end of the year 8 manuscript reports and 4 manuscript maps were partly completed.

*Work of the year.*—In addition to the routine duties, 9 principal projects, 7 of which involved new field work, were carried on during the season of 1934. The field projects included 5 that were principally geologic and 2 that were primarily topographic. The projects involving new geologic field work were located in the area adjacent to Ketchikan, southeastern Alaska; in part of the Alaska Range, including the headwater region of the Copper River Valley and parts of the Tanana Valley; in the Kaiyuh Mountains, which lie south and east of the Yukon River in the region west of Ruby and southeast of Kaltag; in the northern and eastern part of Kodiak Island, southwestern Alaska; and in the coal fields adjacent to Eska, in the Matanuska district of the Cook Inlet-Susitna region. The Eska work was financed by and carried on at the request of the Alaska Railroad and mainly in its interest. The topographic projects include the mapping of an extensive tract of Admiralty Island and

adjacent parts of the Juneau district, in southeastern Alaska, and mapping of parts of the Alaska Range at the head of the Copper River, especially in the vicinity of Mentasta Pass and Suslota Lake. The two projects not directly involving new field work were the continuation of the compilation of drainage maps of southeastern Alaska from the airplane photographs taken by the Navy Department and the annual canvass of mineral production.

In order to utilize effectively the all too short open season, the Geological Survey field parties begin work in the spring as early as climate and other conditions permit. The field projects for the season of 1935 were begun a month or more before the end of the fiscal year, but as most of the field parties were out of touch by ordinary means of communication, it is not practicable to give here more than a summary of the work that it is expected will be accomplished.

Six field projects have been authorized for the season of 1935, and their completion, with the essential office work, will occupy all the time until well into the spring of 1936. These projects include 4 geologic investigations and 2 topographic mapping projects, in addition to the usual canvass of mineral production, further compilation of planimetric base maps, and other miscellaneous general work.

The four geologic projects include studies of that part of the Alaska Range region east of the Richardson Highway and north of Slana; of the central and southern part of Kodiak Island; of the Tikchik Lake district of southwestern Alaska; and a general study of the permanently frozen ground as affecting mining development in central and western Alaska, especially in the Fairbanks and Nome districts.

The two topographic field projects include the continuation of surveying and mapping in the Admiralty Island area of southeastern Alaska west of Juneau and in the Alaska Range region, especially in the Tok Valley and adjacent parts of the Tanana region south of Tanana Crossing.

## 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 topographic field sheets prior to their submission for reproduction and the computation and adjustment of the results of control field work.

The status of topographic surveys shows that the country as a whole is now 46.7 percent mapped, the year's increment amounting to 0.7 percent. The area covered by topographic base maps without contours and prepared from aerial photographs after field examinations continued large.

### FIELD SURVEYS

Abbreviations for projects used below: Federal Emergency Administration of Public Works, "P. W."; Tennessee Valley Authority, "T. V. A."; Federal Emergency Relief Administration, State projects, "F. E. R. A." Cooperation with States was continued on a smaller scale than in recent years.

*Alabama.*—Palos and Basham 15' quadrangles (P. W.) completed, and Mount Hope 15' quadrangle (P. W.) continued. Mapping without contours from aerial photographs begun for 7½' quadrangles within Iuka 15' quadrangle (T. V. A.).

*Arizona.*—Payson No. 1, Payson No. 2, and Castle Dome Peak No. 3 15' quadrangles (P. W.) completed; Grand Encampment National Monument (P. W.) continued; Payson No. 3 15' quadrangle (P. W.) begun.

*Arkansas.*—In cooperation with the United States Army district engineer at Vicksburg, Felsenthal, Moro Bay, Stuttgart, and S½ Ingalls 15' quadrangles completed. Watalula and Alexander 15' quadrangles (P. W.) and Scott No. 2, Cabot No. 3, and Alexander No. 1 7½' quadrangles (P. W.) completed; Caddo Gap No. 1 and Caddo Gap No. 2 15' quadrangles (P. W.) and North Little Rock No. 4 7½' quadrangle (P. W.) begun.

*California.*—In cooperation with the county surveyor of Los Angeles County, Acton, Mount Wilson, Chileno Canyon, Camp Rincon, Camp Bonita, Pallett Creek, Boneyard Canyon, Mescal Creek, and Valyermo 6' quadrangles completed; Mount Emma, Alder Creek, Trail Canyon, and Mount Gleason 6' quadrangles begun. Paynes Creek 30' quadrangle (P. W.) continued; Burney 30' quadrangle (P. W.) begun.

*Colorado.*—Como No. 2 and Taylor Park 15' quadrangles (P. W.), Grand Encampment 30' quadrangle (P. W.), Colorado National Monument and Black Canyon National Monument (P. W.) completed; Castle Rock Nos. 1 and 2, Castle Rock Nos. 3 and 4, East Denver Nos. 3 and 4, Leadville No. 1, and Leadville No. 4 15' quadrangles (P. W.) begun.

*Connecticut.*—7½' New London and Niantic 7½' quadrangles (P. W.) completed; New London No. 2 7½' quadrangle (P. W.) begun.

*Delaware.*—Wilmington special map (P. W.) begun.

*Florida.*—De Funiak Springs, Oscar, Mary Esther, and Y Y 15' quadrangles (P. W.) completed; Point Washington 15' quadrangle (P. W.) begun.

*Georgia.*—Warm Springs 15' quadrangle (P. W.) completed; Thomaston 15' quadrangle (P. W.) continued. Mapping without contours from aerial photographs completed for 7½' quadrangles within Hemp, Porter Springs, Blue Ridge, Randa, Blairsville, Cartecay, and Cohutta 15' quadrangles (T. V. A.).

*Idaho.*—American Falls No. 1, American Falls No. 2, and American Falls No. 3 15' quadrangles (P. W.) and Metaline 30' quadrangle (P. W.) completed; Yellow Pine No. 2 and Washington Creek No. 2 15' quadrangles (P. W.) and Mackay and Dickey 30' quadrangles (P. W.) begun.

*Illinois.*—Burlington, Oquawka, Iuka, Wenona, Morrison, and Lamotte 15' quadrangles completed; Keithburg, Arcola, Shelbyville, Lovington, and Delavan 15' quadrangles continued; Mionok, Stewardson, and Miles 15' quadrangles begun in cooperation with the Department of Registration and Education of Illinois, Geological Survey. Sycamore, De Kalb, and Mattoon 15' quadrangles (P. W.) completed; Watseka and Pontiac 15' quadrangles begun.

*Indiana.*—Heltonville, Watseka, and Porter 15' quadrangles (P. W.) completed; Oolitic 15' quadrangle (P. W.) continued.

*Iowa.*—Melrose, McPaul, Iowa City, and Humeston 15' quadrangles (P. W.) completed.

*Kansas.*—W½ of Waldron 15' quadrangle (P. W.) and Armourdale No. 1, Olathe 1b, and Olathe 2a 7½' quadrangles (P. W.) completed.

*Kentucky.*—Munfordville and Cecilia 15' quadrangles (P. W.) completed. Mapping without contours from aerial photographs completed for Sneedville No. 2 quadrangle (T. V. A.).

*Louisiana.*—The Louisiana Board of State Engineers cooperating, mapping without contours from aerial photographs completed for 7½' quadrangles within Creole, Dulac, Pointe a la Hache, Crowley, Welsh, Jennings, Lafayette,

Sulphur, Donaldsonville, Bayou de Large, Dime, Chandeleur, Bodreau, Shell Beach, St. Bernard, Bonnet Carre, Spanish Fort, Chef Menteur, Toulme, Timbalier, Cheniere Caminada, Lake Felicity, East Delta, West Delta, Breton Island, Forts, Quarantine, Fort Livingston, La Fortuna, Cat Island, Rigolets, Mount Airy, Raccoon Point, Caillou Island, and Marsh Island 15' quadrangles. Contours for 7½' quadrangles within Chef Menteur, Spanish Fort, Bonnet Carre, New Orleans N½, and Hahnville N½ 15' quadrangles (P. W.) completed; contours for St. Bernard NW. quadrangle (P. W.) begun.

*Maine.*—In cooperation with the Public Utilities Commission of Maine, Mars Hill 15' quadrangle continued. Houlton, Burleigh, and Bridgewater Center 15' quadrangles (P. W.) completed; St. Croix 15' quadrangle (P. W.) and Acadia National Park (P. W.) begun.

*Maryland.*—Patuxent No. 2 E½ and Prince Frederick 15' quadrangles (P. W.) completed; Leonardtown 15' quadrangle (P. W.) begun.

*Massachusetts.*—In cooperation with the Department of Public Works, Division of Waterways, Wareham, Mount Tom, 7½' Plymouth, Easthampton, and Northampton No. 4 7½' quadrangles completed; Falmouth No. 1 and Northampton No. 1 7½' quadrangles begun. Worcester No. 4 7½' quadrangle (P. W.) completed; Webster No. 1 7½' quadrangle (P. W.) begun.

*Michigan.*—Merrill and Sanford 15' quadrangles (P. W.) and Toledo Nos. 1 and 2 7½' quadrangles (P. W.) completed; Cement City 15' quadrangle (P. W.) continued; Ithaca 15' quadrangle (P. W.) begun.

*Minnesota.*—Cochrane, Fountain City, Plainview, and Grand Forks 15' quadrangles (P. W.) and Grand Forks No. 1 7½' quadrangle (P. W.) completed; Rochester 15' quadrangle (P. W.) begun.

*Mississippi.*—Vicksburg National Military Park (P. W.) completed; Edwards 15' quadrangle (P. W.) continued. Mapping without contours from aerial photographs begun for 7½' quadrangles within Iuka 15' quadrangle (T. V. A.).

*Missouri.*—In cooperation with the Geological Survey and Water Resources of Missouri, Nebo, Berryman, Upalika, Hardin, Greenville, Elsberry, Zaroni, and Linn 15' quadrangles and Versailles 3a, Versailles 3c, Versailles 3d, Versailles 4a, Versailles 4b, Versailles 4c, Versailles 4d, Butler 4c, Butler 4d, Meramec State Park, Jefferson City 2a, Harrisonville 1b, Harrisonville 2a, Springfield 3a, Independence 3c, and Eldon No. 4 7½' quadrangles completed; Stone Hill and Kearney 15' quadrangles continued; Boss, Nevada No. 1, and Knobnoster 15' quadrangles and Stockton 2b, Independence 4d, Butler 3d, Clinton 3c, Warsaw 4d, Harrisonville 1a, Harrisonville 1c, Harrisonville 2c, Harrisonville 2d, Glasgow 4b, and Olathe 1d 7½' quadrangles begun. Armourdale No. 1, Armourdale No. 4, Independence 3a, Independence 4b, and Gravois Mills No. 4 7½' quadrangles (P. W.) completed; Eldon No. 3, Gravois Mills No. 3, Warsaw 1d, Warsaw 3a, Warsaw 4a, Warsaw 4b, Independence 3b, and Versailles 3b 7½' quadrangles (P. W.) and Morrison and Sullivan No. 2 15' quadrangle (F. E. R. A.) begun.

*Montana.*—Dupuyer No. 1 and Dupuyer No. 2 15' quadrangles (P. W.) and Thompson 30' quadrangle (P. W.) completed; Jennings and Silver Tip 30' quadrangles (P. W.) begun.

*Nebraska.*—Utica, Seward No. 1, and McPaul 15' quadrangles (P. W.) completed; Seward No. 4 15' quadrangle (P. W.) begun.

*Nevada.*—Skelton 30' quadrangle (P. W.) completed; Gold Creek No. 4 15' quadrangle (P. W.) continued; and Washoe district (P. W.) begun.

*New Hampshire.*—Mount Washington 15' quadrangle (P. W.) completed; Whitefield 15' quadrangle (P. W.) continued.

*New Jersey*.—Ramapo No. 4 and Paterson No. 1 7½' quadrangles (P. W.) completed; Paterson No. 4 7½' quadrangle (P. W.) begun.

*New Mexico*.—Arabela No. 3 15' quadrangle (P. W.), Potash special (P. W.), Albuquerque 4a, Albuquerque 4b, Albuquerque 4c, and Albuquerque 4d 7½' quadrangles (F. E. R. A.) completed; Los Lunas 1a 7½' quadrangle (F. E. R. A.) and Arabela No. 4 and Hillsboro Peak No. 1 15' quadrangles (P. W.) begun.

*New York*.—Rhinebeck 15' quadrangle completed and Poughkeepsie Nos. 2 and 3 7½' quadrangles begun, in cooperation with the Department of Public Works of New York. Saratoga No. 3, Saratoga No. 4, Quaker Springs, Castle Creek, and 7½' New London 7½' quadrangles (P. W.) completed; Schuylerville No. 4, Binghamton No. 1, and Binghamton No. 7½' quadrangles (P. W.) begun.

*North Carolina*.—Corundum, Banner Elk, and Ranger 15' quadrangles (P. W.) completed; Blowing Rock and Farner 15' quadrangles (P. W.) continued. Mapping without contours from aerial photographs completed for 7½' quadrangles within Hayesville, Hemp, Ranger, Blue Ridge, Blairsville, Erwin, Montreat, Meat Camp, Mountain City, Highlands, Addie, Lake Toxaway, Mount Rogers, and Pattonville 15' quadrangles (T. V. A.) and begun for 7½' quadrangles within Tigersville, Edneyville, Arden, Democrat, and Brevard 15' quadrangles (T. V. A.).

*North Dakota*.—Grand Forks No. 1 7½' quadrangle (P. W.) and Grand Forks, Emerado, and Larimore No. 1 15' quadrangles (P. W.) completed; Larimore No. 2 and McVile 15' quadrangles (P. W.) begun.

*Ohio*.—Toledo No. 1, Toledo No. 2, Toledo No. 3, Toledo No. 4, and Maumee Bay No. 2 7½' quadrangles (P. W.) completed; McClure No. 1 and Swanton No. 4 7½' quadrangles (P. W.) begun.

*Oklahoma*.—Edmond 15' quadrangle (P. W.) and Edmond No. 3 7½' quadrangle (P. W.) completed.

*Oregon*.—McKenzie Bridge 30' quadrangle (P. W.) completed; Disston 30' quadrangle (P. W.) and extension of Crater Lake National Park (P. W.) continued.

*Pennsylvania*.—In cooperation with the Department of Internal Affairs of Pennsylvania, Topographic and Geologic Survey, Allentown and Kane 15' quadrangles completed and Mount Jewett and Sheffield 15' quadrangles begun. Mifflintown 15' quadrangle (P. W.) completed; Needmore and Menno 15' quadrangles (P. W.) begun. Cultural revision completed for Cameron and Wheeling 15' quadrangles (P. W.).

*Rhode Island*.—Providence No. 3 7½' quadrangle (P. W.) completed.

*South Carolina*.—Greenville, Killian, Camden, and Wellford 15' quadrangles (P. W.) completed. Mapping without contours from aerial photographs completed for 7½' quadrangles within Timmonsville, Marion, and Florence 15' quadrangles (F. E. R. A.) and begun within Irmo and Fort Motte 15' quadrangles (F. E. R. A.).

*South Dakota*.—Fort Pierre No. 1 and Van Metre No. 1 15' quadrangles (P. W.) and Wind Cave National Park (P. W.) completed; Oacoma No. 2 15' quadrangle (P. W.) begun.

*Tennessee*.—Tellico 15' quadrangle (P. W.) completed; Farner 15' quadrangle continued. Mapping without contours from aerial photographs completed for 7½' quadrangles within Damascus, Gate City, Elizabeth, Blountville, Robbinsville, Surgoinsville, Small, Sneedville, Johnson City, Grady, Erwin, Meat Camp, Mountain City, Tellico, Wallace, Dandridge, Pattonville, Mount Rogers, and Hagan 15' quadrangles (T. V. A.) and begun for 7½' quadrangles within Gillises Mills, Adamsville, Tate Springs, English Mountain, Straw Plains, Co-hutta, Midway, Conasauga, Ooltewah, Rogersville, Newport, and Sevierville 15' quadrangles (T. V. A.).

*Texas*.—Longview No. 3 15' quadrangle (P. W.) completed; Longview No. 2 and Dumas No. 4 15' quadrangles (P. W.) begun.

*Utah*.—A portion of Salt Lake County (P. W.) completed; Theodore 30' quadrangle (P. W.) continued; Elk Ridge 30' quadrangle (P. W.) begun.

*Vermont*.—In cooperation with the State geologist of Vermont, Woodsville 15' quadrangle continued. Wolcott 15' quadrangle (P. W.) completed; Wheelock 15' quadrangle (P. W.) begun.

*Virginia*.—Mount Rogers and Mouth of Wilson 15' quadrangles and Studley 7½' quadrangle completed and Charlottesville and Burkes Garden 15' quadrangles, Midlothian No. 1 and Midlothian No. 4 7½' quadrangles, and Charlottesville special begun in cooperation with the Conservation and Development Commission of Virginia, Geological Survey. Balcony Falls 15' quadrangle (P. W.) and Fredericksburg-Spotsylvania Battlefield National Monument (P. W.) completed; Vesuvius and Amherst 15' quadrangles (P. W.) begun. Mapping without contours from aerial photographs completed for 7½' quadrangles within Carterton, Damascus, Burkes Garden, Marion, Glade Spring, Gate City, Blountville, Rural Retreat, Wise, Robbinsville, Sneedville, Wallace, Mount Rogers, Hagan, Mouth of Wilson, Pound, Coeburn, Whitesburg, Pounding Mill, Big Stone Gap, Richlands, Nolensburg, Bucu, and Pattonville 15' quadrangles (T. V. A.).

*Washington*.—Mount Constance, Fort Simcoe, Eatonville, and Metaline 30' quadrangles (P. W.) and Troutdale 15' quadrangle (F. E. R. A.) completed; Marcus 30' quadrangle (P. W.) begun.

*West Virginia*.—Cultural revision completed for Richwood, White Sulphur Springs, Lobelia, Clintonsville, Cameron, Wheeling, and Clarington 15' quadrangles (P. W.); Steubenville 15' quadrangle (P. W.) begun.

*Wisconsin*.—Chippewa Falls and Elk Mound 15' quadrangles (P. W.) completed; Osseo and Arkansas 15' quadrangles (P. W.) continued.

*Wyoming*.—Grand Encampment 30' quadrangle (P. W.) completed; Grand Teton National Park (P. W.) continued; Viola No. 2 15' quadrangle, Daniel W¼ 7½' by 30' quadrangle and Cokeville N½ 30' quadrangle (P. W.) begun.

*Puerto Rico*.—Parguera, Point Cabo Rojo, and Guanica 7½' quadrangles (P. W.) completed; Puerto Real, Sabana Grande, and San German 7½' quadrangles (P. W.) begun.

## WATER-RESOURCES BRANCH

The importance of water and of records related to the quality, chemical character, and availability of both surface and ground waters becomes increasingly apparent 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 culminated in the disastrous and widespread drought in 1934 and the recent dust storms throughout the Central West, have served to impress on all the people the controlling importance of water in our surface streams and in underground basins in relation to many of man's activities. The Public Works Administration and related activities have found the information with respect to water to be invaluable in studies of projects of all classes and in all sections of the country and have relied on the records of the Geological Survey as a basis for action on many projects.

Reliable information with respect to these supplies of water and to their fluctuations with variations in rainfall is essential to orderly, stable, and economic development along many lines and, therefore, to the national welfare. The work of the water-resources branch thus assumes a position of great importance in the economic affairs of the Nation.

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 were conducted for the following Federal bureaus through advance, transfer, or repay of funds:

Department of Agriculture:

Bureau of Agricultural Engineering.

Weather Bureau.

Bureau of Biological Survey.

Soil Conservation Service.

Department of Commerce: Bureau of Air Commerce.

Department of the Interior:

Subsistence Homesteads.

Bureau of Indian Affairs.

Bureau of Reclamation.

National Park Service.

Department of the Navy: Bureau of Yards and Docks.

Department of State.

Department of War: Office of the Chief of Engineers.

Federal Power Commission.

Tennessee Valley Authority.

Federal Emergency Administration of Public Works.

*States.*—Amounts aggregating \$496,909.46 were made available by States and municipalities for cooperative surface- and ground-water investigations. In addition to the results obtained directly from cooperation, it is estimated that data valued at over \$115,000 were furnished by cooperating officials.

*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 310 gaging stations was conducted by the branch or was performed by permittees and licensees under the supervision of the branch in connection with 129 projects of the Federal Power Commission. Engineers of the branch have had general supervision of operations under permits and licenses of the Federal Power Commission in connection with 132 projects. Examinations and reports on applications for projects have been made for the Commission as requested.

## WORK OF THE YEAR, BY DIVISIONS

The division of surface water conducts investigations of surface water, which consist of the measurement of the flow of rivers, conducted 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, from which the daily discharge of the rivers is computed. In this work 41 States, the Territory of Hawaii, and several Federal bureaus and individuals cooperated in the maintenance of the 3,022 regular gaging stations that were in service at the end of the year. Records for about 113 additional gaging stations were received, ready for publication, from Federal bureaus and from individuals. There were 37,770 discharge measurements made during the year.

The division of ground water investigates the waters that lie below the surface in the zone of saturation (from which the wells and springs are supplied); the surface, 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 generally published in water-supply papers that include maps showing the ground-water conditions. The investigations relating to the chemical composition of the water are made in cooperation with the division of quality of water. Projects involving large expenditures for drilling wells to develop water supplies are considered each year by the several departments of the United States Government, and the ground-water division is called upon to furnish information and advice on many of these projects. During the fiscal year about 80 investigations relating to ground water and reservoir sites were in progress, and work was done in 32 States and in the Territory of Hawaii, in cooperation with State or local governmental agencies, or on Public Works Administration projects. In the hydrologic laboratory 126 samples of water-bearing material were analyzed.

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 such use is affected by the dissolved mineral matter. The analysis (partial or complete) of 1,387 samples of water, including some for nearly all the studies of ground water in the different States, was completed during the year.

The work of the division of power resources comprised the preparation of monthly and annual reports on the production of electricity for public use and the consumption of fuel in generating the electricity reported. The monthly reports also include, through cooperation with the Bureau of Mines, comparative figures of the stocks of bituminous and anthracite coal on hand at electric public

utilities, the monthly consumption of coal, and the number of days' supply of bituminous and anthracite coal on hand at the current rate of consumption. The annual report contains revised figures of the monthly production of electricity and consumption of fuel in 1934 previously published in the monthly reports, a summary of the annual reports from 1919 to 1934, the average annual rate of consumption of coal and the coal equivalent of oil and gas in generating 1 kilowatt-hour of electricity from 1919 to 1934, and the annual exports and imports of electricity between the United States and Canada and Mexico for certain years. A report of the capacity of water wheels in the United States on January 1 was also prepared. The final report of the monthly and annual production of electricity for public use in 1934 was released April 20, 1935. The annual report of the capacity of water wheels in water-power plants in the United States was released January 24, 1935.

The division of water utilization investigates problems affecting the utilization and control of the waters of streams and performs administrative work relating to supervision and investigation of these problems by the field organization of the water-resources branch and of power projects of the Federal Power Commission and of the Interior Department. The field work is generally conducted by personnel otherwise assigned to the division of surface water. In collaboration with the Mississippi Valley Committee of the Public Works Administration studies were made of floods in the United States, with especial reference to their magnitude and frequency, and of the relations of rainfall and run-off in the United States. A report on the flood study was completed and sent to the printer, and a report on the rainfall and run-off study was practically completed by the end of the year.

## CONSERVATION BRANCH

The regular work of the conservation branch was retarded during the fiscal year 1935 by insufficient funds and personnel. Office phases of the work were maintained reasonably current until March, when congestion developed in consequence of the receipt for technical consideration of a large number of proposed unit plans of development and operation, submitted by Federal oil and gas permittees in compliance with departmental requirements. This congestion increased steadily thereafter and attained serious proportions before the end of the year. Field phases of branch work were necessarily neglected in all lines except power classification and agricultural classification, where funds from extra-branch sources made possible the conduct of several needed surveys. Geologic

work was possible in only two small areas, and field inspection of mines and of oil and gas operations, already far in arrears, was further attenuated by the necessary detail of supervisory personnel to Public Works projects and by an abnormal increase in new properties and new operations to be supervised.

By departmental order 884, effective March 21, 1935, the work of agricultural and grazing classification was transferred to the departmental Division of Grazing, and the office and field personnel of the branch engaged in that work was detailed to that division for the remainder of the year.

### MINERAL-CLASSIFICATION DIVISION

The work of the mineral-classification division was restricted rather closely to office phases and was materially impeded by the negligible inflow of basic data from the field. The trend of division activity from strict classification to phases concerned with administration of the mineral leasing law was accentuated by the assignment to the division of the responsibility for determining the areas subject to logical unitization under plans for unit or cooperative development submitted by the holders of Federal oil and gas prospecting permits. Appreciable progress was made, nevertheless, in classifying the vast areas of public land withdrawn early in the century for examination and classification as to mineral. Classifications effected include 224,444 acres as coal land, 661,091 acres as noncoal land, 19,211 acres as oil-shale land, and 248,473 acres as non-oil-shale land.

In addition to the technical adjudication of 2,003 applications for mineral prospecting permit, 118 applications for mineral lease, and 859 conflicts or anticipated conflicts between mineral applicants and surface-right applicants; the technical review and endorsement of 732 assignments, coal-permit extensions, lease and license authorizations; the preparation of 1,648 decisions for the departmental committee affecting the extension of oil and gas prospecting permits and potash permits; and the consideration of some 30 plans of unit operation and development for oil and gas fields or areas, definitions of the "known geologic structure" of two producing oil and gas fields were prepared and promulgated, as follows: Last Chance, Utah, February 23, 1935, 26,480 acres; Rex Dome (addition), Wyo., November 21, 1934, 80 acres. The outstanding definitions of the "known geologic structure" of producing oil and gas fields on June 30, 1935, amounted to 986,906 acres in California, Colorado, Montana, New Mexico, 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 was directed chiefly to field phases. The continued availability of Public Works funds made possible the completion of river-utilization surveys involving some 1,900 linear miles of streams in Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming, with supplemental geologic and geophysical studies of foundation materials and conditions at 14 dam sites in Montana.

Office activities, expanded during the year to include duties involving Carey Act projects, irrigation projects, and reservoir-site reserves, formerly performed by the agricultural division but not transferred to the division of grazing, were necessarily reduced to the minimum. In addition to their showing in the general summary of cases they included action resulting in additions of 72,793 acres to outstanding water-power reserves in 11 public-land States and eliminations of 408,157 acres from such reserves in 8 States, with net decrease of the total reserved area in 22 States to 6,465,007 acres at the end of the year. Field supervision of power projects for the Federal Power Commission involved investigations and report on 15 projects, supervision of construction and operations under 132 projects, and studies of cost accounting on 5 projects.

Statistics compiled by the division show that the holders and users of rights of way for power purposes granted by the Secretary of the Interior had for the calendar year 1934 aggregate installed horsepower of 3,139,010, including 2,094,964 at hydraulic plants and 1,044,046 at fuel plants, and aggregate energy generation of 6,930,000,000 kilowatt-hours, which is less by 25 percent than the production in 1933 because of the elimination of one large producer from the roster of departmental grantees during 1933. Revenues accrued to the Government from these grants aggregate \$205,680 from 1912 to 1934, and \$15,663 additional has been assessed for the calendar year 1935. Accrued charges for unauthorized occupancy of public lands by power projects prior to the issuance of license therefor by the Federal Power Commission amount to \$112,230 additional, about \$12,000 of which is in litigation.

## AGRICULTURAL DIVISION

Until its functions of agricultural and grazing classification were transferred to the departmental Division of Grazing, March 21, 1935, the work of the agricultural division was restricted chiefly to office phases and to cooperation with departmental officials in preparing and promulgating regulations for effectuating the purposes of the

Taylor Grazing Act of June 28, 1934 (48 Stat. 1269), in organizing the departmental Division of Grazing, in conducting public hearings throughout the West to explain the purposes of the grazing act and the procedure of grazing-district organization, and in the conduct of reconnaissance surveys of grazing resources and conditions in several districts established under said act.

Although the filing of applications for agricultural classification and for designations under the stock-raising and enlarged homestead laws and the Nevada ground-water law was essentially terminated by the withdrawals approved by Executive order of November 26, 1934, the number of unadjudicated applications for rights under these laws transferred to the Division of Grazing on March 31, 1935, aggregated 1,999, an increase of 6.5 percent over the number pending at the beginning of the fiscal year.

Accomplishments prior to the transfer of function, not indicated in the general summary of cases, included the designation of 35,450 acres in 15 States as subject to entry under the Stock Raising Homestead Act and the cancelation of prior designations of 16,945,535 acres under that act, with net reduction of the outstanding designated area in 20 States to 102,429,247 acres; the designation of 1,894 acres in 7 States as enterable under the Enlarged Homestead Act and the cancelation of prior designations of 25,947,994 acres in 5 States, with net reduction of the outstanding designated area in 14 States to 268,467,585 acres; the inclusion of 12,480 acres in 11 States in public water reserves and the exclusion of 460 acres in 3 States from such reserves, with net increase of the gross area reserved in 13 States to 506,748 acres; and the designation of 2,600 acres under the Nevada Ground Water Act, with increase of the aggregate area so designated to 1,732,095 acres. Liaison service was maintained for the Interior Department with the Committee for Acquisition of Submarginal Land, of the Federal Emergency Relief Administration, and cooperative studies of the grazing and farm resources of Arizona, with the University of Arizona and the United States Forest Service, were continued.

## MINING AND OIL- AND GAS-LEASING DIVISION

The work of the mining and oil- and gas-leasing divisions, consisting of inspectional and regulatory supervision of mineral prospecting and development on public lands, Indian lands, and naval petroleum reserves, increased notably in volume and in difficulty of effective performance in the fiscal year 1935.

*Public lands.*—The number of public-land properties under supervision increased 17 percent, to a total of 8,394, involving 10,866,120 acres in 20 States and Alaska, and in the absence of sufficient funds for the most effective use of available personnel or for needed re-

placements and increase in supervisory forces the essential work of property inspection, already far in arrears, was perilously meager. With the aid of funds allotted in 1933 by the Public Works Administration the supervisory force was maintained essentially intact, though available only in part for regular inspectional and regulatory work, and was enabled to accomplish important conservational and remedial results outlined more fully under the heading "Public Works projects."

The work of the oil- and gas-leasing division was vastly increased in 1935, both in Washington and in the field, by the necessity of 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 of reviewing and revising the engineering and royalty features of such plans after their submission.

Three unit plans were completed and approved during the year—for the Round Mountain field, California, the Fourbear field, Wyoming, and for unit 5 of the Cedar Creek field, Montana—and at the end of the year about 400 other plans were awaiting technical consideration in the Washington office alone, with little prospect of timely consideration by the small and fully preoccupied personnel available. The work of this division was further increased by departmental regulations approved October 23, 1934, under the O'Mahoney Water Act, of June 16, 1934 (48 Stat. 977), to include remedial work necessary to preserve and make accessible water supplies found in wells drilled for oil and gas on public land and determined to be valuable for agricultural, domestic, or other purposes.

Drilling activity on public lands during the year included the spudding of 203 new wells and the completion of 268 others, 120 of which were productive of oil or gas and 148 barren. The total number of wells under supervision at the end of the year was 7,200 in 15 States and Alaska, including 3,699 capable of oil or gas production. The production of petroleum, natural gas, and natural gasoline from public land in 1935 was substantially greater than in other recent years, and the revenues accrued therefrom were materially increased.

The regular work of the mining division, involving Federal properties under development or exploration for coal, potash, sodium, phosphate rock, sulphur, and oil shale, increased moderately in the fiscal year 1935, but its performance was subordinated, by necessity, to remedial activities financed by Public Works funds. Coal properties under supervision in 14 States and Alaska increased 28, to a total of 758; potash properties in 8 States decreased 8, to a total of 204; sodium properties in 9 States increased 6, to a total of 45; and sulphur properties in 1 State increased 4, to a total of 26.

The number of phosphate properties (8 in 3 States) and of oil-shale properties (1) remained unchanged. Mineral prospecting during the year included 30 holes with aggregate of 14,957 feet, drilled for coal in Wyoming; 3 holes, 2,546 feet, drilled for sodium in California; and 5 holes, 5,331 feet, drilled for potash in New Mexico, as well as innumerable shallow holes and surface excavations in all public-land States. Safety and welfare conditions on mining properties under supervision remained generally satisfactory throughout the year, five coal properties receiving awards and one coal operator a trophy from the Joseph A. Holmes Safety Association, for outstanding accident-free accomplishment.

*Indian lands.*—On behalf of the Office of Indian Affairs technical supervision of mineral development was continued in 1935 on tribal and restricted allotted lands within the limits of numerous Indian reservations. Oil and gas supervision involved 4,812 leaseholds, 4,477 wells, and aggregate royalty and rental accruals of \$338,164.63 for Indian beneficiaries in 7 States and in 27 different tribes and included royalty accounting for certain agencies, appraisals of bonus and royalty offers and of 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 36 lead and zinc leaseholds in the Quapaw Reservation, Okla., with aggregate royalty accruals of \$216,557.04 during the year; 39 coal leaseholds involving Choctaw, Chickasaw, and Five Tribes land in Oklahoma, with aggregate production of 860,033 tons of coal and revenue accruals of \$103,505.05; 1 asphalt lease involving segregated Choctaw and Chickasaw land, Oklahoma; 1 lime phosphate lease involving restricted allotted Five Tribes land, Oklahoma; and several scattered agency coal mines in the Western States. It included also special investigations of mining and marketing procedure under an asbestos leasehold in the San Carlos Reservation, Ariz., and of feasible methods of controlling coal-mine fires affecting lands in the Crow and Fort Peck Reservations, Mont.

*Naval petroleum reserves.*—On behalf of the Navy Department supervision was continued during the 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 the California reserves aggregated 3,415,743.46 barrels of petroleum, 3,633,889,000 cubic feet of natural gas, and 12,841,346.20 gallons of natural gasoline, and had an aggregate royalty value of \$561,541.31.

## PUBLIC WORKS PROJECTS

Under the supervision of conservation branch personnel aggregate expenditures of \$535,872.05 were made during the fiscal year 1935 from funds allotted by the Public Works Administration in 1933, for field investigations and conservational work pertinent to branch functions. On four Federal projects \$1,875.75 was expended for repairs and improvements at field camps maintained for branch employees at Taft, Calif., and Midwest, Wyo. On 11 projects \$179,058.86 was expended for utilization surveys of power and storage resources of important streams in 11 public-land States. On 13 projects \$354,934.44 was expended in 11 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 thereafter improperly abandoned or merely deserted; in extinguishing or controlling coal-outcrop fires, and in filling, bulkheading, or otherwise safeguarding abandoned mine or prospect 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. Work was terminated under practically all these projects on or before June 30, 1935, by reason of the exhaustion of funds originally allotted. On a few projects unexpended balances were available and work was continued beyond the end of the fiscal year under authority of the President.

## SUMMARY OF FIELD ACTIVITIES, BY STATES

*Alabama.*—Visited oil and gas prospecting operations throughout the State in aid of mineral classification. Examined one tract in Fayette County for adjudication of conflicting mineral and nonmineral filings. Supervised 1 lease for coal and 1 lease and 1 prospecting permit for oil and gas.

*Alaska.*—Supervised 1 power project; 2 leases, 1 license, and 9 prospecting permits for coal; and 100 prospecting permits for oil and gas.

*Arizona.*—Supervised 25 power projects, completed 111 miles of stream-utilization surveys on Little Colorado, Verde, Williams, Gila, and San Francisco Rivers and examined the Williams reservoir site. Conducted range-classification studies and participated in grazing-law hearings at Prescott and Phoenix. Supervised on public land 2 prospecting permits for coal, 6 for potash, 4 for sodium, and 62 for oil and gas; and on Indian land, 2 leases for oil and gas.

*Arkansas.*—Visited oil and gas prospecting operations in the western part of the Arkansas Valley in aid of mineral classification and examined for minerals lands in Logan and Yell Counties sought for recreational purposes by the State. Supervised 1 power project and 7 oil and gas prospecting permits.

*California.*—Supervised 90 power projects, completed 237 miles of stream-utilization surveys on Kern, Sacramento, and Yuba Rivers and Putah and Clear Creeks, and mapped in detail the Kennett, Kiswick, Whiskeytown, Anthony House, Upper Nanous, Copoy, and Monticello reservoir sites. Con-

ducted range-classification studies in Grazing Districts Nos. 1 and 2 and participated in grazing-law hearings at San Francisco, Bakersfield, and Alturas. Supervised on public land 4 prospecting permits for coal, 2 for potash, 18 for sodium, and 980 for oil and gas, also 3 leases for potash and 214 for oil and gas; and on naval petroleum reserves 24 leases for oil and gas.

*Colorado.*—Examined land on the Garmesa anticline to determine the source of seepage gas. Supervised 13 power projects, completed 176 miles of stream-utilization surveys on Gunnison, Lake Fork of Gunnison, Crystal, and Yampa Rivers and Roaring Fork, Cattle, and Frying Pan Creeks, and mapped in detail the Trujillo and Arboles reservoir sites, also 15 minor reservoir sites and 5 dam sites. Participated in grazing-law hearings at Glenwood Springs and Grand Junction. Supervised on public land 83 leases for coal, 1 for sodium, and 26 for oil and gas, 17 licenses for coal, 52 prospecting permits for coal, 1 for potash, and 541 for oil and gas; and on Indian land 7 leases for oil and gas.

*Florida.*—Visited oil and gas prospecting operations throughout the State and examined 1 tract each in Glades, Levy, Marion, and Suwannee Counties and 2 each in Dixie and Lafayette Counties for purposes of mineral classification.

*Idaho.*—Supervised 34 power projects, completed 132 miles of stream-utilization surveys on Snake, Kootenai, North Fork of Coeur d'Alene, and Priest Rivers and mapped in detail the Rush Beds and Black Canyon reservoir sites and 6 dam sites. Conducted range-classification studies in the southern part of the State, including investigations to determine well-drilling sites for the development of stock water, and participated in grazing-law hearings at Boise. Supervised 1 lease and 17 prospecting permits for coal, 2 leases for phosphate rock, and 76 prospecting permits for oil and gas.

*Kansas.*—Supervised 17 prospecting permits for oil and gas.

*Louisiana.*—Visited oil- and gas-prospecting operations throughout the State in aid of mineral classification. Supervised 11 leases for oil and gas.

*Mississippi.*—Visited oil- and gas-prospecting operations throughout the State and examined one tract in George County for purposes of mineral classification. Supervised 1 prospecting permit for oil and gas.

*Montana.*—Supervised 35 power projects, completed 260 miles of stream-utilization surveys on Blackfoot, Flathead, Kootenai, and Ruby Rivers, mapped in detail the Hungry Horse and Ruby reservoir sites, and made geologic and geophysical surveys of 14 dam sites. Conducted range-classification studies in Grazing District No. 1 and participated in grazing-law hearings at Billings and Malta. Supervised on public land 94 leases, 49 licenses, and 41 prospecting permits for coal, 5 leases for phosphate rock, 1 prospecting permit for potash, and 88 leases and 775 prospecting permits for oil and gas and on Indian land 68 leases for oil and gas.

*Nebraska.*—Supervised one prospecting permit for potash.

*Nevada.*—Supervised 17 power projects, completed 77 miles of stream-utilization surveys on Muddy, Little Humboldt, and Carson Rivers, and mapped in detail the Narrows reservoir site, 7 minor reservoir sites, and 3 dam sites. Participated in grazing-law hearings at Reno. Supervised 5 prospecting permits for coal, 1 for sodium, 7 for potassium, and 70 for oil and gas, and 1 lease for phosphatic material.

*New Mexico.*—Supervised 6 power projects, completed 268 miles of stream-utilization surveys on Chama, Grande, Gila, and Pecos Rivers and Willow Creek, and mapped in detail the Elvado reservoir site. Participated in grazing-law hearings at Albuquerque. Supervised on public land 25 leases and 26 prospecting permits for coal, 9 leases and 158 prospecting permits for potash, 12 prospecting

permits for sodium, 26 prospecting permits for sulphur, and 117 leases, 1,502 prospecting permits, and 8 suspended preference-right leases for oil and gas and on Indian land 9 leases for oil and gas.

*North Dakota.*—Participated in grazing-law hearings at Bismarck. Supervised 72 leases, 20 licenses, and 1 prospecting permit for coal and 21 prospecting permit for oil and gas.

*Oklahoma.*—Supervised 3 power projects. Supervised on public land 26 prospecting permits and 16 leases for oil and gas and on Indian land 4,704 leases for oil and gas, 39 leases for lead and zinc, and 31 leases, 3 awarded leases, 9 prospecting permits, and 5 awarded permits for coal.

*Oregon.*—Supervised 40 power projects, completed 129 miles of stream-utilization surveys on Hood and Umatilla Rivers and Gales and Willamina Creeks, and mapped in detail the Umatilla and Catherine Creek reservoir sites and 5 minor reservoir sites. Participated in grazing-law hearings at Klamath Falls, Burns, and Vale. Supervised 1 lease and 4 prospecting permits for coal, 2 prospecting permits for sodium, 107 prospecting permits for oil and gas, and 1 lease for oil shale.

*South Dakota.*—Participated in grazing-law hearings at Rapid City. Supervised 4 leases, 3 licenses, and 2 prospecting permits for coal and 38 prospecting permits for oil and gas.

*Utah.*—Supervised 18 power projects and completed the mapping of the Huntington Creek reservoir site. Participated in grazing-law hearings at Salt Lake City. Supervised on public land 41 leases, 3 licenses, and 81 prospecting permits for coal, 10 prospecting permits for sodium, 23 prospecting permits for potassium, and 11 leases and 597 prospecting permits for oil and gas and on Indian land 2 leases for oil and gas.

*Washington.*—Supervised 20 power projects, completed 260 miles of stream-utilization surveys on Clark Fork, Nooksack, Similkameen, Quinault, Hump-tulips, and Satsop Rivers and Sheep and Chewack Creeks, and mapped in detail 11 dam sites and numerous minor reservoir sites. Supervised 1 lease and 18 prospecting permits for coal, 1 prospecting permit for sodium, and 10 prospecting permits for oil and gas.

*Wisconsin.*—Supervised 1 power project.

*Wyoming.*—Made detailed geologic surveys of the Garland anticline, Big Horn and Park Counties, and the Osage oil and gas field, Weston County, for purposes of mineral leasing-law administration. Supervised 10 power projects, completed 296 miles of stream-utilization surveys on Laramie, Bear, and Green Rivers, and mapped in detail 2 dam sites and several minor reservoir sites. Participated in grazing-law hearings at Casper. Supervised on public land 48 leases, 28 licenses, and 60 prospecting permits for coal, 1 prospecting permit for sodium, and 414 leases, 1,510 prospecting permits, and 4 suspended preference-right leases for oil and gas and on Indian land 69 leases for oil and gas.

## WORK ON PUBLICATIONS

*Texts.*—The book publications of the year in the regular series numbered 35, covering 3,509 pages. Besides these publications, 36 brief papers in mimeographed form were issued as memoranda for the press. During the year 16,213 pages of manuscript were edited and prepared for printing, and 3,085 galley proofs and 10,414 page proofs were read and corrected. Indexes were prepared for 36 publications, covering 6,050 pages. Copy and proof or

stencils for 1,336 pages of multigraph and mimeographed matter were read. In addition to the Survey work, the proof of the volume on copper resources of the world, to be published by the International Geological Congress, was read as time was available.

*Illustrations.*—The section of illustrations prepared 2,088 drawings and photographs, transmitted 468 illustrations to accompany 26 reports, received and examined 539 proofs, and examined 32 editions. The work included considerable drafting for the Public Works Administration and the Office of Education.

*Geologic editing and drafting of maps and illustrations.*—The color proof of the geologic map of Colorado, scale 1:500,000, was read, and corrections of color stones were made for the eastern half and begun for the western half. The geologic map of Texas, scale 1:500,000, was drawn, and one section of the map was sent for engraving. The Somerset-Windber, Pa., folio (no. 224) was completed. Illustrations for 21 papers were edited. The section made 120 drawings for papers to be published by State geological surveys or other outside organizations and 134 drawings for the Public Works Administration.

*Engraving and printing.*—During the year 83 newly engraved topographic maps were printed, including 4 revised maps (of this number 47 were completed under the Public Works allotment), and 3 special maps were printed, making a total of 86 new maps printed and delivered. Corrections were engraved on the plates of 125 maps. Reprint editions of 128 engraved topographic maps and 11 photolithographed State and other maps were printed and delivered. In addition, 50 new topographic maps had been engraved and were in press June 30, including 17 under Public Works allotment, and the engraving of 41 other new topographic maps was nearly completed, including 16 under Public Works allotment. One new geologic folio was printed, the edition amounting to 600 copies. Of new and reprinted maps, 226 different editions, amounting to 580,689 copies, were delivered.

A large amount of work was done for more than 60 other units of the Government and State governments, and the charges for it amounted to about \$190,000, for which the appropriation for engraving and printing geologic and topographic maps was reimbursed. Of topographic maps, geologic maps, and contract and miscellaneous work of all kinds, a grand total of 4,688,839 copies were printed and delivered.

The output of the photographic laboratory consisted of 15,902 negatives (including 6,152 wet plates for photolithographs, 990 wet plates for photographic prints, 23 paper negatives, 1,994 dry plates, 1,066 lantern slides, and 5,677 field negatives developed), 29,888

prints (including 2,946 maps and diagrams, 25,876 photographs for illustrations and records, and 1,066 bromide enlargements), 5,278 zinc plates, 206 intaglio etchings, 13 celluloid prints, and 3,108 prints mounted.

*Distribution.*—A total of 260 publications, comprising 35 new books and pamphlets, 86 new or revised topographic and other maps, and 139 reprinted topographic and other maps 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 70,462 books and pamphlets and 580,089 topographic and other maps, a grand total of 650,051. The division distributed 61,665 books and pamphlets, 2,887 geologic folios, and 693,861 maps, a grand total of 758,413, of which 2,315 folios and 543,877 maps were sold. The net proceeds (gross collections less copying fees and amounts refunded) from the sales of publications were \$32,957.12, including \$32,318.31 for topographic and geologic maps and \$638.81 for geologic folios. In addition \$6,940.24 was repaid by other establishments of the Federal Government at whose request maps or folios were furnished. The total receipts, therefore, were \$39,897.36.

## LIBRARY

The resources of the library have been increasingly utilized by the newer agencies of the Government. The total number of readers using the library during the year was 14,089, of whom 7,822 were not members of the Geological Survey. These figures may be compared with those of 1932, when the total number of readers was 7,614, of whom 2,111 were not members of the Survey. Loans outside of the library for the year were 9,038, an increase over 1932 of 40 percent.

The bibliography of North American geology for 1933-34 was completed. Two cooperating staffs have continued the use of the library facilities in the compilation of the bibliography of foreign geology and the annotated bibliography of economic geology.

The Emergency Relief Administration project was discontinued in September. The personnel employed on the project, numbering over 100, was utilized in mending and labeling books, sorting duplicate material, and classifying and cataloging most of the remainder of books and pamphlets of the Kunz collection.

Several lists of references were prepared by the library staff. The subjects covered were the Geological Survey, the Public Works Administration, Federal regulation of the petroleum industry, and the Soil Erosion Service.

The accessions during the year comprised 15,264 books, pamphlets, periodicals, and serial parts and 1,202 maps.

## APPROPRIATIONS AND EXPENDITURES

The appropriations made directly for the work of the Geological Survey for the fiscal year 1935 included 11 items, amounting to \$1,313,500. In addition, \$237,602.54 of the balances for 1934 was continued available for use in 1935, and \$80,036 was transferred to the Geological Survey from the indefinite appropriations for salary restorations. A total of \$1,631,138.54 was thus made directly available to the Geological Survey by Congress, of which \$46,780.70 remained unobligated on June 30, 1935. In addition, \$5,632 was allotted from appropriations for the Interior Department for miscellaneous supplies.

Topographic survey of the United States, July 1, 1934 to June 30, 1935, and total area surveyed in each State

State	Publication contour interval (feet)	Mapped in fiscal year (square miles) (for engraved publication unless otherwise stated) on scale of 1 to—						Total area mapped in fiscal year (square miles)			Total area mapped to June 30, 1935 (square miles)	Percentage of total area of State mapped to June 30, 1935	Spirit levels (miles)	Transit traverse (miles)	Triangulation stations occupied		
		9,600	24,000	31,680	48,000	62,500	125,000	Planimetric mapping	Standard mapping with contours								
									Revision <sup>1</sup>	Resurvey <sup>2</sup>						New survey <sup>3</sup>	
Alabama	20		470			370		70		99	271	21,834	42.0		54		
Arizona	25, 50				258	548				384	422	60,169	52.8	26			
Arkansas	5, 10, 20			168		804				480	492	23,631	44.3	223	242	6	
California	5, 25, 100		247				636			429	454	133,047	84.0	48		40	
Colorado	10, 20, 50, 100			47		712	5			392	372	56,980	54.8	20			
Connecticut	10			84						84		4,965	100.0	8			
Delaware	10											2,370	100.0				
District of Columbia												70	100.0				
Florida	10					446					446	5,949	10.1				
Georgia	20		729			165		729		17	148	25,100	42.4			84	
Idaho	10, 50, 100					617	874		112		1,379	34,283	40.9	769		27	
Illinois	10, 20					1,346			1	73	1,272	38,968	68.8	136			
Indiana	10, 20					407					407	4,092	11.3				
Iowa	20					721			1	177	543	13,710	24.4	68	78		
Kansas	10			119		22				141		64,446	78.4	201	53		
Kentucky	20		7			204		7			204	27,120	66.8		442	3	
Louisiana	5			5,887				5,363		524		11,330	23.4	140			
Maine	10, 20			102		710				102	710	21,694	65.7	174			
Maryland	20					226				226		12,327	100.0				
Massachusetts	10			378						378		8,266	100.0	329			
Michigan	5, 10			19		625				19	625	14,694	25.3	10	194		
Minnesota	5, 20			14		553					567	8,781	10.4	108			
Mississippi	10, 20	8	52			234		52		8	234	7,244	15.5				
Missouri	5, 10, 20			1,348		1,135		9	1,541	933	49,708	71.6	210	4			
Montana	25, 100					342	561				903	44,431	30.2	458	8		
Nebraska	10, 20					515					515	27,867	35.9	132	66		
Nevada	25, 50, 100			28		88	550			28	638	54,356	49.1	124		22	
New Hampshire	20					248				248		9,302	100.0	100			
New Jersey	10			122						122		8,224	100.0				
New Mexico	10, 20			270		698				270	998	44,675	36.4	27			
New York	10, 20			258		13				271		49,204	100.0	576	222		
North Carolina	50		1,743			406		1,743		406		19,040	36.3	36	26	215	
North Dakota	5, 10			16		821					837	14,005	19.8	187	292		
Ohio	5, 20			230		1		1	230			41,040	100.0	122	86		
Oklahoma	10			35		94			129			41,927	59.8				
Oregon	50, 100					300	952		128	172	952	37,884	39.2	270		26	
Pennsylvania	20					1,178			36	746	396	39,156	86.8	232	135	8	
Rhode Island	10			56						56		1,248	100.0		85		
South Carolina	20		1,015			394		1,015			394	14,967	48.3				
South Dakota	20			18		457			18	457		19,812	25.5	79			
Tennessee	50		3,506			189	3,506		189			23,633	56.2		7,100	111	
Texas	20					559				559		89,890	33.8	43			
Utah	5, 20, 100		10		723		595		36	569		20,550	24.2	87		10	
Vermont	20					318				318		8,564	89.5	126			
Virginia	10, 20, 50		3,239	71		583		3,236		657		37,897	88.9	690	107	28	
Washington	25, 50, 100					154	1,907				2,061	39,662	57.4	411			
West Virginia	20, 50					1,390		1,382		8		24,170	100.0				
Wisconsin	20					372					372	19,609	35.0	67		139	
Wyoming	5, 20, 50, 100				778	122	1,024		225	122	799	32,622	33.3	364		18	
Total in continental United States (exclusive of Alaska)		8	10,618	9,270	258	19,387	7,104	15,721	1,895	8,782	20,247	1,414,513	46.7	6,601	9,204	737	
Hawaii												6,435	100.0				
Puerto Rico	1.5			154							154			141		27	

<sup>1</sup> Revision mostly of culture only.

<sup>2</sup> Resurveys in large part cover areas previously surveyed on a smaller scale.

<sup>3</sup> New surveys cover areas not heretofore mapped.

<sup>4</sup> Prepared from aerial photographs with field examination and showing culture, drainage, and woodland but no contours. Reproduction by 3-color photolithography (planimetric mapping).

<sup>5</sup> Includes 5,363 square miles planimetric mapping (see footnote 4) and 524 square miles with contours, publication by 4-color photolithography.

<sup>6</sup> Reproduction by 1-color photolithography.

<sup>7</sup> Linear miles of river surveys.

<sup>8</sup> Includes 3,236 square miles planimetric mapping (see footnote 4) and 3 square miles with contours, reproduction by 1-color photolithography.

<sup>9</sup> Meters.

<sup>10</sup> Publication scale 1:30,000.

*Cooperative State and municipal funds available for work on water-resources investigations, fiscal year 1935*

State	State funds available		Municipal funds available		Total
	Surface water	Ground water	Surface water	Ground water	
Alabama.....	\$2,000.00				\$2,000.00
Arizona.....	13,835.89				13,835.89
California.....	26,825.65	\$17,571.93		\$5,000.00	49,397.58
Colorado.....	25,177.09		\$500.00		25,677.09
Connecticut.....	6,000.00	100.00			6,100.00
Florida.....	4,007.30	2,200.00			6,207.30
Hawaii.....	12,812.22		7,706.59		20,518.81
Idaho.....	22,076.92				22,076.92
Illinois.....	5,428.13				5,428.13
Indiana.....	4,000.00	300.00			4,300.00
Iowa.....	5,008.00				5,008.00
Kansas.....	5,798.33				5,798.33
Louisiana.....	410.01				410.01
Maine.....	6,500.00				6,500.00
Maryland.....	7,509.14	1,750.00			9,259.14
Massachusetts.....	4,298.00	1,450.00			5,748.00
Michigan.....	3,700.00		2,500.00		6,200.00
Minnesota.....	7,704.47				7,704.47
Mississippi.....	953.63				953.63
Missouri.....	8,675.69	188.98			8,864.67
Montana.....	9,515.40				9,515.40
Nebraska.....	12,000.00		4,000.00		16,000.00
Nevada.....	700.00				700.00
New Hampshire.....	5,435.19				5,435.19
New Jersey.....	7,800.00	3,500.00	5,625.00		16,925.00
New Mexico.....	17,152.61		3,592.40		20,745.01
New York.....	17,615.00	7,012.00	2,000.00	6,363.35	32,990.35
North Carolina.....	6,710.05				6,710.05
North Dakota.....	165.20				165.20
Ohio.....	16,935.42	2,000.00			18,935.42
Oregon.....	24,477.44	770.00			25,247.44
Pennsylvania.....	18,588.29		1,826.21		20,414.50
South Carolina.....	3,000.00	353.22			3,353.22
Tennessee.....	9,459.69		1,000.00		10,459.69
Texas.....	17,767.50		9,744.77		27,512.27
Utah.....	5,500.00	69.82		3,864.41	9,434.23
Vermont.....	2,284.00				2,284.00
Virginia.....	19,000.00		156.00		19,156.00
Washington.....	12,414.17	5,057.85			17,472.02
West Virginia.....	3,000.00				3,000.00
Wisconsin.....	7,000.00				7,000.00
Wyoming.....	11,466.50				11,466.50
<b>Total.....</b>	<b>400,706.93</b>	<b>42,323.80</b>	<b>38,650.97</b>	<b>15,227.76</b>	<b>496,909.46</b>

## General summary of cases involving land classification

Class of cases	Record for fiscal year 1935						Record since receipt of first case	
	Pending prior to July 1, 1934	Received during fiscal year	Total	Acted on during fiscal year	Pending June 30, 1935	Gain or loss <sup>1</sup> during fiscal year	Received	Acted on
General Land Office requests:								
General.....	123	1,849	1,972	1,891	81	+42	2,313	2,313
Time extensions.....								
Oil developments.....	11	95	106	92	14	-3	17,389	17,375
Concurrence.....	54	736	790	732	58	-4		
Committee cases—Oil and potash.....	130	1,519	1,649	1,648	1	+129	12,751	12,750
Applications for classification as to mineral:								
Oil.....	144	1,264	1,408	1,232	176	-32	27,420	27,244
Miscellaneous.....	1	16	17	16	1		933	932
Applications for mineral permits.....	269	1,767	2,036	2,003	33	+236	61,327	61,294
Applications for mineral leases.....	11	127	138	118	20	-9	2,145	2,125
Applications for patent, potassium.....							124	124
Federal Power Commission cases:								
Preliminary permits.....	2	33	35	23	12	-10	348	336
Licenses.....							28	28
Determinations under sec. 24.....	7	47	54	52	2	+5	538	536
Applications for classification as to power resources.....	3	11	14	13	1	+2	542	541
Applications for agricultural classification.....	41	94	135	<sup>2</sup> 135			1,578	<sup>3</sup> 1,526
Applications for rights-of-way.....	8	102	110	101	9	-1	7,092	7,083
Irrigation project reports.....		3	3	1	2	-2	941	939
Applications under enlarged homestead acts.....	67	56	123	<sup>2</sup> 123			57,996	<sup>3</sup> 57,926
Applications under stock-raising homestead acts.....	1,809	1,442	3,251	<sup>2</sup> 3,251			143,917	<sup>1</sup> 142,040
Applications under ground-water reclamation act.....	2	1	3	3		+2	988	<sup>3</sup> 988
Indian Office requests for information.....							9,548	9,548
Unit or cooperative agreements.....		1,454	1,454		1,454	-1,454	1,454	
Total.....	2,682	10,616	13,298	<sup>4</sup> 11,434	1,864	-1,099		

<sup>1</sup> The terms "gain" and "loss" signify, respectively, decrease and increase in the number of cases pending.

<sup>2</sup> See footnote 4.

<sup>3</sup> These figures as of Mar. 11, 1935.

<sup>4</sup> Includes 1,999 cases transferred to Grazing Division Mar. 31, 1935, as follows: Agricultural classification, 52; enlarged homestead, 70; stock-raising homestead, 1,877.

## Summary of outstanding mineral withdrawals and classifications, June 30, 1935, 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	9,373,884	1,336,697	67,651			280,089	3,833	
Nevada.....									39,422
New Mexico.....	4,124,578	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	11,344,473		2,737,274	2,703,755	277,344	2,937	
Washington.....	691,801	141,444							
Wyoming.....	2,143,991	<sup>3</sup> 6,847,235	541,777		2,079,897	425,214	989,133	25,293	
Total.....	26,976,775	33,276,103	5,168,593	71,884	5,989,949	4,081,208	1,889,601	302,219	9,411,906

<sup>1</sup> Includes 3,151 acres of coal land reserved for use of the United States (coal reserve no. 1).

<sup>2</sup> Includes 13,578 acres withdrawn as helium reserve.

<sup>3</sup> Includes 2,078 acres of coal land reserved for use of the United States (coal reserve no. 2).

*Mineral production from public lands and revenues accrued therefrom, fiscal year 1935*

State	Petroleum (barrels)	Natural gas (thousand cubic feet)	Natural-gas gasoline (gallons)	Coal (short tons)	Potassium (short tons)	Sodium (short tons)	Phosphate (short tons)	Accrued revenue
Alaska.....								
Alabama.....				97, 107. 00				\$11, 192. 40
California.....	14, 239, 308	44, 717, 415	69, 136, 666	26. 00		52, 288. 38		2, 267, 439. 94
Colorado.....	939, 102	1, 908, 204	39, 885	361, 530. 90				124, 938. 64
Idaho.....				1, 847. 84			38, 184. 03	4, 235. 32
Louisiana.....	2, 543	1, 431, 639	27, 955					6, 027. 38
Montana.....	341, 071	2, 704, 612		304, 992. 67				83, 450. 38
Nevada.....								480. 00
New Mexico.....	3, 460, 294	9, 933, 463	766, 640	39, 020. 55	334, 367. 41	3, 018. 67		297, 108. 96
North Dakota.....				396, 226. 07				24, 172. 53
Oklahoma.....	227, 434		480, 165					29, 520. 19
Oregon.....				77. 00				219. 25
South Dakota.....				2, 245. 12				451. 04
Utah.....	918	37, 673	2, 668	1, 054, 165. 31				125, 123. 03
Washington.....				25, 964. 97				2, 599. 50
Wyoming.....	9, 059, 044	12, 300, 319	27, 410, 277	1, 040, 817. 45				1, 405, 240. 12
Total.....	28, 269, 714	73, 033, 325	97, 864, 356		334, 367. 41	55, 307. 05	38, 184. 03	
1934.....	25, 055, 175	57, 866, 857	87, 728, 595	2, 691, 686. 54	294, 155. 89	46, 047. 27	43, 066. 91	3, 975, 506. 91

## Financial statement of United States Geological Survey for the fiscal year ended June 30, 1935

	Funds available				Obligations			Balance
	Amounts appropriated or transferred	Repayments on account of work performed		Total	Disbursements	Outstanding liabilities	Total	
		Made	To be made					
<b>APPROPRIATIONS</b>								
Salaries.....	\$115,324.00	\$483.11		\$115,807.11	\$115,137.33		\$115,137.33	\$669.78
Topographic surveys.....	<sup>1</sup> 164,908.00	214,212.22	\$62,483.24	441,603.46	400,797.52	\$38,319.18	439,116.70	2,486.76
Geologic surveys.....	307,220.00	25,113.86	6,060.46	338,394.32	318,429.81	6,099.83	324,529.64	13,864.68
Volcanologic surveys.....	6,391.00	133.43		6,524.80	6,523.80	1.00	6,524.80	
Alaskan mineral resources.....	29,092.00	1,599.18	34.52	30,725.70	16,801.33	10,358.79	27,160.12	3,565.58
Gaging streams.....	<sup>2</sup> 516,233.54	323,094.34	119,699.35	959,027.23	910,707.24	26,604.54	937,311.78	21,715.45
Classification of lands.....	108,112.00	10,381.12	1,474.34	119,967.46	110,315.81	7,616.63	117,932.44	2,035.02
Printing and binding.....	<sup>3</sup> 104,800.00	3.74		104,803.74	8,840.73	95,963.01	104,803.74	
Preparation of illustrations.....	16,035.00	1,657.01		17,692.01	17,587.93	44.06	17,631.99	60.02
Geologic and topographic maps.....	79,113.00	154,498.51	33,979.85	267,591.36	256,564.78	10,061.84	266,626.62	964.74
Mineral leasing.....	183,910.00	32,633.26	2,285.99	218,829.25	206,982.29	10,428.29	217,410.58	1,418.67
	<sup>4</sup> 1,631,138.54	763,809.78	226,018.12	2,620,966.44	2,368,688.57	205,497.17	2,574,185.74	46,780.70
<b>TRANSFERS</b>								
Construction, irrigation system, Wapato project, Wash., act Feb. 14, 1920 (special fund) (act Mar. 2, 1934).....	550.00			550.00	277.75	237.25	515.00	35.00
Irrigation, Indian reservations (reimbursable) (act Mar. 2, 1934), 1935.....	250.00			250.00	150.29	35.00	185.29	64.71
Maintenance and improvement of existing river and harbor works (War Department, act Feb. 17, 1933).....	<sup>5</sup> 1,467.97	40.49		1,508.46	1,022.19	486.27	1,508.46	
Maintenance and operation, San Carlos project, Gila River Reservation, Ariz. (reimbursable) (act Mar. 2, 1934), 1935.....	2,750.00			2,750.00	2,443.03	281.19	2,724.22	26.78
National industrial recovery, Interior, Geological Survey, 1933-37.....	<sup>7</sup> 2,961,974.36	32,764.38	48,888.23	3,043,626.97	2,684,463.20	101,311.01	2,785,774.21	257,852.76
Operating and care of canals and other works of navigation (War Department, act Feb. 17, 1933).....	<sup>6</sup> 386.77			386.77	335.75	49.20	384.95	1.82

<sup>1</sup> Includes \$50,000 of 1934 balance continued available for expenditure during the fiscal year 1935.

<sup>2</sup> Includes \$152,602.54 of 1934 balance continued available for expenditure during the fiscal year 1935.

<sup>3</sup> Includes \$35,000 of 1934 balance continued available for expenditure during the fiscal year 1935.

<sup>4</sup> In addition to these appropriations, there was an allotment of \$5,632 for miscellaneous supplies from the appropriation for contingent expenses of the Interior Department.

<sup>5</sup> Includes \$80,036 from indefinite appropriations for salary restorations under acts of Mar. 28, 1934, and Feb. 13, 1935.

<sup>6</sup> Balance unobligated on June 30, 1934, and continued available for expenditure during the fiscal year 1935.

<sup>7</sup> Includes \$2,296,974.36 balance unobligated on June 30, 1934, and continued available for expenditure during the fiscal year 1935.

	Funds available			Obligations			Balance	
	Amounts appropriated or transferred <sup>§</sup>	Repayments on account of work performed		Total	Disbursements	Outstanding liabilities		Total
		Made	To be made					
<b>TRANSFERS—continued</b>								
Supervising mining operations on leased Indian lands (act Mar. 2, 1934), 1935.....	\$60,000.00	\$2,949.87	\$1,889.84	\$64,839.71	\$62,684.23	\$2,051.30	\$64,735.53	\$104.18
Waterways treaty, United States and Great Britain (State Department, act Apr. 7, 1934), 1935.....	49,600.00			49,600.00	37,867.55	9,890.95	47,758.50	1,841.50
Working fund, Department of the Interior (Army Engineers, for stream gaging).....	24,180.00	540.35	196.26	24,916.61	21,361.41	1,442.05	22,803.46	2,113.15
Working fund, Department of the Interior (Army Engineers, for topographic mapping).....	32,000.00	68.60		32,068.60	19,799.32	138.61	19,937.93	12,130.67
Working fund, Department of the Interior (Federal Power Commission).....	600.00			600.00	182.92		182.92	417.08
Working fund, Department of the Interior (General Land Office).....	4,225.00			4,225.00	3,362.10	862.90	4,225.00	
Working fund, Department of the Interior (Navy Department, operation and conservation of naval petroleum reserves).....	37,921.00	5,475.21	2,129.85	45,526.06	44,775.22	750.84	45,526.06	
Working fund, Department of the Interior, Public Works (Agriculture, Public Roads).....	42,877.24	205.99		43,083.23	35,528.10		35,528.10	7,555.13
Working fund, Department of the Interior, Public Works (Agriculture, Weather Bureau).....	72,086.47	5,449.21	475.62	78,011.30	77,460.60	411.93	77,872.53	738.77
Working fund, Department of the Interior, Public Works (Army Engineers).....	935,020.23	864.74	43.07	35,928.04	14,631.34	825.90	15,457.24	20,470.80
Working fund, Department of the Interior, Public Works (Mississippi Valley Committee).....	17,913.62	1,285.30		19,198.92	19,197.71	.71	19,198.42	.50
Working fund, Department of the Interior, Public Works (Bureau of Reclamation).....	893.87	710.44	46.52	1,650.83	1,650.83		1,650.83	
Working fund, Department of the Interior, (Tennessee Valley Authority).....	103,547.22	12,873.14	86.76	116,007.12	114,602.99	1,126.98	115,729.97	277.15
Working fund, Department of the Interior, Public Works (advance for water-resources branch supplies and materials).....	1,590.00	106.55		1,696.55	1,696.55		1,696.55	
Working fund, Interior, Geological Survey (Agriculture, Soil Erosion, P. W. A.).....	4,100.00			4,100.00	1,403.72	1,652.30	3,056.02	1,043.98
Working fund, Interior, Geological Survey (Agriculture, Weather Bureau, N. I. R.).....	12,815.00		181.03	12,996.03	12,814.35	105.54	12,919.89	76.14
Working fund, Interior, Geological Survey (Indians).....	600.00			600.00	600.00		600.00	
Working fund, Interior, Geological Survey (Navy, naval petroleum reserves).....	1,435.00			1,435.00		1,435.00	1,435.00	
Working fund, Interior, Geological Survey (Public Works Administration, N. I. R.) (National Resources Board, water resources).....	17,000.00			17,000.00	14,089.49	8.75	14,098.24	2,901.76
Working fund, Interior, Geological Survey (Reclamation, N. I. R.).....	5,000.00			5,000.00	1,702.23		1,702.23	3,297.77
Working fund, Interior, Geological Survey (Tennessee Valley Authority, N. I. R.).....	19,585.51	.70	17.50	19,603.71	15,555.85	3,611.12	19,166.97	436.74
Working fund, Interior, Geological Survey, Topographic mapping (Tennessee Valley Authority, N. I. R.).....	175,000.00		136.60	175,136.60	167,426.66	7,709.94	175,136.60	
Working fund, Interior, Geological Survey (War, Rivers and Harbors).....	8,980.00	4.85	7.45	8,992.30	3,715.69	2,652.63	6,368.32	2,623.98
Working fund, Interior, Geological Survey (War, Rivers and Harbors, N. I. R.).....	1,900.00		16.20	1,916.20	1,730.49	.88	1,731.37	184.83
Transfer total.....	3,696,849.26	62,839.82	54,114.93	3,813,804.01	3,362,528.56	137,078.25	3,499,606.81	314,197.20
Grand total.....	5,327,987.80	826,649.60	280,133.05	6,434,770.45	5,731,217.13	342,575.42	6,073,792.55	360,977.90

<sup>§</sup> Balance unobligated on June 30, 1934, and continued available for expenditure during the fiscal year 1935.  
<sup>§</sup> Includes \$22,536.47 balance unobligated on June 30, 1934, and continued available for expenditure during the fiscal year 1935.  
<sup>§</sup> Includes \$2,620.23 balance unobligated on June 30, 1934, and continued available for expenditure during the fiscal year 1935.  
<sup>10</sup> Includes \$1,913.62 balance unobligated on June 30, 1934, and continued available for expenditure during the fiscal year 1935.  
<sup>11</sup> Includes \$3,547.22 balance unobligated on June 30, 1934, and continued available for expenditure during the fiscal year 1935.

*Classification of obligations incurred by the United States Geological Survey during the fiscal year ended June 30, 1935*

	Salaries	Topographic surveys	Geologic surveys	Volcanologic surveys	Alaskan mineral resources	Gaging streams
Salaries of permanent employees	\$115, 137. 33	\$596, 402. 99	\$289, 421. 68	\$6, 403. 03	\$26, 359. 68	\$928, 144. 64
Wages of temporary employees		1, 062, 025. 83	161, 792. 81	11. 00	16, 443. 35	294, 643. 99
Supplies and materials		29, 421. 18	7, 214. 08	7. 36	2, 258. 39	35, 218. 11
Dead storage of passenger-carrying vehicles		16. 23				8. 00
Other storage and pasturage of animals		2, 921. 55	264. 65		199. 86	641. 31
Communication services		1, 841. 13	325. 03	3. 63	44. 44	4, 822. 35
Travel expenses		230, 776. 31	38, 691. 81	22. 12	13, 611. 54	113, 097. 34
Hire, maintenance, repair, and operation of passenger-carrying vehicles		240. 09	1, 715. 43	75. 22		15, 274. 38
Transportation of things		9, 856. 35	1, 232. 15		3, 945. 78	12, 054. 55
Hire, maintenance, repair, and operation of freight-carrying vehicles		98, 902. 72	7, 724. 27		20. 00	25, 456. 61
Printing and binding		136, 479. 01	3, 373. 51	1. 44	237. 58	5, 265. 15
Furnishing of heat, light, power, water, and electricity			35. 00		31. 48	174. 80
Rents		470. 23	614. 09	1. 00		4, 744. 71
Repairs and alterations		9, 525. 29	2, 731. 79		216. 09	81, 151. 44
Special and miscellaneous current expenses		235. 32	228. 90		48. 70	130. 71
Purchase of passenger-carrying vehicles		545. 75	1, 071. 00			10, 261. 30
Purchase of freight-carrying vehicles		34, 143. 68				15, 137. 74
Purchase of scientific instruments and parts		31, 420. 66	2, 733. 26		579. 79	70, 952. 81
Other equipment		22, 087. 03	2, 806. 33		1, 478. 17	8, 057. 96
Structures and parts						76, 001. 97
Miscellaneous refunds, adjustments, and transfers		135, 544. 50	11, 009. 67		1, 633. 70	11, 831. 67
Total	115, 137. 33	2, 402, 855. 85	532, 986. 16	6, 524. 80	67, 109. 15	1, 713, 072. 24

  

	Classification of lands	Printing and binding	Preparation of illustrations	Geologic and topographic maps	Mineral leasing	Total
Salaries of permanent employees	\$82, 195. 95		\$16, 839. 90	\$200, 670. 08	\$223, 006. 45	\$2, 484, 581. 71
Wages of temporary employees	2, 746. 93			348. 53	346, 082. 92	1, 884, 095. 68
Supplies and materials	660. 19		195. 35	54, 809. 81	6, 741. 02	136, 526. 16
Dead storage of passenger-carrying vehicles	2. 15				35. 25	61. 63
Other storage and pasturage of animals					13. 00	4, 040. 40
Communication services	309. 23			3. 62	2, 913. 31	10, 263. 94
Travel expenses	10, 859. 04		4. 50	397. 13	32, 475. 98	439, 935. 27
Hire, maintenance, repair, and operation of passenger-carrying vehicles	3, 148. 52				8, 757. 49	29, 211. 13
Transportation of things	1, 518. 45			81. 00	3, 863. 76	32, 552. 04
Hire, maintenance, repair, and operation of freight-carrying vehicles	26. 90				2, 464. 24	134, 594. 74
Printing and binding	2, 528. 15	\$104, 803. 74	586. 92	4, 599. 01	4, 676. 19	262, 550. 70
Furnishing of heat, light, power, water, and electricity					4, 223. 95	4, 465. 23
Rents	67. 77				7, 136. 48	13, 136. 48
Repairs and alterations	58. 92		5. 32	5, 509. 99	23, 768. 45	122, 967. 89
Special and miscellaneous current expenses	2. 50			75. 40	290. 78	1, 012. 31
Purchase of passenger-carrying vehicles	8, 430. 37				9, 756. 23	30, 064. 65
Purchase of freight-carrying vehicles	1, 350. 00					50, 631. 42
Purchase of scientific instruments and parts	546. 30			29. 40	742. 36	107, 004. 58
Other equipment	3, 341. 07			29. 25	4, 538. 50	42, 338. 31
Structures and parts					1, 463. 20	77, 465. 17
Miscellaneous refunds, adjustments, and transfers	140. 00			4, 298. 10	41, 835. 47	206, 293. 11
Total	117, 932. 44	104, 803. 74	17, 631. 99	270, 851. 62	724, 887. 23	6, 073, 792. 55

In addition to the above amounts, there was expended directly by cooperating agencies \$49,242.42 for topographic surveys and \$292,058.32 for stream gaging.