DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR.

TWENTY-SEVENTH ANNUAL REPORT

OF THE

DIRECTOR

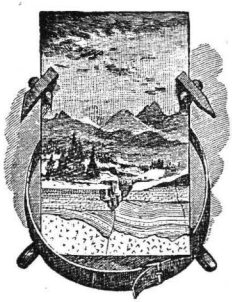
OF THE

UNITED STATES GEOLOGICAL SURVEY

TO THE

SECRETARY OF THE INTERIOR

1905-6



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TWENTY-SEVENTH ANNUAL REPORT

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DIRECTOR OF THE UNITED STATES GEOLOGICAL SURVEY.

CHARLES D. WALCOTT, *Director.*

INTRODUCTION.

During the last fiscal year the character of the work and the organization of the force remained substantially the same as described in the Twenty-sixth Annual Report. Accounts of the work performed in geology and paleontology, chemistry and physics, topography and geography, and hydrography, hydrology, and hydro-economics, as well as in the lines of publication and administration, will be found on later pages.

Appropriations and allotments.—A plan of operations, including an itemized statement of the appropriations, amounting to $1,513,482.30, and the allotments thereof, was approved by the Secretary of the Interior on May 15, 1905. The work of the year conformed to this plan, copies of which are on file at the Department and the Survey.

State cooperation.—Many of the States, following a well-established policy, cooperated with the National Survey in geologic, topographic, and hydrographic work; details are given on pages 12, 29, 72, and 74.

INVESTIGATION OF FUELS AND STRUCTURAL MATERIALS.

The special investigation of the fuel resources of the United States, authorized by Congress in 1904, was continued during the last fiscal year on the same site in Forest Park, at St. Louis, with an allotment of $202,000. The general purpose of these investigations is the making of a series of comparative tests of representative coals and lignites from the important fields of the United States, the same equipment and methods of procedure being used in all cases except when modifications seem necessary in order to ascertain the highest efficiency in the utilization of special fuels. The equipment includes 2 boilers, 1 steam engine, 2 electric generators, 2 gas producers, 1 gas engine, all

on an approximated 250-horsepower basis; a coal-washing and briquetting plant, a drier, a battery of 3 beehive coke ovens, and a well-equipped chemical laboratory. The samples of coal and lignite are collected by trained men employed for this work and are brought to the testing plant in lots of from 50 to 100 tons. The larger tests are supplemented by an elaborate series of chemical examinations of smaller samples from both the car shipments and the coal beds in the mine, the complete history of each of these samples being known. To June 30, 1906, the number of coals, lignites, and peats examined was 2,400; the number of boiler tests, 401; producer-gas tests, 119; coking tests, 218; washing tests, 102; briquetting tests, 54; chemical determinations, 12,878; miscellaneous tests, a considerable number.

The investigation of structural materials was conducted under the same supervision and at the same location as the fuel testing, the station supplying the necessary heat, light, and power for both. The allotment being small ($12,500), the work was necessarily confined to the completion of tests already begun and the beginning of limited additional tests of cement, concrete, and other constituent materials. In addition to this testing work, a general inquiry was instituted, at the request of a number of architects and engineers, into the present state of knowledge relative to the strength and other properties of building materials available for use in the United States. During May and June, with the cooperation of the War Department and the committee of engineers representing the American Society of Civil Engineers and associated organizations, an investigation was made of the effect of the earthquake and fire at San Francisco on buildings and building material. A report on these investigations will be published soon.

NEED FOR INCREASE OF APPROPRIATIONS.

Geology.—While the demands for geologic work in many localities and along many lines are increasing more rapidly than they can be met with present appropriations, they are specially urgent in two directions, for which an increase in the appropriation for geology of $50,000 is recommended.

The known iron-ore deposits in the United States are being rapidly absorbed, and there is keen competition on the part of the large iron companies in increasing their ore reserves. Such companies are fully aware of the value of expert geologic advice and are able to pay for it, but in order that any fair return may be received by present owners of ore lands reliable information regarding the occurrence and value of iron-ore deposits should be acquired and disseminated. The Government itself is directly interested, since extensive deposits of iron ore occur upon the public lands. These are being investigated as rapidly as possible, but the force employed for this purpose should be at least doubled.

The Government is the largest holder of coal lands in the world. These lands have up to the present been on the market, yet the Government has spent less in determining the value of its property than many private companies. It has been demonstrated that many millions of dollars can be saved to the Government by a geologic examination of its coal lands at a cost of less than 1 per cent of the amount saved. In view of the rapid development of western coal mining and the proposition to withdraw coal lands from sale in order to sell the coal itself on a royalty basis, there is an urgent demand for immediate accurate information, which the present appropriation is wholly inadequate to provide without sacrificing other important work in progress elsewhere. Requests for information regarding the extent, location, and value of coal on public lands have been received from the President and from the Senate (Senate resolution of June 29, 1906), which can not be adequately complied with, since the information requested is not in existence.

Topography.—No increase in appropriations for topographic surveys has been asked for the last two years, altho an increase was made by Congress for 1905-6 to meet pressing demands. These demands have been growing with such urgency that it is no longer possible to ignore them, and it is therefore recommended that an appropriation of $400,000 for such surveys be requested for the fiscal year 1907-8, this sum being $50,000 in excess of the amount appropriated for 1906-7.

The demand for topographic surveys on which this request for increase in appropriation is based comes from people living in many States and Territories, who are engaged in various kinds of work that depend upon or are related to the topography and economic resources of the country. The requests are received thru representatives in Congress, thru the Secretary of the Interior, thru State geologists, commissioners of agriculture, State engineers, and other State officials, and thru the War Department on behalf of the Army of the United States. For two years past these requests for topographic surveys have so far exceeded the ability of the Survey to comply with them, because of lack of funds, that the plans approved for the fiscal year 1906-7 are more than half a million dollars short on work urgently called for.

Requests are on file for topographic mapping in 62 localities in which work is considered urgent, but for lack of available funds none of these requests can be complied with. Twenty-eight of these localities are mining districts, containing precious metals, coal, oil, and iron; 5 are areas of which the Reclamation Service requested maps; 5 are areas of which maps are especially wanted for the administration of the Forest Service; 2 are areas for the proposed forest reserves in the Eastern States; 18 are areas for which there are petitions indorsed by Senators and Members of Congress, and 4 are areas for the survey

of which requests have been received thru the Secretary of War on behalf of the General Staff of the Army.

Hydrography.—The amount appropriated annually by Congress since 1902 for the investigation of water resources of the United States had been $200,000 until Congress at its last session reduced the amount to $150,000 for the fiscal year 1906-7. This action will cause a corresponding reduction of work during the present year.

In adjusting the work to meet the decreased appropriation, it has been the aim to discontinue the investigations that are of the least importance in each locality rather than to make a uniform reduction thruout. The investigations relate principally to (1) occurrence and availability of ground waters, (2) measurement of stream flow, and (3) the quality of water and its application to domestic and industrial uses. In some regions large numbers of stream-measurement stations that had been established as a result of urgent demands and local needs have been discontinued; in other regions valuable ground-water investigations have been given up. In each locality the work for which there seems to be greatest economic need has been continued. While this is apparently the best solution of the difficulty, there result loss of valuable records, which by reason of their suspension will become practically useless, and retardation of the industrial growth of many localities dependent upon the development of water supplies and water power. It will be impossible for private parties or the States to undertake these investigations, for they involve in most cases interstate studies and continuous gagings for a considerable period.

Water is the most valuable of all the mineral resources of the United States. Upon no other single resource or group of resources is social and economic welfare so dependent, and to teach people how to utilize water resources is to promote their prosperity as it can be promoted perhaps in no other way. Investigations that furnish data concerning the amount, availability, and character of water, whether from ground or surface sources, should, therefore, be maintained and encouraged by the General Government.

The benefit derived from the hydrographic work in the United States is thoroly demonstrated. As an investment it has produced large returns. The results obtained under the former appropriation justify the restoration of the $50,000 at the next session of Congress. By reason of the wide extent of country involved, the lessened appropriation of $150,000 must be distributed in allotments so small that many of the investigations can not in any single year be made sufficiently thoro to permit the preparation of final reports, but with the $50,000 restored the allotment for each piece of work would be sufficient to produce results which the Survey would be warranted in publishing annually.

RECLAMATION SERVICE.

The Director of the Geological Survey acted as Director of the Reclamation Service during the year, and the chief disbursing clerk of the Survey as the chief disbursing officer of the Reclamation Service.

The more or less intimate relations that existed between the Reclamation Service and the Geological Survey from 1902 to 1905 were gradually changed, so that by June 30, 1906, connection was practically abolished, except the directorship and the disbursing. As the result of the appropriation made by Congress for additional rental for the Reclamation Service, a large proportion of its force and all of its archives were moved to another building near the Survey, and it is expected that in the early future the dissociation of the Survey and the Reclamation Service will be complete. With this in view, in the estimates it is recommended that Congress be asked to appropriate $3,000 additional rental for the Survey, and also to authorize the expenditure of $3,000 by the Reclamation Service for rental.

WORK OF THE YEAR.

FIELD AND OFFICE WORK BY THE DIRECTOR.

During the summer of 1905 the Director made a detailed study of the great series of rocks between the "Rocky Mountain front," facing the Great Plains, and Ravalli, Mont. The object of this was to work out a reference section for an extensive area of strata in northwestern Montana and northern Idaho. A detailed section of the Cambrian rocks of the House Range, Utah, was completed and large collections of fossils were made. In September the Director examined the country affected by the Strawberry irrigation project in Utah and the Gunnison tunnel or Uncompahgre project in Colorado, and late in that month he made a visit to the fuel-testing plant at St. Louis. Administrative duties pertaining to the Survey and to the Reclamation Service prevented him from doing any considerable amount of personal scientific work in the Survey, except to prepare for publication the Montana geologic section and to advance the study of the Cambrian faunas.

GEOLOGIC BRANCH.

Administration.—The geologic branch comprises four divisions, viz, the division of geology and paleontology, the division of Alaskan mineral resources, the division of mining and mineral resources, and the division of chemical and physical research. The chiefs of these four divisions formerly reported directly to the Director, but last year they were combined into a single administrative unit under the geologist in charge of geology. The purpose of this concentration of

administrative authority was to secure proper cooperation and coordination in the various lines of work.

State cooperation.—Three States made appropriations for cooperative geologic work, viz, Maine, $1,500; Pennsylvania, $4,000, and North Carolina, $1,000.

Publications.—The official publications of the geologic branch during the year included 13 geologic folios, 1 monograph and the atlas accompanying another (XXXII), 12 professional papers, 16 bulletins, and the annual volume on mineral resources. These embody the economic results of the work and the principal contributions to science resulting from the various investigations. In addition there were published, with the permission of the Director, in scientific journals and the transactions of scientific societies, a large number of papers based in whole or in part on the work of this branch.

DIVISION OF GEOLOGY AND PALEONTOLOGY.

Organization.—As during the last several years, the administrative control of the division was in the hands of the geologist in charge of geology, while scientific supervision was exercised by the section chiefs. The latter are responsible for the methods employed in the various lines of investigation and for the quality of the results presented in Survey publications. The form of organization, altho somewhat complex, is thoroly satisfactory, and is necessitated by the diversity and complexity of the problems under investigation.

Personnel.—The scientific force of the division at the beginning of the fiscal year consisted of 47 geologists, 6 paleontologists, 40 assistant geologists, and 16 geologic aids. Of these, 31 geologists, 15 assistant geologists, and 10 aids were occupied continuously thruout the year; the remainder, being on the per diem roll, gave only a portion of their time or none at all to Survey work. During the year resignations and appointments resulted in a net gain of 4 in the force. In addition to the above regular force 5 field assistants were employed for a portion of the year.

GEOLOGIC WORK IN NEW ENGLAND AND NORTHERN APPALACHIAN REGION.

During the year cooperative work in Maine was continued. The mapping of the Rockland quadrangle was finished and the geologic folio prepared, and work on the Mount Desert area was continued. The text for the Penobscot Bay folio, previously surveyed, was completed and submitted for publication. Brief reports on the limestone and clay of the Rockland area and on new occurrences of slate and graphite in the State were prepared for the annual economic bulletin. A special examination of the granite quarries was made, and

the detailed report, which will be issued as a bulletin of the Survey, is nearly ready for publication.

The maps and manuscripts for the Quinsigamond and Ware folios, covering several quadrangles in Massachusetts, were completed with the exception of the Pleistocene geology, on which considerable progress was made, the mapping of the Quaternary deposits of the Brookfield quadrangle being finished. Considerable progress was also made in the study of the Pleistocene geology of the areas covered by the Housatonic and adjacent folios in Massachusetts.

A special investigation was made of the several drift sheets and Pleistocene formations of Rhode Island and the southern part of Massachusetts for the purpose of differentiating them and correlating them with the pre-Wisconsin deposits of Long Island. In connection with this investigation a study was made of the clays of Cape Cod, a brief report of which was prepared for the annual economic bulletin.

In cooperation with the New Jersey State Survey the Franklin Furnace folio was completed. In connection with this work a general study of the iron-ore deposits of the pre-Cambrian region of New Jersey and southeastern New York was made for the purpose of determining the mode of origin of these ores, the study having a direct bearing on the investigation of the zinc and manganese-bearing ores in the Franklin Furnace area. As a result of this investigation a special report on the zinc-ore deposits of the Franklin Furnace and Stirling Hill regions is in preparation. It will contain a chapter on the interesting minerals of this portion of New Jersey, which has long been classical collecting ground for the mineralogist.

The mapping of the crystalline rocks of the Raritan and Passaic quadrangles and of portions of the Greenwood Lake and Easton quadrangles of New Jersey was also completed.

Special attention was given to the critical examination of type localities of crystalline rocks in New England, the New Jersey Highlands, and the Pennsylvania Piedmont Plateau region, with a view to clarifying the relations of the various crystalline rocks, a problem which is directly connected with the economic resources of the East.

Additional field work was done in the Mercersburg and Chambersburg quadrangles, in Pennsylvania, with a view to mapping the Ordovician formations on a partially paleontologic basis, and in the West Chester, Norristown, and Philadelphia quadrangles, for the purpose of elucidating certain complicated structural problems. Considerable progress was also made in the areal and economic surveys of the Coatesville and Phoenixville quadrangles, Pennsylvania, but additional field work will be necessary before the results can be prepared for publication.

GEOLOGIC WORK IN ATLANTIC COASTAL PLAIN.

In cooperation with the Maryland State Survey, stratigraphic and paleontologic studies were made in Delaware, Maryland, Virginia, and North Carolina for the purpose of correlating the Coastal Plain formations of New Jersey with those of North Carolina. The economic deposits and water-bearing horizons were studied at the same time.

As a result of cooperation with the division of hydrology in the investigation of the position and availability of the water-bearing beds of the region, considerable additions were made to the knowledge of the stratigraphy and structure of portions of the Coastal Plain in North Carolina and much valuable paleontologic material was obtained.

GEOLOGIC WORK IN EASTERN APPALACHIAN AND PIEDMONT REGIONS.

The survey of the West Virginia and Pennsylvania portions of the Pawpaw and Hancock quadrangles was completed and the Quaternary gravels of the Flintstone and Frostburg quadrangles in Maryland were mapped in detail.

Special studies were made of the cement resources of Virginia and Alabama, of the Oriskany iron ores of Virginia, and of the brown ores of southwestern Virginia. Brief reports of the results of these investigations were prepared for the annual economic bulletin, and a detailed report on the iron-ore investigations is in preparation.

The field work connected with the investigation of the granites and granite industry of Maryland, Virginia, North Carolina, South Carolina, and Alabama was nearly completed, and considerable progress was made in the laboratory study of the rocks.

In cooperation with the State Geological Survey of Virginia, a special study was made of the copper resources of the Appalachian region from Virginia southward into Alabama. A brief report on this investigation was published in the annual economic bulletin of the Survey and a full report has been prepared for publication as a special bulletin of the Virginia State Survey.

The areal and economic surveys of the Roan Mountain quadrangle in North Carolina and Tennessee, of the Morganton quadrangle in North Carolina, and of the Ellijay quadrangle in Georgia were completed. The text for the Roan Mountain folio and the geologic map for the Ellijay folio were finished and considerable progress was made in the preparation of the text for the Morganton folio.

The areal geology of the Dahlonega mining district was mapped in detail and considerable progress made in the preparation of a special economic report, but additional field work will be necessary before this report can be completed.

The investigation of the economic resources of the Balsam Mountain region in North Carolina, which was undertaken in cooperation

with the North Carolina State Survey, was completed and good progress made in the preparation of the report, which will be published as a bulletin of the Survey and will include a chapter on the copper deposits of the neighboring Cowee quadrangle.

In addition, a special report, to be published as a bulletin of the Survey, on the gold belt of South Carolina was completed and submitted for publication.

GEOLOGIC WORK IN WESTERN APPALACHIAN REGION.

During the year detailed areal and economic surveys of the Punxsutawney, New Castle, and Claysville quadrangles in Pennsylvania, of the Kenova quadrangle in West Virginia and Kentucky, and of the Nicholas quadrangle in West Virginia were completed, and surveys of the Sewickley and Clarion quadrangles in Pennsylvania were started. The study of the physiography and Quaternary geology of the Catatonk quadrangle in New York was completed, and the Watkins Glen-Catatonk folio is nearly ready for publication. The manuscripts for the Amity, Rogersville, and Barnesboro-Patton (Pennsylvania) geologic folios and for the following economic bulletins were also completed and submitted for publication: On the oil and gas sands of the Claysville, Burgettstown, and Steubenville quadrangles, Pennsylvania; on the oil and gas of Greene County, Pa.; on the economic resources of the Amity, Pa., quadrangle; on the economic resources of the Kenova quadrangle in Ohio, West Virginia, and Kentucky, and on the Berea grit sandstone of the Steubenville quadrangle in Ohio. Other economic bulletins are in preparation, as follows: On the Pittsburg coal of the Claysville, Burgettstown, and Steubenville quadrangles in Pennsylvania; on the economic resources of the Nicholas, W. Va., quadrangle, and on the coal resources of the Barnesboro-Patton region in Pennsylvania. The work in Pennsylvania was done in cooperation with the State.

In addition, the following brief reports on economic investigations in this region were prepared for the annual economic bulletin, No. 285:

Coal resources of the Kenova quadrangle (Kentucky-Ohio-West Virginia).
The Clearfield coal field, Pennsylvania.
The Punxsutawney and Glen Campbell coal fields of Indiana and Jefferson counties, Pa.
The Nineveh and Gordon oil sands in western Greene County, Pa.
Notes on clays and shales in central Pennsylvania.
Clay resources of northeastern Kentucky.
Clays of western Kentucky and Tennessee.
Cement resources of the Cumberland Gap district, in Virginia and Tennessee.
Glass-sand industry in eastern West Virginia.
Iron ores of Bath County, Ky.

GEOLOGIC WORK IN GULF REGION.

During the year the study of the red hematite or fossil ores of northern Alabama was completed, and a brief report on the same was prepared for the annual economic bulletin. A large amount of work was also done in the study of the iron ores and other economic resources of the Birmingham district, and in the independent study of the newly discovered gray ore districts in the vicinity of Talladega, Ala. A series of detailed reports on these investigations is now in preparation. A brief report on the Warrior coal basin, in the Birmingham quadrangle, was prepared for the annual economic bulletin.

Progress was made in the areal and economic survey of the Brookwood and Birmingham quadrangles, Alabama, but additional field work will be necessary before the reports can be completed.

The resurvey, based on paleontologic evidence that made possible a more accurate classification and correlation of the coal-bearing formations, which had heretofore yielded meager faunas, of the southern parts of the McAlester, Tuskahoma, and Windingstair quadrangles, in Indian Territory, was completed. Brief investigations were also made of the oil and gas prospects in the vicinity of Huntsville, Ala., and of the copper deposits of Archer County, Tex.

GEOLOGIC WORK IN GREAT LAKES REGION.

During the year the detailed areal survey of the Hartford, West Bend, and Poynette quadrangles, in southeastern Wisconsin, made with special reference to the Quaternary geology, was completed, and that of the Baraboo quadrangle was commenced. The manuscript for the Milwaukee Special folio was completed. The revision of the manuscript for a professional paper on the bowlder trains of south-central Wisconsin and their relations to the glacial formations of the region was completed, but additional critical field studies will be made—it is expected during the present field season—before the manuscript is transmitted to the printer.

The glacial formations, ancient lake deposits, soils, surficial and underground waters, and physiographic features of the eastern portion of the upper peninsula of Michigan were studied in the field and mapped, the results being incorporated in a report which will be published as a monograph. In connection with this study considerable additional information was obtained regarding the former extent of the Great Lakes in this region. Additional studies were also made of the lacustrine features of the territory covered by the proposed monograph on the Michigan glacial lobe, but considerable additional work will be necessary to complete this report. In connection with these surveys in Michigan cooperation was carried on with the division of

hydrography in an investigation of the underground waters of the State, the results of which will be published in the series of water-supply papers.

GEOLOGIC WORK IN MISSISSIPPI VALLEY.

During the year the areal and economic survey of the Eureka Springs quadrangle, in Arkansas, was completed and considerable progress made in the preparation of the folio. The manuscript for the Winslow folio, previously surveyed, was also completed and submitted for publication.

Progress was made in the general study of the lead and zinc deposits of the Mississippi Valley. A detailed report on the deposits of the upper Mississippi Valley was prepared and submitted for publication, and other reports are in preparation. In connection with this study special paleontologic investigations were made for the purpose of elucidating stratigraphic problems which have a direct bearing upon the distribution of these metals.

A detailed paleobotanical microscopic examination was made of samples of the oil shales which are associated with the lead and zinc deposits of southwestern Wisconsin, for the purpose of determining the causes of the localization of the hydrocarbons that seem to have influenced the distribution of the ores. As this investigation seems likely to offer a satisfactory explanation of the origin of the oil and gas in the older Paleozoic rocks, plans have been made to continue it and extend it to some of the areas of Ordovician and Silurian oil and gas.

In April a general reconnaissance of the Carboniferous coal field of Arkansas was undertaken and is still in progress.

Brief reports on the glass sand of the middle Mississippi basin and on the clays of Garland County, Ark., were prepared for the annual economic bulletin.

GEOLOGIC WORK IN ROCKY MOUNTAIN AND PACIFIC STATES.

In the Rocky Mountain and Pacific States—a region that presents complex geologic problems and is rich in metalliferous and other economic resources—many surveys and investigations were carried on. These group themselves into the following classes: Areal and stratigraphic studies; glacial and physiographic studies; investigations of gold, silver, lead, and copper deposits; fuels; iron ores; miscellaneous economic deposits.

Areal and stratigraphic studies.—The Santa Cruz (California) geologic folio and a bulletin on the geology of the Taylorsville (Cal.) region were completed and submitted for publication. The mapping of the Corona quadrangle, in southern California, was also completed.

The Corona is the first of a series of quadrangles, comprising the Hesperia, Deep Creek, San Bernardino, Redlands, and one (unnamed) which includes the south end of the Tehachapi Mountains at the point of their junction with the Coast Ranges, which have been selected for early mapping, because it is believed they will furnish the key to the general geology of this section of the State. A geologic reconnaissance from the southern borders of the San Joaquin Valley in California northward to the south line of Merced County resulted in the preparation of a report designed to be published as a bulletin of the Survey, but it is probable that the report will not be published until the additional work necessary to complete the reconnaissance of the valley north of Suisun Bay has been done.

In Colorado about half of the Lake City quadrangle was surveyed in detail, some preliminary work was done in the neighboring San Cristobal quadrangle, and a reconnaissance was made of the Uncompahgre plateau for the purpose of elucidating certain stratigraphic problems. Special studies included one on the stratigraphy of the Cretaceous rocks of the Routt County coal field and another on the Morrison formation and overlying strata near Canyon, the latter being a continuation of a study of the same beds in New Mexico and southern Colorado which was made earlier in the season.

In connection with the completion of the detailed survey of the Cœur d'Alene mining district, which was begun the preceding field season, a stratigraphic reconnaissance was made in northern Idaho and northwestern Montana, the general results of which are incorporated in the economic report on the Cœur d'Alene district, which is nearly ready for publication.

Progress was made in the study of the marine Tertiary fauna of the Pacific coast, which has been of fundamental importance in determining the petroleum horizons of that region. As a result of the field work in this connection several geologic reconnaissance maps were prepared of areas studied, chiefly within the counties of Fresno, Kern, King, and San Luis Obispo, in California.

Glacial and physiographic studies.—Special glacial and physiographic work in this region included the completion of the report on the glaciation of the Uinta Mountains, Utah, which was submitted for publication, and the preparation of a bulletin on the landslides and rock streams of the San Juan region, Colorado, which is nearly ready for publication. Considerable progress was also made in the determination of the maximum glaciation of the Sierra Nevada, a problem of great scientific interest; but much additional field work will be necessary before a satisfactory report can be prepared.

Investigations of gold, silver, lead, and copper deposits.—The revival of mining activity in Nevada and the recent development of several new and important districts in the southwestern part of the State have

created a great demand for information concerning the geology of this region. This has been met by a geologic reconnaissance of about 8,500 square miles of southwestern Nevada and eastern California. The area surveyed has been designated the Amargosa region, and includes the Goldfield, Bullfrog, Tokop, Silverbow, Kawich, Lida, and other mining districts, as well as a large part of Death Valley. A general report on the geology of this region has been practically completed. The Goldfield and Bullfrog districts were mapped and studied in detail, and complete geologic reports are in preparation. A preliminary outline of these investigations, with notes on the Manhattan, Searchlight, Eldorado, and other mining districts in the southwestern part of the State, is now ready for publication.

Other investigations of the precious metals, lead, and copper of the West include a report on the ore deposits, chiefly gold, of the Silver Peak quadrangle, Nevada, which was completed and is now in the hands of the Public Printer; a detailed report on the geology and ore deposits, principally lead and silver, of the Cœur d'Alene mining district, in Idaho, which was carried nearly to completion; a detailed report on the copper deposits of the Butte, Mont., district, which is nearly completed and will be submitted for publication before the close of the present calendar year; a detailed report on the Park City mining district, Utah, including a reconnaissance report on the neighboring Cottonwood mining region, which was carried nearly to completion and will be finished before the end of the year; a brief study of the copper deposits of the Sierra Nacimiento and the neighboring Zuni Mountains, the results of which have been embodied in brief reports that will appear as chapters in the general report on the mineral deposits of New Mexico; a short study of the placer gold deposits near Hahns Peak, Colorado, which resulted in the preparation of a contour map, covering about 25 square miles, and a brief report, published in the annual economic bulletin; and the completion of the special geologic map of the "Downtown district" of the Leadville region, Colorado.

In addition to the foregoing the annual economic bulletin contains a number of short papers on the precious metal and copper resources of other localities in the Western States.

A special study was also made to determine the horizon of the supposed Jurassic rocks of the northern Sierra Nevada, in which are contained the extensive metalliferous deposits of that region. This investigation, however, was not completed, and another season of field work will be necessary before the results can be prepared for publication.

Fuels.—In response to the demand for information regarding the fuel resources of the country a number of reconnaissance surveys were made of the coal fields of the West, notably the following: An area

of approximately 2,250 square miles in southwestern Wyoming, surveyed with special reference to coal and oil; an area of about 1,200 square miles, comprizing the coal lands in the valley of Yampa River, in Routt County, Colo.; the lignite coal fields of southwestern North Dakota, northwestern South Dakota, and eastern Montana; the Durango-Gallup coal field, in the northwestern part of New Mexico and the adjacent part of Colorado. Brief reports on all of these surveys were prepared for the annual economic bulletin, and detailed reports have been completed and submitted for publication.

In cooperation with the General Land Office an investigation of certain contested coal lands in Utah was undertaken, with a view to the classification of the lands according to their mineral or nonmineral character. During the season surveys were made of the Book Cliffs coal field and of the coal lands in the vicinity of Coalville and Provo. Brief reports were prepared for the annual economic bulletin, and detailed reports were completed and submitted to the General Land Office. During the last four months of the fiscal year the Survey cooperated with the Department of Justice in the investigation of coal-land frauds in Utah and Colorado. These investigations are still in progress.

A detailed report on the three southernmost oil fields of California was completed and submitted for publication, and a brief report on the recently developed Salt Lake oil fields near Los Angeles was prepared for the annual economic bulletin. In addition, the annual economic bulletin contained the following reports on the fuel resources of the West: The Engle coal field of New Mexico; the coal of the Mount Diablo Range, Monterey County, Cal.; the mineral resources, chiefly coal and lignite, of the Bighorn Mountains and the Bighorn Basin, Wyoming.

Iron ores.—In pursuance of the systematic investigation of the iron ores and iron industry of the United States the following investigations were made during the year in the Rocky Mountain and Pacific Coast States: A reconnaissance of the iron ores of central Colorado, including deposits near Ashcroft and White Pine in the Sawatch Range, those in the Cebolla district south of Gunnison, and in the pre-Cambrian rocks in the vicinity of Salida; the detailed mapping of the deposits of Iron County in southern Utah and a study of the genesis of the ores; an examination of the deposits near Daggett, in San Bernardino County, Cal.; an examination of the deposits in the Seminole Mountains, northwest of Rawlins, Wyo.; laboratory studies of the western iron ores. A brief paper on the iron ores of the western United States and British Columbia was also prepared for the annual economic bulletin.

Miscellaneous economic investigations.—The special investigation of the relation of hydraulic mining and natural stream erosion in the

Sierra Nevada to agriculture, grazing, and other industries in the Sacramento Valley, which is being made in response to a memorial to the President and in cooperation with the division of hydrography, was well advanced, but owing to the intricacy of the problem and the many and conflicting interests at stake additional field and laboratory work will be necessary before the results can be prepared for publication. In connection with this investigation a laboratory has been equipped at Berkeley for the purpose of studying the natural laws which control the transportation of débris by streams, the necessary space, power, and other facilities for the experiments being contributed by the State University of California.

Other economic investigations in the West included the following: A reconnaissance of the mineral deposits of New Mexico, a special report on which was completed and submitted for publication; an examination of the asphalt lands near Thistle Junction, Utah, and of the ozokerite deposits near Colton and Soldiers Summit in the same State, brief reports on which were prepared for the annual economic bulletin, the detailed reports being submitted to the General Land Office.

The following additional brief reports were prepared for the annual economic bulletin: A Nevada zinc deposit; Cement resources of Washington; Some magnesite deposits of California; Gypsum deposits of the Uncompahgre region, Colorado; Gypsum deposits and bentonite of the Laramie Basin, Wyoming; Volcanic ash near Durango, Colo.

GENERAL SCIENTIFIC INVESTIGATIONS.

Geologic map of the United States.—In order to meet the demand for revised geologic maps of the United States and of the several States which shall represent the present condition of knowledge, a map of the United States on the scale of 1:2,500,000 was undertaken and considerable progress made in its preparation, also in the assembling of data for the preparation of geologic maps of the States, or of groups of States, on the scale of 1:1,000,000. The United States map awaits the completion of the base, on which as rapid progress as possible is being made, and the data for the State maps, which will necessarily be more detailed, are being rapidly collated.

Special geologic map of North America.—In cooperation with the Governments of Canada and Mexico, a geologic map of North America on the scale of 1:5,000,000 is in preparation by the Geological Survey. A preliminary edition of this map will be issued at the expense of the International Geological Congress to be held in the City of Mexico in September, 1906, and an edition will later accompany a professional paper.

Earthquakes.—The record catalog of earthquakes occurring in the United States has been continued. It contains information obtained

thru newspapers, thru reports of the Weather Bureau, thru the Light-House Board, and by special correspondence. The severe earthquake which occurred in California on the morning of April 18 was made the subject of a special investigation, in which the Geological Survey cooperated with the State of California and the Carnegie Institution. Two officers of the Geological Survey became members of the commission appointed by Governor Pardee, of California, and a third was temporarily detailed to assist in the work. This commission is studying the phenomena of the earthquake in a systematic manner, and has already made a preliminary report. The Geological Survey has also investigated the injury to buildings and other structures in San Francisco and vicinity, for the purpose of ascertaining what materials and forms of construction are best adapted to withstand earthquake vibrations.

PALEONTOLOGIC WORK.

In addition to the usual routine work of the paleontologists—that of aiding, by the identification of contained fossils, in the determination of questions of age and stratigraphy—which is performed for members of the Survey and the various State surveys, many special paleontologic investigations were carried on during the year.

Tertiary and Quaternary.—The study of the marine Tertiary fauna of the Pacific coast, which has been of fundamental importance in determining the oil and petroleum horizons of that region, was considerably advanced during the year, especially by the large collections of fossils obtained in Fresno, King, Kern, and San Luis Obispo counties, Cal. Satisfactory progress was made in the preparation of a monograph on this fauna, and in connection with it a bibliography and reference card catalog of the several thousand Tertiary and Quaternary species of the coast was prepared in order to facilitate the identification and study of fossils from those horizons.

The knowledge of Tertiary faunas was especially augmented by a large collection of Pliocene and Pleistocene fossils from Port Limon, Costa Rica, which have an important bearing upon the relations of the Tertiary of California to that of the Gulf of Mexico.

The monograph on the Tertiary corals of North America was also well advanced, and considerable progress was made in the preparation of a report on the Miocene of the Coos Bay region of Oregon.

The study of large collections of fossils from Georgia, gathered in connection with the investigation of underground waters, resulted in mapping the Tertiary formations of a large part of southeastern Georgia of which previously little or nothing was known, while an interesting collection from the Oligocene of Florida threw much light on the Tertiary of that region.

Cretaceous.—Considerable progress was made in the study and description of the Lower Cretaceous fauna of Texas, a work which

has been in preparation for several years, such time as could be spared from immediately pressing duties being devoted to it.

Triassic.—Satisfactory progress was made in the preparation of the monograph on the Triassic cephalopods of America. A large quantity of valuable material was collected from the Upper Trias of Shasta County, Cal., and that previously collected from the Triassic of Nevada, Idaho, and California was classified and studied in detail. The work in Shasta County resulted in clarifying certain stratigraphic problems of that region which have a direct bearing upon the study of the economic resources.

Carboniferous.—The manuscript for a professional paper on the unique Guadalupian fauna of Texas, which is widely different from the typical Pennsylvanian, from the Permian of the Mississippi Valley, and from the Russian Permian, altho bearing some resemblances to the latter, was completed and submitted for publication, and the manuscript for a professional paper on the Lower Carboniferous ore-bearing beds of Missouri was partly written. The latter study was made in order to facilitate the correlation of the different ore-bearing horizons of the Mississippian series with one another and with the standard section of the Mississippi Valley in Missouri and Iowa.

The Devono-Carboniferous series of Pennsylvania was made the subject of a special geologic and paleontologic study, but additional field work will be necessary before the results can be prepared for publication.

Devonian and Silurian.—The Devonian and Silurian stratigraphy and faunas were the subject of an investigation with reference to the modifications which they exhibit in passing north and northwest from central Kentucky to Wisconsin, a question which has an important bearing on the distribution of the lead and zinc deposits of that region.

Cambrian.—A monograph on the Cambrian brachiopods was brought very nearly to completion and will be submitted for publication early in the next year. Field investigations in the extensively developed Cambrian formations of western Montana and central Utah were continued.

General.—Special paleontologic field studies were made in southeastern Alaska for the purpose of determining the limits of the principal geologic horizons and the order of succession. A bulletin on the paleontology of the Santa Cruz region in California, based on material gathered in connection with the areal and economic survey of that quadrangle, was well advanced. The monograph on the Ceratopsia was completed and is now in the hands of the printer, and considerable progress was made on the Sauropoda and Titanothere monographs, but owing to the magnitude and difficulty of the tasks additional work remains to be done. This study is being greatly facilitated by the notes and collections incidentally made by geologists

engaged in other investigations. Special collections of fossils were made in the vicinity of Murfreesboro, N. C., for the purpose of recovering species obtained in that locality by Wagner about 1832 and hitherto not represented in the Survey collections.

PALEOBOTANIC WORK.

A monograph on the fossil flora of the Laramie, the great coal-bearing formation of the West, was well advanced, and will probably be finished next year. This monograph is one of the results of a special investigation made for the purpose of affording an easy means of identifying this formation and aiding in the classification of the coals of the different localities.

In connection with the mapping of the areal geology of the Kenova quadrangle, in Kentucky, Ohio, and West Virginia, a special study was made of the paleobotany of the Upper Carboniferous formations of that region for the purpose of ascertaining the extent of the basal unconformity and to aid in correlating the succeeding Coal Measures groups with the rocks in Pennsylvania. A similar study was made in the Birmingham, Ala., quadrangle, which it is hoped will establish the correlation of the enormously thickened coal-bearing section of that State with the formation recognized in the basins farther north in the Appalachian trough and permit the identification of the equivalents of the minor subdivisions or coal groups in the several detached basins.

At the request of the chief of the Brazilian coal commission several collections of fossil plants from the coal fields of Santa Catharina and Rio Grande do Sul were examined and reported upon by Survey paleobotanists, and on the completion of the work the material, which is of considerable scientific value, was presented to the United States National Museum by the Brazilian commission.

Satisfactory progress was made in the work on the bibliography and compendium of paleobotany, which not only serves as a working guide for Survey paleobotanists but is consulted by American paleobotanists generally, and frequently by those of other countries.

PETROGRAPHIC LABORATORY.

The petrographic laboratory, in which three persons were employed continuously and one temporarily, remained in charge of the chief of the section of petrology. Its high record of efficiency was maintained thruout the year, the total output being as follows: Thin sections of average size, 6,295; large or difficult sections, 257; saw cuts, 1,134; surfaces polished, 85. The petrographic reference collection also remained in charge of the chief of the section of petrology, and was substantially increased during the year.

DIVISION OF ALASKAN MINERAL RESOURCES.

The work of the division of Alaskan mineral resources was carried on under the appropriation of $80,000 made for "a continuation of the investigations of the mineral resources of Alaska." Under this authority the following classes of work were done: Reconnaissance and detailed geologic surveys; special investigations of mineral deposits; reconnaissance and detailed topographic surveys.

SEASON OF 1905.

The permanent technical field personnel of the division embraced 11 geologists on annual salaries, 1 geologist on a per diem salary, and 4 topographers. One paleontologist gave a part of his time to the Alaskan work. The office work included 1 geologist, 1 clerk, and 1 typewriter on annual salaries, and 1 typewriter holding a temporary appointment. In addition to the regular technical force, 4 geologic and 4 topographic assistants and 1 special assistant, together with 28 packers, cooks, etc., were employed in Alaska during the summer of 1905.

Nine parties were engaged in field work during the open season, from about May 15 to October 15, in 1905. Several of these were subdivided after reaching Alaska, making 14 parties in all.

Southeastern Alaska.—A party of 2 geologists, a part of the time assisted by a paleontologist, continued the reconnaissance work in the Panhandle. The preliminary study of the geology and mineral resources of the Ketchikan and Wrangell districts was completed. An outline of the results has been published in Bulletin No. 284 and a more complete statement is in preparation.

Yakutat Bay.—Three geologists were engaged in this field from June until September. A geologic reconnaissance was completed and a preliminary statement of results has been published in Bulletin No. 284. In connection with the survey of the gold-bearing beach gravels and the lignite deposits, a special study was made of the glaciers of this region, of the evidence of former glaciation, and of the remarkable deformation of the earth's crust which occurred during the earthquake shock of September, 1899. A detailed report on these investigations is in preparation.

Controller Bay.—Two geologists and 2 topographers were employed in detailed surveys in this field from May until October. Topographic surveys of 430 square miles, lying between 60° and 60° 30′ north latitude and 139° 45′ and 144° 35′ west longitude, were completed for publication on a scale of 1:62,500, with 50-foot contours. Of levels, 97½ miles were run and 9 permanent bench marks were set. Of traverse, 183 miles were run. Reconnaissance topographic surveys (1:250,000)

were also carried over about 200 square miles of additional area. The geologists made surveys of about the same area as the topographers, and made a special study of the coal fields of the region. An outline of the important results is contained in Bulletin No. 284.

Prince William Sound.—Two geologists were engaged from June 25 to September 15 in making a reconnaissance of the shores of Prince William Sound. All the known copper deposits were examined in detail. A preliminary statement of results has been published (Bulletin No. 284) and the final report is in preparation.

Matanuska Valley.—The coal fields of this district were hastily examined by a geologist during the month of August, and a statement of the results is in press (Bulletin No. 289).

Herendeen Bay.—A rapid reconnaissance of the coal-bearing rocks of this region was made by a geologist in June, 1905, and the results have been published in Bulletin No. 284.

Seward Peninsula.—Three topographers, working from June to October, 1905, completed the survey of the areas of the Solomon Special and the Casadepaga Special maps, embraced between longitude 164° and 164° 30′ and latitude 64° 30′ and 65°, and including 470 square miles. The scale was 1:62,500, with 25-foot contours. Levels to the extent of 93.9 miles were run and 17 permanent bench marks were established.

Detailed studies of an area of about 300 square miles in the Nome region were made by two geologists during the summer of 1905. In addition to this the same men made a further study of the tin deposits at York and of the gold placers of the Solomon River and Ophir Creek regions. The results of the latter work are contained in Bulletin No. 284.

Yukon-Tanana region.—Topographic reconnaissance surveys (1:250,000, contours 200 feet) were extended over an area of 4,300 square miles by two topographic parties. The mapped area includes a part of the Birch Creek, Beaver Creek, and Tolovana River basins. The work was controlled by triangulation carried westward from points previously established in the Birch Creek basin. A part of the area covered by these surveys is included in the Circle quadrangle, in the Yukon-Tanana region, a report on which is in press (Bulletin No. 295). A geologist accompanied the topographic party, working in the Beaver Creek region, and made an areal reconnaissance of the area traversed, and the results have been published in Bulletin No. 284. The field season was cut short by the early snow which fell on September 4.

A party of two geologists carried a reconnaissance westward from the international boundary at the head of Sixtymile Creek to the mouth of Delta River and thence to Fairbanks. A part of the results of this work is in print (Bulletin No. 284).

General.—The geologist in charge has been chiefly occupied in routine administrative work. In July, 1905, he visited the parties working in southeastern Alaska and in the Controller Bay region. Considerable time was also spent on a report entitled "The gold placers of Seward Peninsula," which is now nearly completed.

SEASON OF 1906.

Under a continuation of the same appropriation 12 parties were dispatched to Alaska during the months of May and June, 1906. Of these, one topographic and one geologic party were sent to southeastern Alaska. A geologic party went to the St. Elias region and one to complete the mapping of the Controller Bay region. The region lying adjacent to the upper end of Cook Inlet is to be surveyed by two parties. A geologic party is to continue detailed work in the Nome region. By cooperation with the division of hydrography stream gaging was begun in the Nome region. Two topographic parties are continuing reconnaissance surveys in the Yukon-Tanana region. One geologic party has been dispatched to the newly discovered Kantishna placer district and another has been directed to work along the upper Yukon.

DIVISION OF MINING AND MINERAL RESOURCES.

During the year ending June 30, 1906, the division was engaged in the preparation of the reports on the mineral resources of the United States for 1904 and 1905. The report for 1904 was completed and published, and the report for 1905 is approaching completion. Manuscripts for most of the chapters are in hand, and some of them have already been published as advance extracts. The reports received indicate that the total value of the mineral products of the country in 1905 may exceed the value in 1904 by 10 per cent.

The work on the black sands of the Pacific coast, which was authorized by Congress and organized before the fiscal year began, was pushed vigorously during the year at Portland, Oreg., where exceptional facilities for this work were offered by the Lewis and Clark Exposition. The results have exceeded all expectation, and the investigation bids fair to lead to the development of an important and lucrative industry in the utilization of the black sands of the country as a source of gold, platinum, iron ore, and some of the rare metals. It is highly important that this work be continued on the Pacific coast and that it be extended to the promising fields along the Atlantic seaboard.

A considerable portion of the time of this division is consumed in answering technical inquiries, and laboratory facilities should be afforded the division for making simple tests for determining the mineralogic character of the large number of specimens submitted to

it annually. It is not intended that the work of this division should take the place of the commercial chemist, but merely that it be placed in a position to advise correspondents of the nature of specimens submitted and whether or not the material is worth further investigation.

The chief of the division has been designated by the Secretary of the Interior to cooperate with the Jamestown Exposition Company in the organization of a mining exhibit at the exposition, to be held in 1907.

DIVISION OF CHEMICAL AND PHYSICAL RESEARCH.

During the year 144 analyses were reported from the laboratory, together with 567 determinations of minerals received from various sources. This, with the usual amount of administrative detail, correspondence, etc., represents the routine work of the laboratory.

Apart from the routine, the scientific work of the division has been as follows:

Progress was made on a monograph of geochemistry, and the first draft of the manuscript is approaching completion. Much work was done on analytical methods, especially with reference to the determination of the moisture in coals, of fluorine, ferric iron, and manganese in rocks, and a revision of Bulletin No. 176 is nearly completed. A considerable number of rare minerals was examined, especially a series of unusual ores of mercury from Texas. Progress was made upon a research into the secondary enrichment of ores. An investigation was made upon the determination of manganese and zirconia in rocks. A large amount of work was done upon crystallographic measurements, especially of the mercury minerals referred to above. Studies were also made upon the minerals of the lithia region of California.

In the physical laboratory, after completion of the memoir on "The isomorphism and thermal properties of the feldspars," two other series of minerals were taken up, in order, if possible, to carry thru an equally careful investigation of some typical eutectic series. The minerals chosen for these studies were the magnesium silicates and the lime silicates. A paper on "Wollastonite and pseudowollastonite, polymorphic forms of calcium metasilicate," was completed and published, and a paper on a very interesting and complicated tetramorphic relation occurring in the magnesium silicate series is now nearly ready for publication. As a part of the same general plan of investigation, another investigator was engaged upon the limestone series, studying all possible stable forms from pure lime to pure silica. A careful investigation was also made of the phenomena attending the melting of pure silica (quartz); this has immense technical interest on account of the value of quartz glass, which can be heated white hot without softening and while still hot be plunged into water without breaking.

The more interesting facts developed in the experiments upon quartz were published in Science during the year. A paper on the calcium silicates is nearly ready for the printer, and considerable progress can be reported upon a fundamental investigation of the scale of temperatures in terms of which all the work of the laboratory is exprest. The existing German scale extends only to 1,150° C., which is insufficient for effective work with the minerals. A gas thermometer was therefore constructed, and after several months of preliminary work it is possible to say that greater accuracy as well as greater range has been attained.

Members of the division have been engaged, also, in the study of finite elastic strains, as an incident to which a useful series of mathematical tables was prepared.

TOPOGRAPHIC BRANCH.

The organization of the topographic branch remained the same as it had been during the two immediately preceding years.

COOPERATION BY STATES.

Cooperative arrangements for topographic surveys were made with fourteen States. The governor of the State of Illinois allotted $10,000; the legislature of California appropriated $15,000; the director of the Kentucky Geological Survey allotted $5,000; the State Survey Commission of Maine, $3,200; the State geologist of Maryland, $2,500; the State geologist of Michigan, $2,000; the State engineer and surveyor of New York, $600; the commissioner of agriculture of North Carolina, $4,000; the governor of the Territory of Oklahoma, $5,000; the governor of Ohio, $23,800; the governor of Oregon, $2,500; the State Survey Commission of Pennsylvania, $14,000; the State geologist of West Virginia, $15,000; and $400 was allotted by the forestry commission of New Hampshire for a special sheet. Thus $103,000 was allotted by the States mentioned, in addition to the Federal appropriation for topographic work

SUMMARY OF RESULTS.

The following summary includes all small-scale topographic surveys made by the divisions of topography, including those of forest reserves, and by the division of Alaskan mineral resources:

Primary azimuth observations were made at two triangulation stations. Triangulation stations to the number of 328 were occupied or located and marked, and 3,261 miles of primary traverse were run. In the course of this work 51,430 square miles were covered by primary control.

The condition of topographic surveys to June 30, 1906, distinguished as to scale, etc., is shown on a general map of the United States, Pl. I,

and the detailed distribution of this work in the various States and Territories is shown on the accompanying maps, Pls. II–XXIII. On the latter are indicated by proper symbols the sheets published to June 30, 1906, the sheets in course of publication, and the areas surveyed during the field season of 1905 and drawn in map form in the office season of 1905–6. By appropriate symbols these maps also show areas in which precise or primary spirit levels have been run and unmapped areas which are controlled by primary triangulation or traverse or by astronomic positions.

As shown in the following table giving the details of topographic mapping and spirit leveling for the fiscal year, the total of new surveys was 36,605 square miles. The total area surveyed in the United States to date is 992,601 square miles, or about 32 per cent.

In addition, 3,179 square miles of revision or resurvey were completed by final topographic mapping in the eastern division and 1,016 in the western division, over which preliminary reconnaissance surveying had been previously carried, thus making the total area of actual surveys for the season 40,800 square miles.

In connection with these surveys there were run 38,307 linear miles of spirit levels, of which 892 miles were precise, making the spirit leveling done since the authorization of this class of work by Congress, in 1896, amount to 196,371 miles. In addition, 327 miles of forest-reserve boundary lines were run, 12 miles were retraced, and 15 miles of supplemental lines were run.

The total area covered by topographic surveys made in Alaska during the fiscal year 1905–6, as reported in detail on pages 25–26, was about 5,300 square miles, in the course of the mapping of which 191 miles of spirit levels were run and 26 permanent bench marks were established.

Present condition of topographic surveys of the United States, and new areas surveyed in 1905–6.

State or Territory.	New area surveyed in 1905–6.	Total area surveyed to April 30, 1906.	Percentage of total area of State surveyed to April 30, 1906.
	Sq. miles.	*Sq. miles.*	
Alabama	.....	17,534	34
Arizona	775	62,375	55
Arkansas	.....	20,469	38
California	6,441	74,976	47
Colorado	1,221	36,711	35
Connecticut	.....	5,047	100
Delaware	.....	1,008	49
District of Columbia	.....	70	100
Florida	.....	1,821	3
Georgia	1,310	16,829	28
Idaho	263	15,196	18
Illinois	1,430	6,345	11
Indian Territory	.....	30,620	99
Indiana	131	2,442	7
Iowa	291	9,686	17
Kansas	.....	64,159	78

MAP OF UNITED STATES, SHOWING AREAS COVERED BY TOPOGRAPHIC SURVEYS

AND THE SCALE EMPLOYED FOR EACH AREA

Scale
100 0 100 200 300 miles

1906

LEGEND

Scale 1:62500 OR LARGER | Scale 1:125000 | Scale 1:250000

C. J. Peters & Son Co., Map Makers, Boston.

Present condition of topographic surveys of the United States, and new areas surveyed in 1905–6—Continued.

State or Territory.	New area surveyed in 1905–6.	Total area surveyed to April 30, 1906.	Percentage of total area of State surveyed to April 30, 1906.
	Sq. miles.	*Sq. miles.*	
Kentucky	547	13,791	34
Louisiana	71	7,698	16
Maine	210	6,515	20
Maryland	.....	10,294	84
Massachusetts	.....	8,332	100
Michigan	47	3,313	6
Minnesota	236	2,876	3
Mississippi	404	653	1
Missouri	925	33,489	47
Montana	856	44,830	31
Nebraska	200	25,974	34
Nevada	7,232	36,185	33
New Hampshire	266	3,089	33
New Jersey	.....	7,756	98
New Mexico	.....	28,022	23
New York	1,061	37,576	76
North Carolina	607	16,645	32
North Dakota	841	8,678	12
Ohio	3,901	16,497	40
Oklahoma	356	4,510	12
Oregon	2,255	15,296	16
Pennsylvania	1,286	18,245	40
Rhode Island	.....	1,131	100
South Carolina	312	5,328	17
South Dakota	329	17,814	23
Tennessee	.....	19,849	47
Texas	321	64,539	24
Utah	93	63,320	75
Vermont	.....	3,463	36
Virginia	66	29,463	69
Washington	505	16,971	25
West Virginia	713	22,576	91
Wisconsin	5	10,914	19
Wyoming	1,098	21,681	22
	36,605	992,601	.....

EASTERN DIVISION.

FIELD WORK.

SUMMARY.

During the season topographic surveying was carried on by 67 parties working in 26 States, namely, Alabama, Arkansas, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New York, North Carolina, North Dakota, Ohio, Pennsylvania, South Carolina, Vermont, Virginia, West Virginia, and Wisconsin. The survey of 49 new quadrangles and the resurvey or revision of 11 reconnaissance sheets were completed. In addition, 60 new quadrangles were partly surveyed and 8 were partly resurveyed. The total new area mapped was 14,863 square miles, of which 3,076 square miles were for publication on the scale of 1:125,000 and 11,787 square miles were for publication on the scale of 1:62,500. There were resurveyed or revised 1,296 square miles on the publication scale of 1:125,000 and 1,883 square miles on the publication scale of 1:62,500.

In connection with this work 33,590 linear miles of spirit levels of all grades were run, and 1,317 permanent bench marks were established along the routes run by precise and primary methods. Along the remainder, of secondary order, temporary bench marks were set at distances of about 1 mile. Primary control was carried on during the season by 6 parties working in portions of 19 States. They controlled 19,130 square miles lying within 77 quadrangles.

Topographic surveys in eastern division from May 1, 1905, to April 30, 1906.

State or Territory.	Contour interval.	Scale of publication.				Total area surveyed.	Levels.	
		1:125,000.		1:62,500.				
		New.	Resurvey or revision.	New.	Resurvey or revision.		Distance run.	Bench marks.
	Feet.	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Miles.*	
Alabama	20	.....	.....	.....	384	384	669	51
Georgia	50	1,310	.....	.....	[a]81	1,391	1,780	113
Illinois	10, 20	.....	.....	1,430	.....	1,430	3,740	101
Indiana	20	.....	.....	131	.....	131	202	2
Iowa	20	.....	.....	291	.....	291	587	19
Kentucky	20	.....	.....	[b]547	.....	547	1,289	20
Louisiana	10	.....	.....	71	.....	71	282	23
Maine	20	.....	.....	210	.....	210	220	19
Maryland	20	.....	.....	.....	299	299	519	63
Michigan	20	.....	.....	[c]47	.....	47	189	24
Minnesota	20	.....	.....	236	.....	236	592	24
Mississippi	20	.....	.....	404	.....	404	355	21
Missouri	20, 50	925	4	3	.....	932	1,369	71
Nebraska	20	.....	.....	200	.....	200	290	18
New Hampshire	20	.....	.....	[d]266	.....	266	394	32
New York	20	.....	.....	1,061	3	1,064	964	35
North Carolina	100, 20, 10	.....	1,149	607	.....	1,756	2,048	43
North Dakota	50	841	.....	.....	.....	841	906	31
Ohio	10, 20	.....	.....	3,901	124	4,025	8,651	236
Pennsylvania	20	.....	.....	1,286	48	1,334	2,958	109
South Carolina	100, 20	.....	143	312	.....	455	1,402	27
Vermont	.....	.....	.....	.....	.....	.....	66	11
Virginia	50, 10	.....	.....	66	9	75	490	38
West Virginia	20	.....	.....	713	717	1,430	2,546	124
Wisconsin	20	.....	.....	5	218	223	704	62
Total	.....	3,076	1,296	11,787	1,883	18,042	33,212	1,317

[a] One square mile of the above was mapped on Kenesaw Battlefield Special, on scale of 5 inches to 1 mile, with contour interval of 10 feet. Eighty square miles were mapped on Dahlonega Special, on publication scale of 1:36,000, with contour interval of 20 feet.
[b] Included in this area are 37 square miles, embracing suburbs of Louisville, on scale of 1:24,000.
[c] Marquette quadrangle has been mapped for publication on scale of 1:24,000.
[d] Blue Mountain Special, covering 29 square miles of this area, has been mapped on publication scale of 1:24,000.

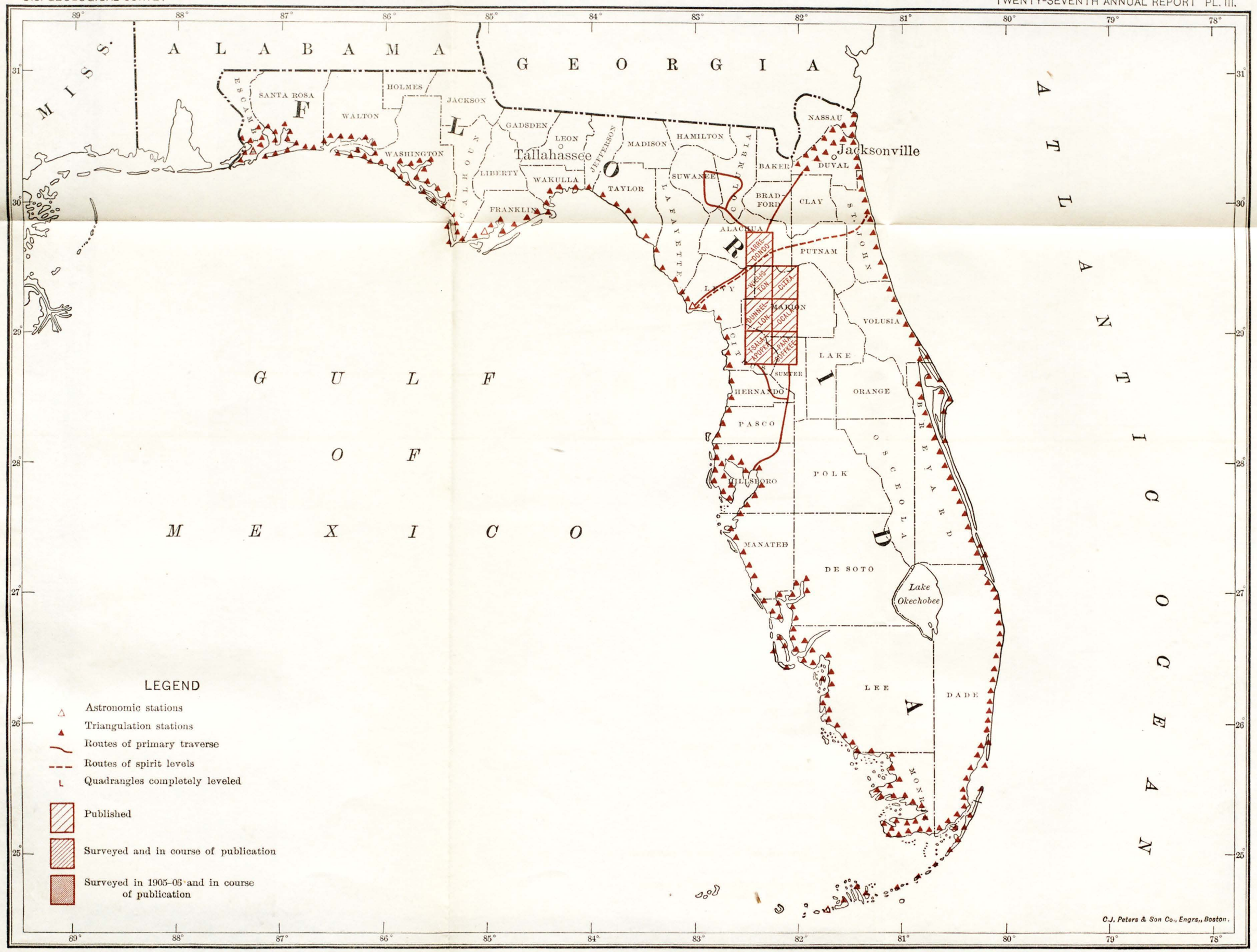
DETAILS OF TOPOGRAPHIC FIELD WORK, BY STATES.

Alabama.—One party was engaged in field work in the State during the season. The resurvey of the Bessemer Special quadrangle, in Jefferson and Shelby counties, and of the Leeds quadrangle, in Jefferson, St. Clair, and Shelby counties, was completed. This work was on the publication scale of 1:62,500, with a contour interval of 20 feet. A partial resurvey was made of the Bessemer quadrangle, in Bibb, Chilton, Jefferson, and Shelby counties, which was originally intended for publication on the scale of 1:125,000, with a contour interval of 50 feet, but it has been decided to publish the results on four 15-minute sheets, with a scale of 1:62,500. In the course of this work 364 square miles were resurveyed, during which 669 miles of spirit levels were

LEGEND

- Astronomic stations
- Triangulation stations
- Routes of primary traverse
- Routes of spirit levels
- L Quadrangles completely leveled
- Published
- Surveyed and in course of publication
- Surveyed in 1905-06 and in course of publication

MAP OF ALABAMA, MISSISSIPPI, ARKANSAS, AND LOUISIANA, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL



LEGEND

- Astronomic stations
- Triangulation stations
- Routes of primary traverse
- Routes of spirit levels
- L — Quadrangles completely leveled
- Published
- Surveyed and in course of publication
- Surveyed in 1905-06 and in course of publication

C.J. Peters & Son Co., Engrs., Boston.

MAP OF FLORIDA, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL

run and 51 bench marks and 4,706 elevations were established, and 2,095 linear miles of road traverse were run.

Georgia.—Four parties were engaged in field work during the season. The survey of the Talbotton quadrangle, in Harris, Meriwether, Muscogee, Talbot, Troup, and Upson counties was completed for publication on the scale of 1:125,000, with a contour interval of 50 feet. The mapping of the Kenesaw Battlefield Special—a resurvey of a portion of the Marietta 30-minute quadrangle—on the scale of 5 inches to 1 mile, with a contour interval of 10 feet, was completed. The survey of the Opelika (Alabama-Georgia) quadrangle, in Harris, Muscogee, and Troup counties, was continued, the Georgia portion being completed. The resurvey of the Dahlonega Special quadrangle, in Lumpkin County, for publication on the scale of 1:36,000, with a contour interval of 20 feet, was completed. This special sheet covers portions of the Dahlonega, Ellijay, Suwanee, and Gainesville sheets, previously published on the scale of 1:125,000. The resurvey for the Stilesboro sheet, a reduction of the Cartersville 30-minute sheet, was in progress, for publication on the scale of 1:62,500, with a contour interval of 50 feet. The total new survey made in the field covered 1,310 square miles, during the mapping of which there were run 1,328 miles of spirit levels, in the course of which 54 permanent bench marks and 4,877 elevations were established, and 3,616 linear miles of road traverse were run. The resurvey of 81 square miles in the State was completed, during which 103 trigonometric points were located; 342 miles of spirit levels were run, in the course of which 41 bench marks and 2,129 elevations were established; and 1,088 linear miles of road traverse were run.

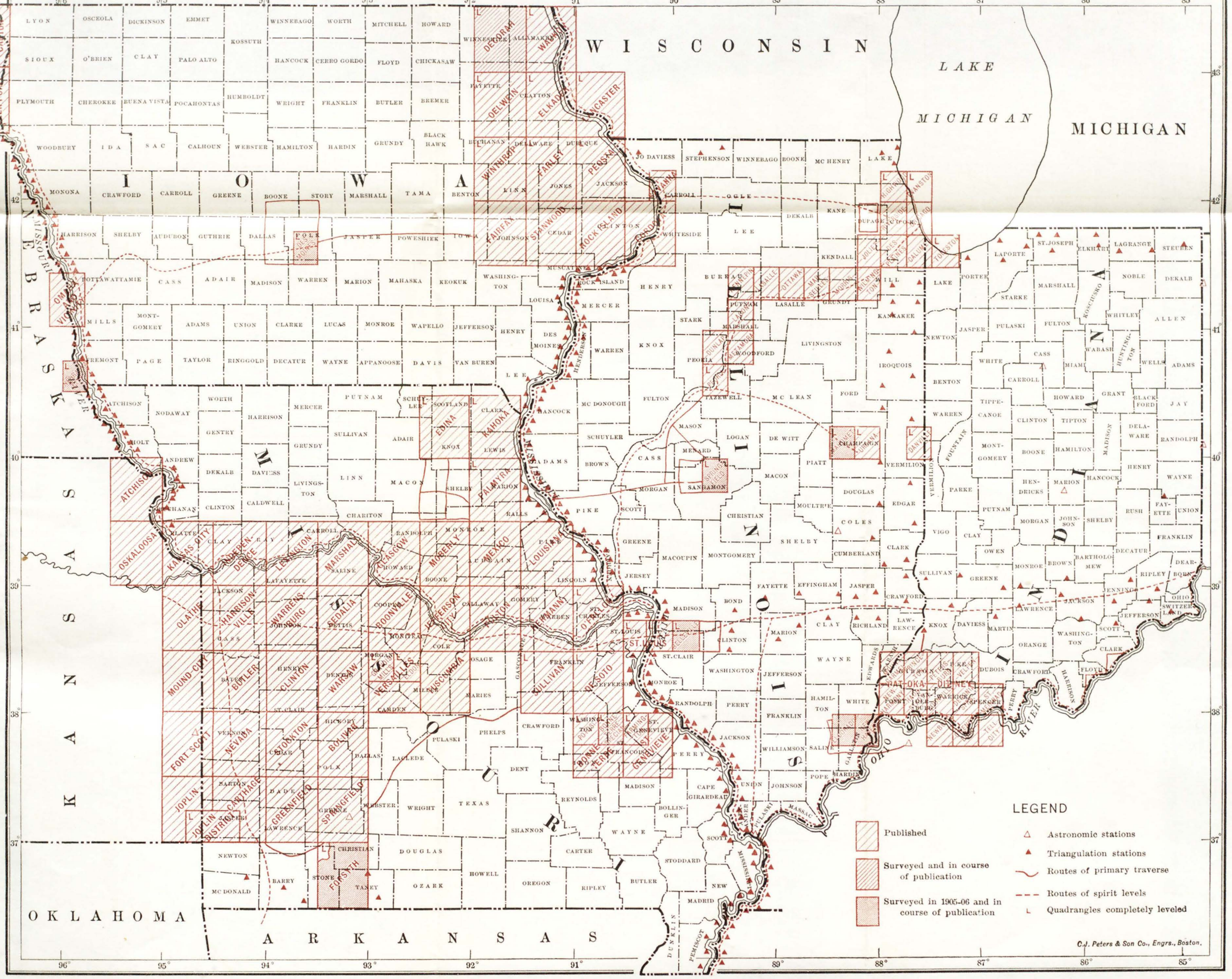
Illinois.—The governor of the State of Illinois allotted $10,000 toward cooperative topographic surveys within the State, and the Director of the United States Geological Survey allotted an equal sum to the same work. Three parties were engaged in field work in the State during the season. The survey of the following quadrangles was completed: Belleville, in Madison and St. Clair counties; Eldorado, in Gallatin, Hamilton, Saline, and White counties; Mahomet, in Champaign and Platt counties; New Haven (Illinois-Indiana-Kentucky), in Gallatin and White counties; Springfield, in Logan, Menard, and Sangamon counties; and Urbana, in Champaign County. A partial survey was made of the following quadrangles: Breese, in Bond, Clinton, St. Clair, and Madison counties; Carmi (Illinois-Indiana), in White County; Havana, in Fulton and Mason counties; Petersburg, in Logan, Menard, and Sangamon counties; Saidora, in Cass, Fulton, Mason, and Schuyler counties; and Wheaton, in Dupage County. This work is all for publication on the scale of 1:62,500, with contour intervals of 10 and 20 feet. In all there were mapped in the

above quadrangles 1,347 square miles of the area of the State, and in addition 83 square miles beyond quadrangle limits, which will be incorporated in future map work. There were run 3,740 miles of levels, in the course of which 101 permanent bench marks and 24,446 elevations were established, and 6,223 linear miles of road traverse were run.

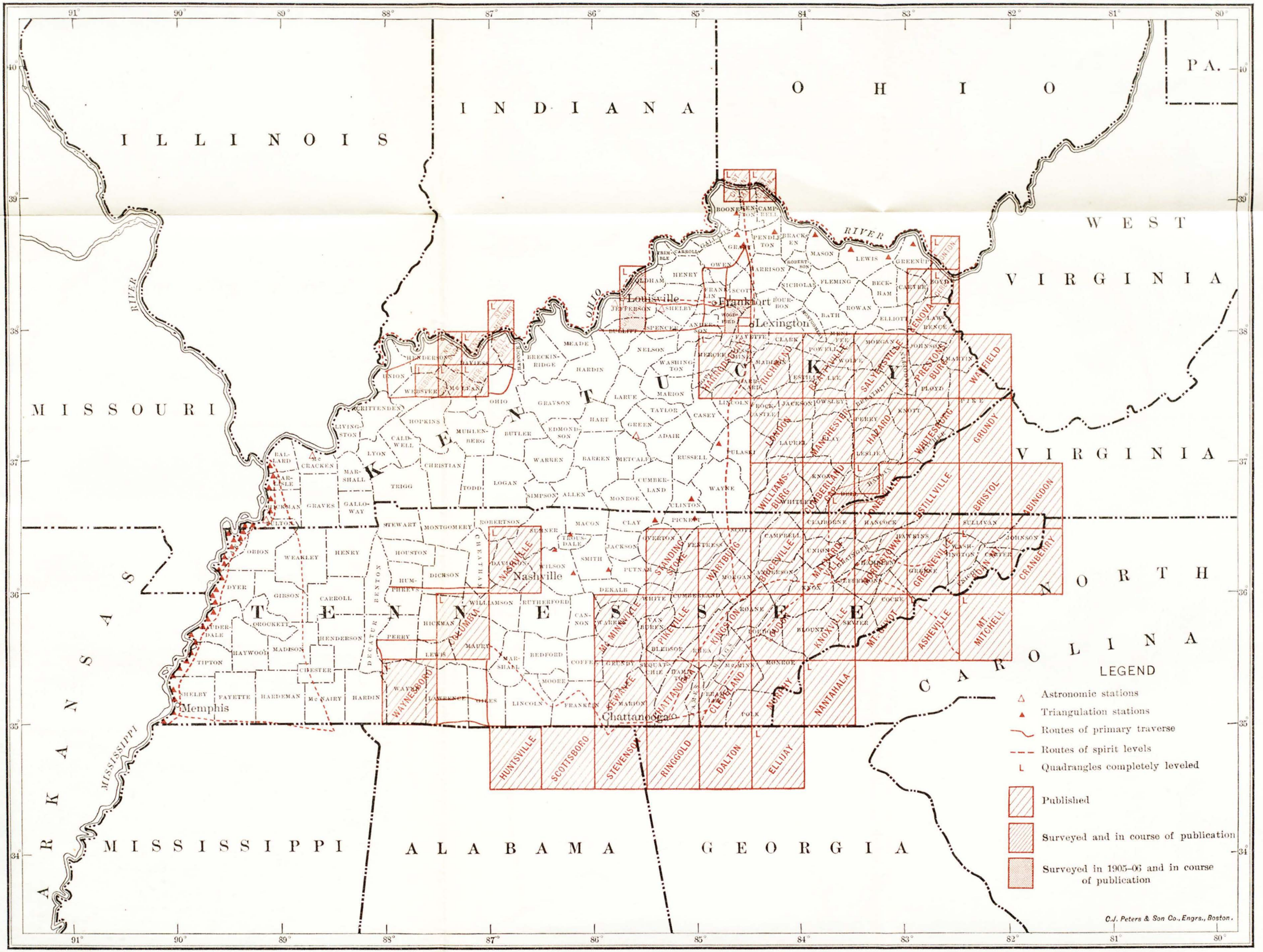
Indiana.—Two parties were engaged in field work in the State during the season. The survey of the New Haven (Illinois-Indiana-Kentucky) quadrangle, in Posey County, was completed, and a partial survey was made of the New Albany (Kentucky-Indiana) quadrangle, in Clark, Floyd, and Harrison counties, and of the Prospect (Kentucky-Indiana) quadrangle, in Clark County. There were completed 131 square miles of the area of the State for publication on the scale of 1:62,500, with a contour interval of 20 feet; 202 miles of levels were run, in the course of which 2 permanent bench marks were established; and 166 miles of traverse were run.

Iowa.—Two parties were engaged in field work during the season. The survey of the Des Moines quadrangle, in Polk and Warren counties, and of the Nebraska City (Nebraska-Iowa-Missouri) quadrangle, in Fremont County, was completed. This work is for publication on the scale of 1:62,500, with contour interval of 20 feet. There were mapped in the course of this work 256 square miles in the above-named quadrangles, and in addition 35 square miles beyond quadrangle limits; 587 miles of spirit levels were run, in the course of which 19 permanent bench marks and 4,466 elevations were determined; and 772 miles of linear road traverse were run.

Kentucky.—The director of the State Geological Survey allotted $5,000, and the Director of the United States Geological Survey an equal amount, for cooperative topographic surveys within the State. Three parties were engaged in field work during the season. The survey of the Louisville quadrangle, in Jefferson, Spencer, and Bullitt counties, and of the New Haven (Indiana-Illinois-Kentucky) quadrangle, in Union County, was completed, and a partial survey was made of the following quadrangles: Georgetown, in Fayette, Franklin, Scott, and Woodford counties; Morganfield, in Crittenden, Union, and Webster counties; and Prospect (Kentucky-Indiana), in Bullitt and Jefferson counties. A special map of the city of Louisville was made on the publication scale of 1:24,000, with a contour interval of 20 feet, which will be reduced to form parts of the Louisville, Prospect, Riverview, and New Albany sheets. All of the above work is for publication on the scale of 1:62,500, with a contour interval of 20 feet. In the progress of this work there were mapped 547 square miles of the area of the State; 1,289 miles of levels were run, in the course of which 20 permanent bench marks and 6,928 elevations were determined; and 2,628 linear miles of road traverse were run.



MAP OF INDIANA, ILLINOIS, IOWA, AND MISSOURI, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL



MAP OF KENTUCKY AND TENNESSEE, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL

Louisiana.—One party was engaged during the fall in the survey of the Baton Rouge quadrangle, in West Baton Rouge, East Baton Rouge, Ascension, and Iberville parishes, in the course of which 71 square miles were mapped; 282 miles of spirit levels were run, in connection with which 23 permanent bench marks and 1,165 elevations were determined; and 940 linear miles of road traverse were run. This work is for publication on the scale of 1:62,500, with a contour interval of 10 feet.

Maine.—The State Survey Commission allotted $3,200, and the Director of the United States Geological Survey a like sum, for continuation of cooperative topographic surveys. One party was engaged in the surveys during the season. The mapping of The Forks quadrangle, in Piscataquis and Somerset counties, was completed, and a partial survey was made of the Lewiston quadrangle, in Androscoggin, Kennebec, and Sagadahoc counties, and of the Poland quadrangle, in Androscoggin, Cumberland, and Oxford counties. This work is for publication on the scale of 1:62,500, with a contour interval of 20 feet. There were completely mapped 210 square miles of the State, in connection with which 220 miles of spirit levels were run and 19 permanent bench marks and 875 elevations were determined, and 1,481 linear miles of road traverse were run.

Maryland.—The State geologist of Maryland allotted $2,500 for cooperative topographic surveys within the State, and the Director of the Federal Survey allotted a like amount. One party was engaged in field work within the State. The resurvey of the Relay quadrangle, in Anne Arundel, Baltimore, and Howard counties, was completed, and a partial resurvey was made of the Laurel quadrangle, in Anne Arundel, Howard, Montgomery, and Prince George counties. The revision of the Owensville quadrangle, in Anne Arundel, Calvert, and Prince George counties, and of the Prince Frederick quadrangle, in Anne Arundel, Calvert, Charles, Prince George, and St. Mary counties, was completed. All of the above work is for publication on the scale of 1:62,500, with a contour interval of 20 feet. In all, there were 299 square miles resurveyed or revised; 519 miles of levels were run, in the course of which 63 permanent bench marks and 656 elevations were determined; and 706 linear miles of road traverse were run.

Michigan.—The State geologist allotted $2,000 toward cooperative topographic surveys, and the Director of the United States Geological Survey allotted an equal amount for the same purpose. One party was engaged in field work in the State. The survey of the Marquette quadrangle, in Marquette County, was completed, and a partial survey was made of the Pontiac quadrangle, in Oakland County. The Marquette sheet will be published on the scale of 1:24,000, with a contour interval of 20 feet. There were mapped 47 square miles; 189 miles of spirit levels were run, in the course of which 24 perma-

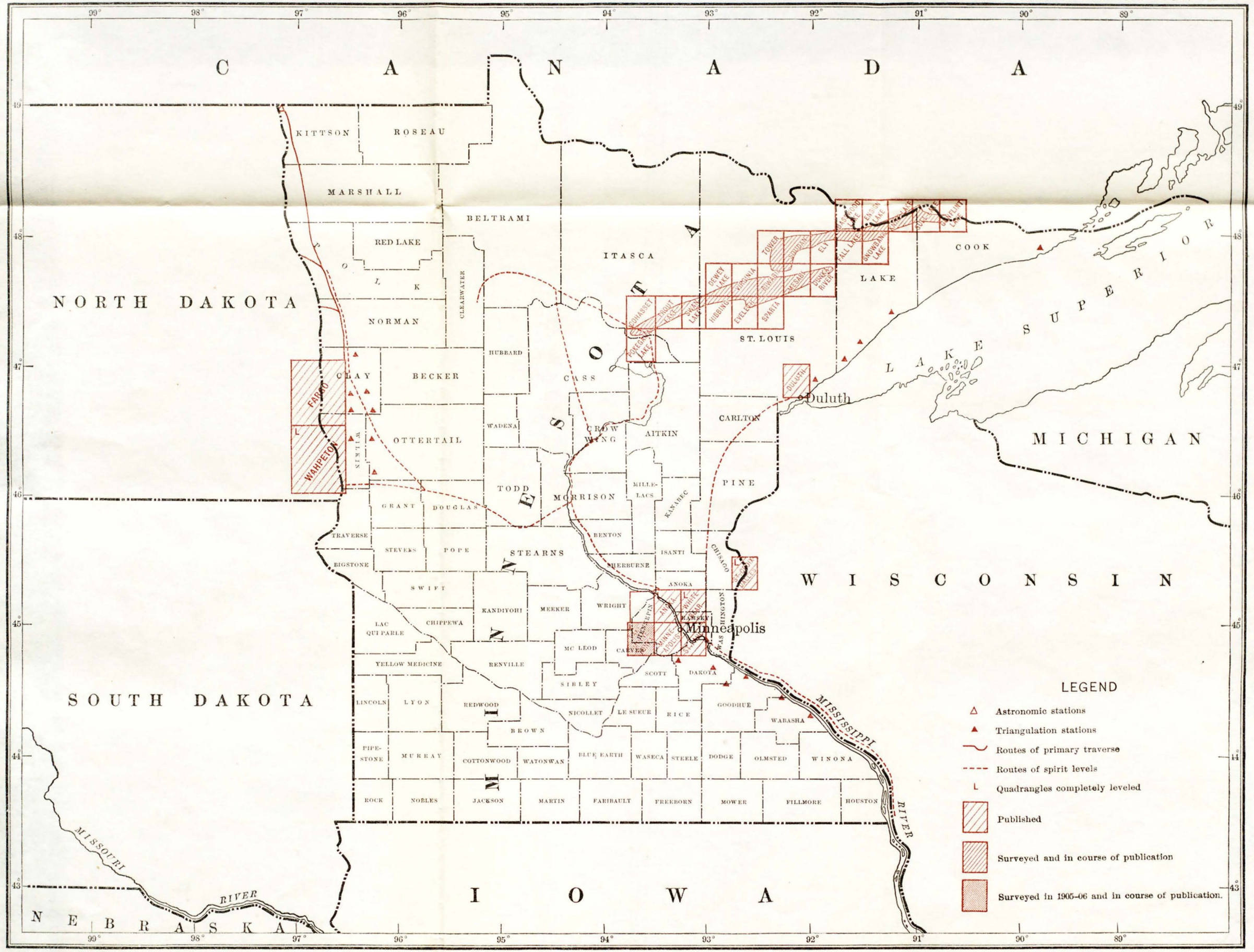
nent bench marks and 1,256 elevations were determined; and 692 miles of road traverse were run.

Minnesota.—One party was engaged in completing the survey of the Lake Minnetonka quadrangle, in Carver, Hennepin, and Scott counties, for publication on the scale of 1:62,500, with a contour interval of 20 feet. There were mapped 224 square miles within the quadrangle, and in addition 12 square miles beyond the quadrangle limits. There were 592 miles of spirit levels run, in the course of which 24 permanent bench marks and 4,794 elevations were determined, and 797 linear miles of road traverse were run.

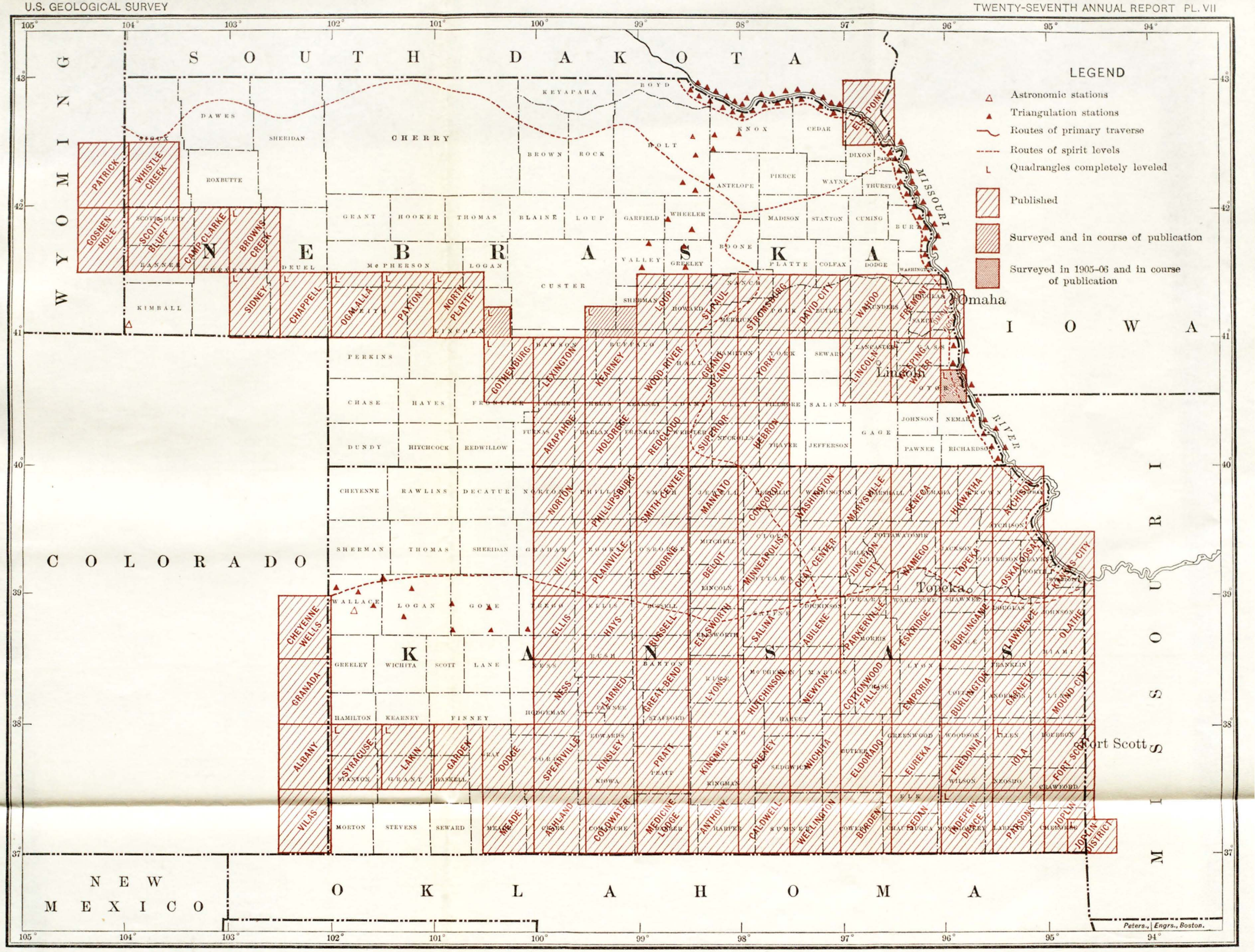
Mississippi.—One party was engaged in the field during the fall on the survey of the Jackson quadrangle, in Hinds, Madison, and Rankin counties, which was completed. A partial survey was made of the Florence quadrangle, in Copiah, Hinds, Rankin, and Simpson counties, and of the Raymond quadrangle, in Hinds and Madison counties. This work is for publication on the scale of 1:62,500, with a contour interval of 20 feet. There were 404 square miles of the State's area mapped. Spirit levels to the extent of 355 miles were run, in the course of which 21 permanent bench marks and 1,523 elevations were determined, and 284 linear miles of road traverse were run.

Missouri.—Two parties were engaged in field work in the State during the season. The survey of the Nebraska City (Nebraska-Iowa-Missouri) quadrangle, in Atchison County, was completed, and partial surveys were made of the following quadrangles: Forsyth, in Christian, Stone, and Taney counties; Atlanta, in Knox, Macon, and Shelby counties; Macon, in Macon, Monroe, Randolph, and Shelby counties; Shelbina, in Monroe and Shelby counties, and Shelbyville, in Knox and Shelby counties. The above work is for publication on the scale of 1:62,500, with a contour interval of 20 feet, except the Forsyth, which is for publication on the scale of 1:125,000, with a contour interval of 50 feet. In the course of these surveys 932 square miles were mapped; 98 trigonometric points were located; 1,324 miles of spirit levels were run, in the course of which 56 permanent bench marks and 5,457 elevations were established, and 4,190 linear miles of road traverse were run. Besides the foregoing, the revision of 4 square miles of the De Soto quadrangle, with 82 miles of road traverse, was accomplished, and an addition of 45 miles of spirit levels, with 15 permanent bench marks and 200 elevations, was made.

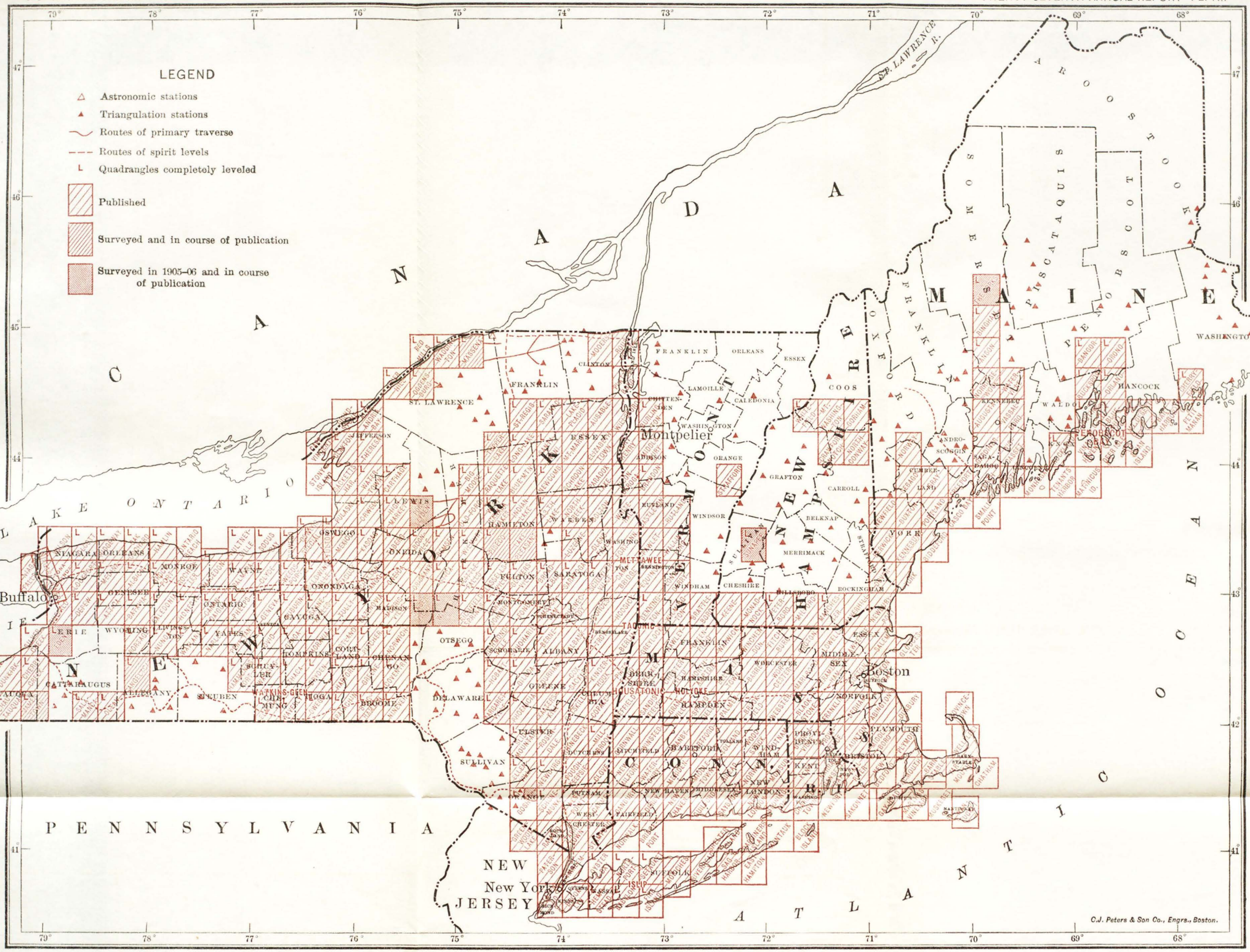
Nebraska.—One party was engaged in field work in the State in the fall. The survey of the Nebraska City (Nebraska-Iowa-Missouri) quadrangle was completed in Nemaha and Otoe counties, for publication on the scale of 1:62,500, with a contour interval of 20 feet. This work resulted in the mapping of 200 square miles. There were run 290 miles of levels, in the course of which 18 permanent bench marks



MAP OF MINNESOTA, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL



MAP OF NEBRASKA AND KANSAS, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL



MAP OF MAINE, NEW HAMPSHIRE, VERMONT, MASSACHUSETTS, RHODE ISLAND, CONNECTICUT, AND NEW YORK, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL

and 2,060 elevations were determined, and 427 miles of road traverse were run.

New Hampshire.—One party was engaged in field work during the season. An allotment of $400 was made by the forestry commission of New Hampshire for the survey of the Blue Mountain Special quadrangle, and the Director of the United States Geological Survey allotted an equal amount for the same purpose. The Federal Bureau also made surveys on its own behalf. The Blue Mountain Special quadrangle, in Sullivan County, and the Sunapee quadrangle, in Merrimac and Sullivan counties, were completely mapped, and the Hanover (New Hampshire-Vermont) quadrangle, in Grafton and Sullivan counties, and the Windsor (Vermont-New Hampshire) quadrangle, in Sullivan County, were partly surveyed. With the exception of the Blue Mountain Special, this work is for publication on the scale of 1:62,500, with a contour interval of 20 feet. The scale of the Blue Mountain Special was 1:24,000, with 20-foot contours. There were mapped 266 square miles of the area of the State; 204 trigonometric points were located; 394 miles of levels were run, in the course of which 32 permanent bench marks and 1,407 elevations were established; and 1,006 linear miles of road traverse were run.

New York.—The State engineer and surveyor allotted $600 to cooperative topographic surveys, and the Director of the United States Geological Survey allotted $7,000 to the same work. Two parties were engaged in field work in the State during the season, and six during the spring months. The mapping was completed of the following quadrangles: Eden, in Erie and Cattaraugus counties; Port Leyden, in Lewis and Oneida counties; Sangerfield, in Madison, Otsego, and Oneida counties; and Winfield, in Herkimer, Oneida, Otsego, and Madison counties. A partial survey was made of the following quadrangles: Bath, in Steuben County; Cooperstown, in Delaware and Otsego counties; Delhi, in Delaware and Otsego counties; Goshen (New York-New Jersey), in Orange County; Loon Lake, in Franklin County; Monticello, in Orange, Sullivan, and Ulster counties; Port Jervis (New York-New Jersey-Pennsylvania), in Orange County; and Potsdam, in St. Lawrence County. The above work was all on the publication scale of 1:62,500, with a contour interval of 20 feet. A resurvey was made of the Niagara Falls Special, for publication on scale of 1 inch to 200 feet; and earlier work on 3 square miles of the Westfield quadrangle, in Chautauqua County, was revised. The total new survey made in the field covered 1,061 square miles; 757 trigonometric points were located; 964 miles of spirit levels were run, in the course of which 35 permanent bench marks and 3,973 elevations were determined; and 1,887 linear miles of road traverse were run.

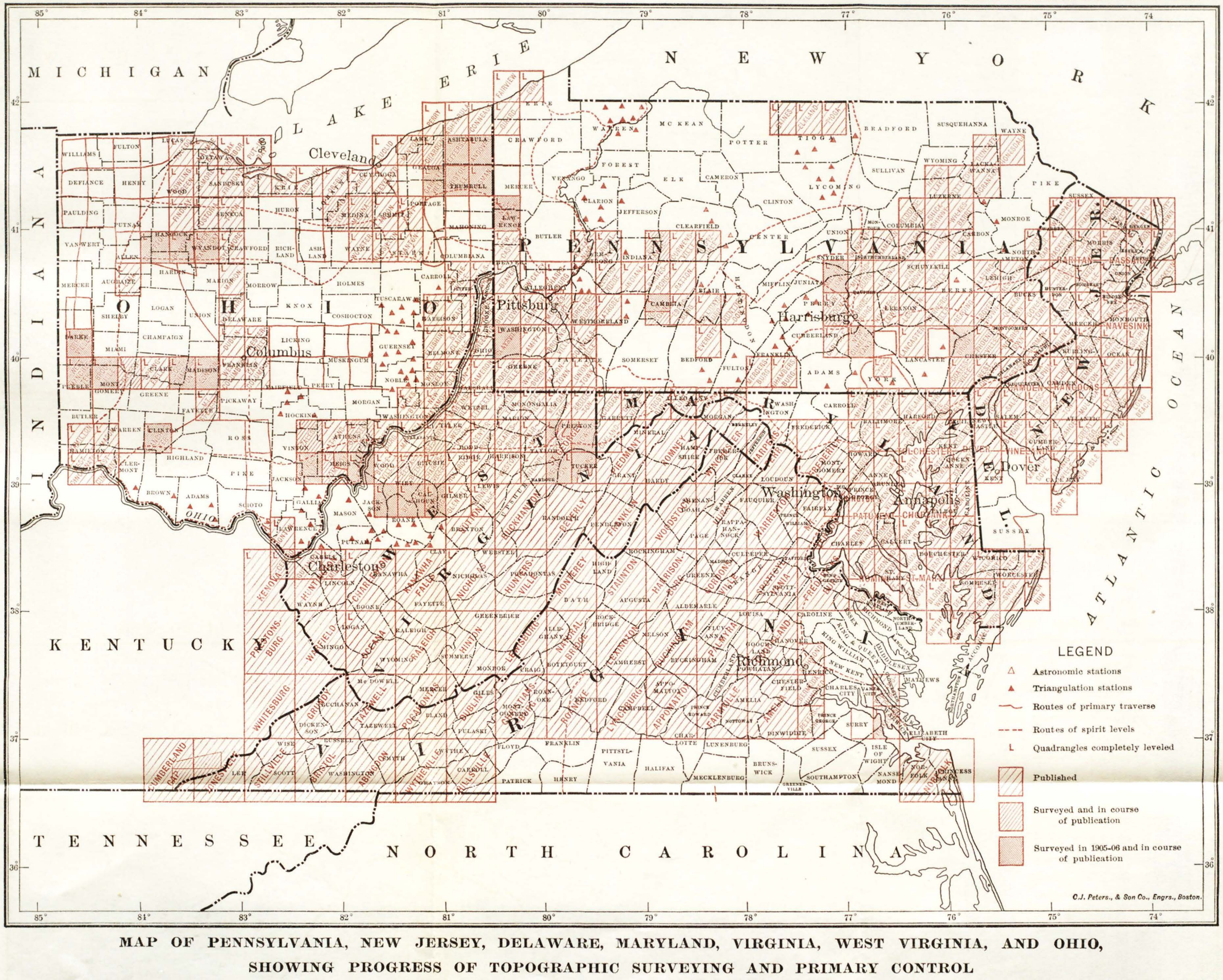
A resurvey was made of the crest line of Niagara Falls, 85 trigonometric points being located. (See Bulletin No. 306.)

North Carolina.—The commissioner of agriculture of North Carolina and the Director of the United States Geological Survey each allotted $4,000 to cooperative topographic surveys of certain sheets in the northeastern part of the State. In addition the Federal Survey conducted topographic field work independently in the southwestern part of the State. Four parties were engaged in the partial survey of the Beckford quadrangle, in Chowan, Gates, Hertford, and Perquimans counties; the Four Oaks, in Harnett, Johnston, Sampson, and Wayne counties; the Salemburg, in Sampson County, and the Winton, in Bertie, Gates, and Hertford counties. This work was cooperative, and is on the publication scale of 1:62,500, with a contour interval of 10 feet. There were mapped 386 square miles of the area of the State; 1,153 miles of levels were run, in the course of which 43 permanent bench marks and 4,997 elevations were determined; and 1,797 linear miles of road traverse were run.

In addition to the above, two parties were engaged in noncooperative work in the State. They completed the survey of the Charlotte (North Carolina-South Carolina) quadrangle, in Mecklenburg and Union counties, for publication on the scale of 1:62,500, with a contour interval of 20 feet. In this work 221 square miles of the area of the State were sketched; 393 miles of spirit levels were run, in the course of which 2,037 elevations were established, and 1,215 miles of road traverse were run. The resurvey of the Cowee (North Carolina-South Carolina) quadrangle, in Haywood, Jackson, Macon, Swain, and Transylvania counties, and of the Saluda (North Carolina-South Carolina) quadrangle, in Buncombe, Henderson, McDowell, Polk, and Rutherford counties, was completed. This work is for publication on the scale of 1:125,000, with a contour interval of 100 feet. There were resurveyed 1,149 square miles; 535 trigonometric points were located; 502 miles of levels were run, in the course of which 3,074 elevations were established; and 928 linear miles of road traverse were run.

North Dakota.—One party was engaged in field work, completing the survey of the Bismarck quadrangle, in Burleigh, Emmons, Morton, and Oliver counties. This is for publication on the scale of 1:125,000, with a contour interval of 50 feet. There were mapped 820 miles of the above quadrangle, and in addition 21 square miles beyond the limits of the quadrangle for incorporation in future map work. In this work 75 trigonometric points were located; 906 miles of spirit levels were run, in the course of which 31 permanent bench marks and 3,495 elevations were determined; and 1,124 linear miles of road traverse were run.

Ohio.—The governor of the State of Ohio and the Director of the United States Geological Survey each allotted $23,800 toward coopera-



MAP OF PENNSYLVANIA, NEW JERSEY, DELAWARE, MARYLAND, VIRGINIA, WEST VIRGINIA, AND OHIO, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL

tive topographic work in the State. Nine parties were engaged in field work. The survey was completed of the following quadrangles: Andover (Ohio-Pennsylvania), in Ashtabula County; Arlington, in Hancock, Hardin, and Wyandot counties; Blanchester, in Clinton, Highland, and Warren counties; Bluffton, in Allen, Hancock, Hardin, and Putnam counties; Bristolville, in Trumbull County; Brookville, in Darke, Miami, and Montgomery counties; Garrettsville, in Geauga, Portage, and Trumbull counties; Greenville, in Darke County; Jefferson, in Ashtabula County; Keno (Ohio-West Virginia), in Athens and Meigs counties; Kinsman (Ohio-Pennsylvania), in Trumbull County; London, in Madison County; Pomeroy (Ohio-West Virginia), in Athens, Meigs, and Gallia counties; South Charleston, in Clark, Greene, and Madison counties; Upper Sandusky, in Hancock, Seneca, and Wyandot counties; West Manchester, in Darke and Preble counties; and Wilkesville, in Athens, Gallia, Jackson, Meigs, and Vinton counties. A partial survey was made of the following quadrangles: Athalia (Ohio-West Virginia), in Gallia and Lawrence counties; Ashland, in Ashland and Richland counties; Bidwell, in Gallia, Jackson, and Lawrence counties; Chagrin Falls, in Geauga, Cuyahoga, Summit, and Portage counties; Chillicothe, in Ross and Pickaway counties; Columbus Grove, in Allen and Putnam counties; Glenwood (West Virginia-Ohio), in Lawrence County; Loramie, in Auglaize, Darke, Mercer, and Shelby counties; Middletown, in Butler, Montgomery, and Warren counties; New London, in Ashland, Huron, and Lorain counties; Point Pleasant (Ohio-West Virginia), in Gallia County; Ravenna, in Portage, Mahoning, and Trumbull counties; Ravenswood (West Virginia-Ohio), in Meigs County; St. Henry, in Mercer and Darke counties; Warren, in Trumbull and Mahoning counties; Waverly, in Jackson, Pike, Ross, and Vinton counties; West Salem, in Ashland, Medina, and Wayne counties; and Youngstown (Ohio-Pennsylvania), in Trumbull and Mahoning counties. This work is all for publication on the scale of 1:62,500, with contours of 10 and 20 feet interval. In all, there were mapped 3,721 square miles of the area of the State; 194 trigonometric points were located; 8,622 miles of levels were run, in the course of which 236 permanent bench marks and 44,959 elevations were determined; and 10,425 linear miles of road traverse were run. In addition, earlier work on 122 square miles of the Mentor quadrangle and on 2 square miles of the Sandusky quadrangle was revised, with 8 miles of road traverse, and check levels to the extent of 29 miles were run in the Medina and Wellington quadrangles.

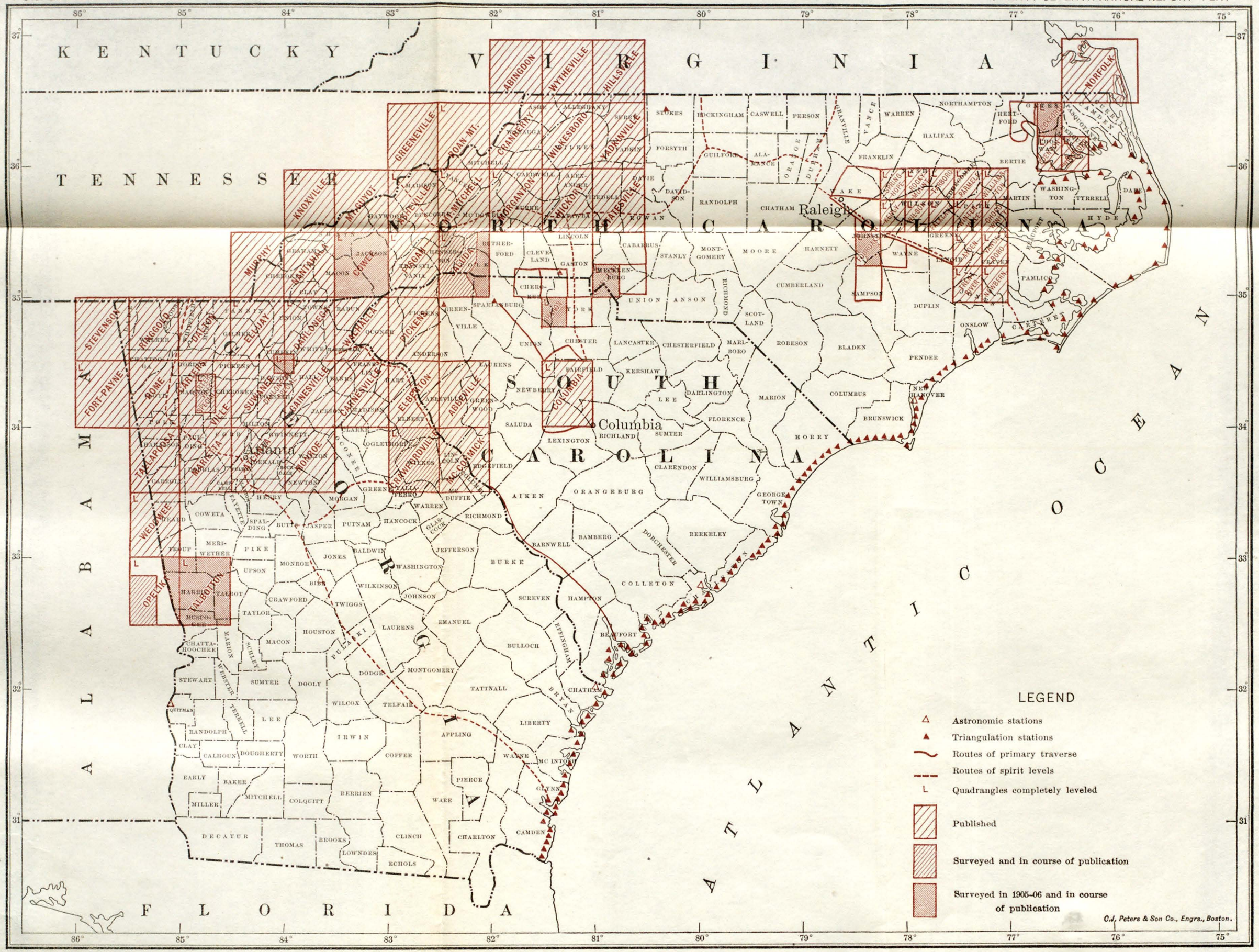
Pennsylvania.—The State Survey Commission of Pennsylvania allotted $14,000 toward cooperative topographic surveys, and the Director of the United States Geological Survey allotted an equal amount for the same purpose. Seven parties were engaged in field

work during the season. The survey of the following quadrangles was completed: Andover (Ohio-Pennsylvania), in Crawford County; Claysville, in Washington County; Kinsman (Ohio-Pennsylvania), in Crawford and Mercer counties; Millerstown, in Juniata, Snyder, and Perry counties; Neshannock, in Lawrence and Mercer counties; New Cumberland, in Cumberland, Dauphin, and York counties; and Honeybrook, in Berks, Chester, and Lancaster counties. The survey of the following quadrangles was unfinished in the field: Clarion, in Armstrong and Clarion counties; Middletown, in Dauphin, Lancaster, Lebanon, and York counties; New Holland, in Berks and Lancaster counties; Port Jervis (New York-New Jersey-Pennsylvania), in Pike County; Sewickley, in Allegheny, Beaver, and Butler counties; and Warren, in Warren County. This work is for publication on the scale of 1:62,500, with a contour interval of 20 feet. In all, there were completely mapped 1,286 square miles of the area of the State; 163 trigonometric locations were determined; 2,958 miles of spirit levels were run, in the course of which there were established 109 permanent bench marks and 13,631 elevations; and 6,397 miles of road traverse were run. The resurvey was completed of 48 square miles of the Pennsylvania portion of the Lambertville (New Jersey-Pennsylvania) quadrangle, and 99 additional miles of road traverse were run in the Ebensburg, Barnesboro, Hollidaysburg, and Houtzdale quadrangles.

South Carolina.—Two parties were engaged in field work during the season. The survey of the Charlotte (North Carolina-South Carolina) quadrangle, in York County, and of the Sharon quadrangle, in Chester, Cherokee, York, and Union counties, was completed for publication on the scale of 1:62,500, with a contour interval of 20 feet; also the resurvey of the Saluda (North Carolina-South Carolina) quadrangle, in Spartanburg and Greenville counties, and of the Cowee (North Carolina-South Carolina) quadrangle, in Oconee County, for publication on the scale of 1:125,000, with a contour interval of 100 feet. There were mapped 312 square miles of new survey and 143 square miles of resurvey; 1,402 miles of levels were run, during which 27 permanent bench marks and 8,854 elevations were determined; and 1,278 miles of road traverse were run.

Vermont.—One party was engaged in the partial survey of the Hanover (New Hampshire-Vermont) quadrangle, in Windsor County, on the publication scale of 1:62,500, with a contour interval of 20 feet. There were located 92 trigonometric points; 66 miles of spirit levels were run, in the course of which 11 permanent bench marks and 338 elevations were determined; and 101 linear miles of road traverse were run.

Virginia.—One party was engaged in field work in the State. The survey of the Yorktown quadrangle, in James City, Surry, and War-



MAP OF NORTH CAROLINA, SOUTH CAROLINA, AND GEORGIA, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL

wick counties, was completed for publication on the scale of 1:62,500, with a contour interval of 10 feet. There were sketched 49 square miles within the quadrangle and 17 square miles beyond its limits, which will be incorporated in future map work; 231 miles of levels were run, in the course of which 10 permanent bench marks and 1,112 elevations were determined; and 320 linear miles of road traverse were run. The resurvey of the Fincastle quadrangle, in Botetourt and Craig counties, and of the Natural Bridge quadrangle, in Botetourt and Rockbridge counties, was not finished; 9 square miles were resurveyed; 92 trigonometric points were located; 259 miles of levels were run, in the course of which 28 permanent bench marks and 853 elevations were determined; and 444 linear miles of road traverse were run. This work was on the publication scale of 1:62,500, with a contour interval of 50 feet.

West Virginia.—The State geologist of West Virginia allotted $15,000 and the Director of the United States Geological Survey a like amount for cooperative topographic surveys within the State. Five parties were engaged in topographic surveys in the State during the season. The survey of the following quadrangles was completed: Arnoldsburg, in Calhoun, Gilmer, and Wirt counties; Keno (Ohio-West Virginia), in Jackson County; Pomeroy (Ohio-West Virginia), in Mason and Wirt counties; Ripley, in Jackson, Roane, and Wirt counties; and Spencer, in Calhoun, Roane, and Wirt counties. The following quadrangles were partially surveyed: Glenwood (West Virginia-Ohio), in Cabell, Mason, and Putnam counties; Point Pleasant (Ohio-West Virginia), in Mason County; and Ravenswood (West Virginia-Ohio), in Jackson and Mason counties. This work is for publication on the scale of 1:62,500; contour interval, 20 feet. The resurvey of the following quadrangles was completed: Belington, in Barbour, Randolph, and Tucker counties; Kingwood, in Preston County; and Thornton, in Monongalia, Preston, Marion, Taylor, and Barbour counties. The resurvey of the following quadrangles was in progress: Davis (West Virginia-Maryland), in Grant, Preston, and Tucker counties; Elkins, in Barbour and Randolph counties; and Parsons, in Preston, Randolph, and Tucker counties. This work is on the publication scale of 1:62,500, with a contour interval of 20 feet. There were surveyed of the area of the State 713 square miles; 406 points were located by trigonometric methods; 1,220 linear miles of levels were run, in the course of which 69 permanent bench marks and 4,598 elevations were determined; and 4,242 linear miles of road traverse were run. A total of 704 square miles was resurveyed, during which 322 trigonometric points were located; 1,283 miles of spirit levels were run, in the course of which 57 permanent bench marks and 4,914 elevations were determined; and 2,839 linear miles of road traverse were run. In addition, some revision work was done in the Glenville and

Oakland quadrangles, consisting of 13 square miles of resketching, 3 trigonometric locations, 43 miles of levels, with 90 additional elevations, and 48 linear miles of road traverse.

Wisconsin.—Two parties were engaged in field work during the season. The survey of the following quadrangles was in progress: Cross Plains, in Dane County; Mazomanie, in Dane, Iowa, and Sauk counties; and Sparta, in La Crosse and Monroe counties. This work is for publication on scale of 1:62,500, with a contour interval of 20 feet. There were mapped 5 square miles of new territory; 74 trigonometric points were located; 332 miles of spirit levels were run, in the course of which 51 permanent bench marks and 2,106 elevations were determined; and 602 linear miles of road traverse were run. The resurvey of the Sun Prairie quadrangle, in Dane, Dodge, and Jefferson counties, was completed. In connection with this resurvey 218 square miles were sketched; 48 points were located by trigonometric methods; 372 miles of spirit levels were run, in the course of which 11 permanent bench marks and 1,738 elevations were determined; and 433 linear miles of road traverse were run. This work is on the publication scale of 1:62,500, with a contour interval of 20 feet. In addition, correction work consisting of 24 miles of road traverse was done in the Mineral Point quadrangle.

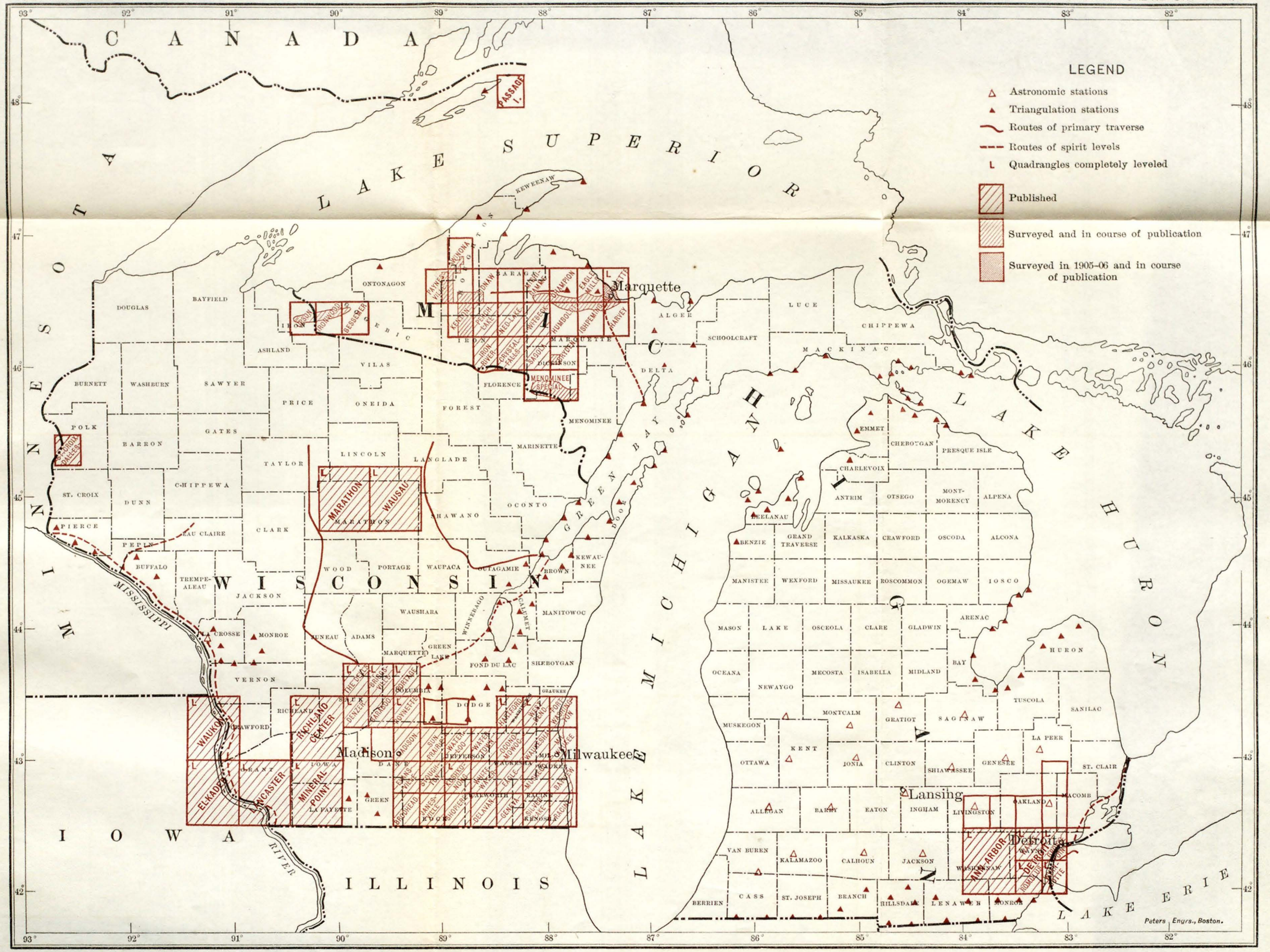
OFFICE DRAFTING.

Alabama.—The drafting of the Bessemer Special and Leeds sheets was completed, and they are being engraved on the scale of 1:62,500, with a contour interval of 20 feet. About 30 per cent of the office drafting of the Bessemer sheet was completed; scale 1:125,000, contour interval 50 feet.

Georgia.—The drafting of the Dahlonega Special sheet was completed, for engraving on the scale of 1:36,000, contour interval 20 feet; also of the Kenesaw Battlefield Special sheet, for engraving on the scale of 5 inches to 1 mile, contour interval 10 feet; the Cartersville Special sheet, for engraving on the scale of 1:62,500, contour interval 20 feet, and the Talbotton sheet, for engraving on the scale of 1:125,000, contour interval 50 feet. About 15 per cent of the office drafting of the unfinished Stilesboro sheet was completed, scale 1:62,500, contour interval 50 feet, and about 50 per cent of the Opelika (Georgia-Alabama) sheet, scale 1:125,000, contour interval 50 feet.

Illinois.—The drafting of the Belleville, Eldorado, Mahomet, Springfield, and Urbana sheets was completed, for engraving on the scale of 1:62,500, with contour intervals of 10 and 20 feet. About 30 per cent of the office drafting of the Breese and Wheaton sheets was completed, scale 1:62,500, contour interval 10 feet.

Indiana.—The drafting of the New Haven (Indiana-Kentucky-Illinois) sheet was completed, for engraving on the scale of 1:62,500,



MAP OF MICHIGAN AND WISCONSIN, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL

with a contour interval of 20 feet. About 6 per cent of the drafting of the New Albany (Indiana-Kentucky) sheet was completed, on the same scale and with the same contour interval.

Iowa.—The drafting of the Des Moines sheet was completed, for engraving on the scale of 1:62,500, with a contour interval of 20 feet.

Kentucky.—The drafting of the Louisville sheet, for engraving on the scale of 1:62,500, contour interval 20 feet, was completed; also of the city of Louisville sheet, scale 1:24,000, contour interval 20 feet; and in addition about 80 per cent of the office drafting of the Georgetown, 25 per cent of the Morganfield, 52 per cent of the Prospect, and 4 per cent of the Riverview sheets, all on the scale 1:62,500, contour interval 20 feet.

Louisiana.—About 25 per cent of the drafting of the Baton Rouge sheet was completed, on the scale of 1:62,500, contour interval 10 feet.

Maine.—The drafting of The Forks sheets, for engraving on the scale of 1:62,500, contour interval 20 feet, was completed.

Maryland.—The drafting of the Owensville and Prince Frederick revised sheets, and of the resurveyed Relay sheet, for engraving on the scale of 1:62,500, with contour intervals of 20 feet, was completed; also about 30 per cent of the drafting of the finished portion of the resurveyed Laurel sheet, scale 1:62,500, contour interval 20 feet.

Michigan.—The drafting of the Marquette sheet, for engraving on the scale of 1:24,000, with a contour interval of 20 feet, was completed.

Minnesota.—The drafting of the Lake Minnetonka sheet, for engraving on the scale of 1 : 62,500, contour interval 20 feet, was completed.

Mississippi.—The drafting of the Jackson sheet, scale 1 : 62,500, contour interval 20 feet, was completed; also about 30 per cent of the office drafting of the unfinished Florence, Raymond, and Terry sheets, scale 1 : 62,500, contour interval 20 feet.

Missouri.—The readjustment of the De Soto sheet was completed, for engraving on the scale of 1 : 125,000, with a contour interval of 50 feet. Drafting of unfinished sheets progressed to the following stages: Atlanta, 30 per cent; Macon, 30 per cent; Shelbyville, 28 per cent; Shelbina, 28 per cent; all on the scale 1 : 62,500, contour interval 20 feet. Of the unfinished Forsyth sheet 85 per cent of the office drafting was completed; scale 1 : 125,000, contour interval 50 feet.

Nebraska.—The drafting of the Nebraska City (Nebraska-Iowa-Missouri) sheet was completed, for engraving on the scale of 1 : 62,500, with contour interval of 20 feet.

New Hampshire.—The drafting of the Blue Mountain Special sheet was completed, for engraving on the scale of 1 : 24,000, with a contour interval of 20 feet; also of the Sunapee sheet, for engraving on the scale of 1 : 62,500, with a contour interval of 20 feet.

New York.—The drafting of the Eden, Port Leyden, Sangerfield, and Winfield sheets, for engraving on the scale of 1:62,500, with a

contour interval of 20 feet, was completed, and drafting of unfinished sheets progressed as follows: Cooperstown, 5 per cent; Loon Lake, 50 per cent; Potsdam, 5 per cent, and Port Jervis, 10 per cent, all same scale and contour interval.

New Jersey.—The drafting of the resurveyed Pennsylvania portion and of the revised New Jersey portion of the Lambertville (New Jersey-Pennsylvania) sheet was completed, for engraving on the scale of 1:62,500, with a contour interval of 20 feet.

North Carolina.—The drafting of the Charlotte (North Carolina-South Carolina) sheet, for engraving on the scale of 1:62,500, with a contour interval of 20 feet, was completed; also of the resurvey of the Cowee (North Carolina-South Carolina) and the Saluda (North Carolina-South Carolina) sheets, scale 1:125,000, contour interval 100 feet. In addition, about 90 per cent of the Beckford, 60 per cent of the Four Oaks, and 2 per cent of the Salemburg sheets were finished, scale 1:62,500, contour interval 10 feet.

North Dakota.—The drafting of the Bismarck sheet, for engraving on the scale of 1:125,000, with a contour interval of 50 feet, was completed.

Ohio.—The drafting of the Andover, Arlington, Blanchester, Bluffton, Bristolville, Brookville, Garrettsville, Greenville, Jefferson, Keno (Ohio-West Virginia), Kinsman (Ohio-Pennsylvania), London, South Charleston, Upper Sandusky, West Manchester, and Wilkesville sheets, for engraving on the scale of 1:62,500, with contour interval of 10 or 20 feet, was completed. The Mentor sheet was resketched for engraving on the scale of 1:62,500, with a contour interval of 20 feet. Thirty per cent of the drafting of the unfinished Athalia, Bidwell, Chagrin Falls, Chillicothe, Columbus Grove, Middletown, New London, Ravenna, St. Henry, Warren, Waverly, West Salem, and Youngstown sheets was completed; scale 1:62,500, contour interval 10 or 20 feet.

Pennsylvania.—The drafting of the Claysville, Millerstown, New Cumberland, and Neshannock sheets, for engraving on the scale of 1:62,500, with a contour interval of 20 feet, was completed; also drafting of unfinished sheets as follows: 55 per cent of the Clarion, 30 per cent of each of the three sheets Middletown, New Holland, and Sewickley, and 25 per cent of the Warren, all on the scale of 1:62,500, with a contour interval of 20 feet.

South Carolina.—The drafting of the Sharon sheet, for engraving on scale of 1:62,500, with a contour interval of 20 feet, was completed.

Virginia.—The drafting of the Yorktown sheet, for engraving on the scale of 1:62,500, with a contour interval of 10 feet, was completed; also about 20 per cent of the office drafting of the Natural Bridge sheet, scale 1:62,500, contour interval 20 feet.

West Virginia.—The drafting on the Arnoldsburg, Belington, Kingwood, Ripley, and Spencer sheets, for engraving on the scale of 1:62,500, contour interval of 20 feet, was completed; also drafting of unfinished sheets as follows: Glenwood, 25 per cent; Point Pleasant and Ravenswood, 30 per cent; Thornton, 80 per cent.

Wisconsin.—The drafting of the Sun Prairie sheet, for engraving on the scale of 1:62,500, with a contour interval of 20 feet, was completed; also drafting of unfinished sheets as follows: Cross Plains and Mazomanie, 5 per cent; Sparta, 20 per cent; all on the above scale and with the same contour interval.

WESTERN DIVISION.

FIELD WORK.

SUMMARY.

Under the combined allotments for topography and forestry topographic work was done during the year in Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming. This resulted in the completion of 21 quadrangles, 5 special maps, and 2 large reconnaissance maps, and in the partial survey of 24 quadrangles. The total new area surveyed was 21,745 square miles, of which 2,674 square miles were for publication on the scale of 1:62,500; 8,831 square miles were for publication on the scale of 1:125,000; and 10,240 square miles were for publication on the scale of 1:250,000. In addition, 1,016 square miles were resurveyed, of which 457 square miles were for publication on the scale of 1:125,000; 204 square miles were for publication on the scale of 1:62,500; 234 square miles were for publication on the scale of 1:48,000, and 121 square miles were for publication on the scale of 1:24,000. In connection with this work 4,717 miles of spirit levels were run and 1,290 permanent bench marks were established. Forest-reserve boundary surveys were carried on in California and Utah—in the Sierra, Stanislaus, and Santa Barbara reserves of California, and in the Logan and Payson reserves of Utah, the Payson boundary being completed. A total of 327 miles of boundary were run, 12 miles were retraced, and 15 miles of supplemental lines were run.

Topographic surveys in western division from May 1, 1905, to April 30, 1906.

State.	Contour interval.	Scale of publication.				Total area surveyed.	Levels.	
		1:125,000.		1:62,500.			Distance run.	Bench marks.
		New.	Resurvey.	New.	Resurvey.			
	Feet.	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Miles.*	
Arizona	50, 100	655		45		[a] 1,009	193	59
California	5, 10, 20, 50, 100	2,285	31	1,148		[c, d] 6,517	941	206
Colorado	20, 100	784		437		1,221	383	102
Idaho	50, 100	258				[b] 263	134	27
Montana	100	856				856	327	94
Nevada	20, 100					[d] 7,286	255	45
New Mexico							693	238
Oklahoma	20			356		356	516	157
Oregon	50, 100	2,155				[b] 2,255	405	100
South Dakota	20			329		329		
Texas	20	321				321	22	4
Utah	50, 100		426	93	204	[e] 745	194	49
Washington	20, 50	314		191		505	245	56
Wyoming	100	1,098				1,098	409	153
		8,726	457	2,599	204	22,761	4,717	1,290

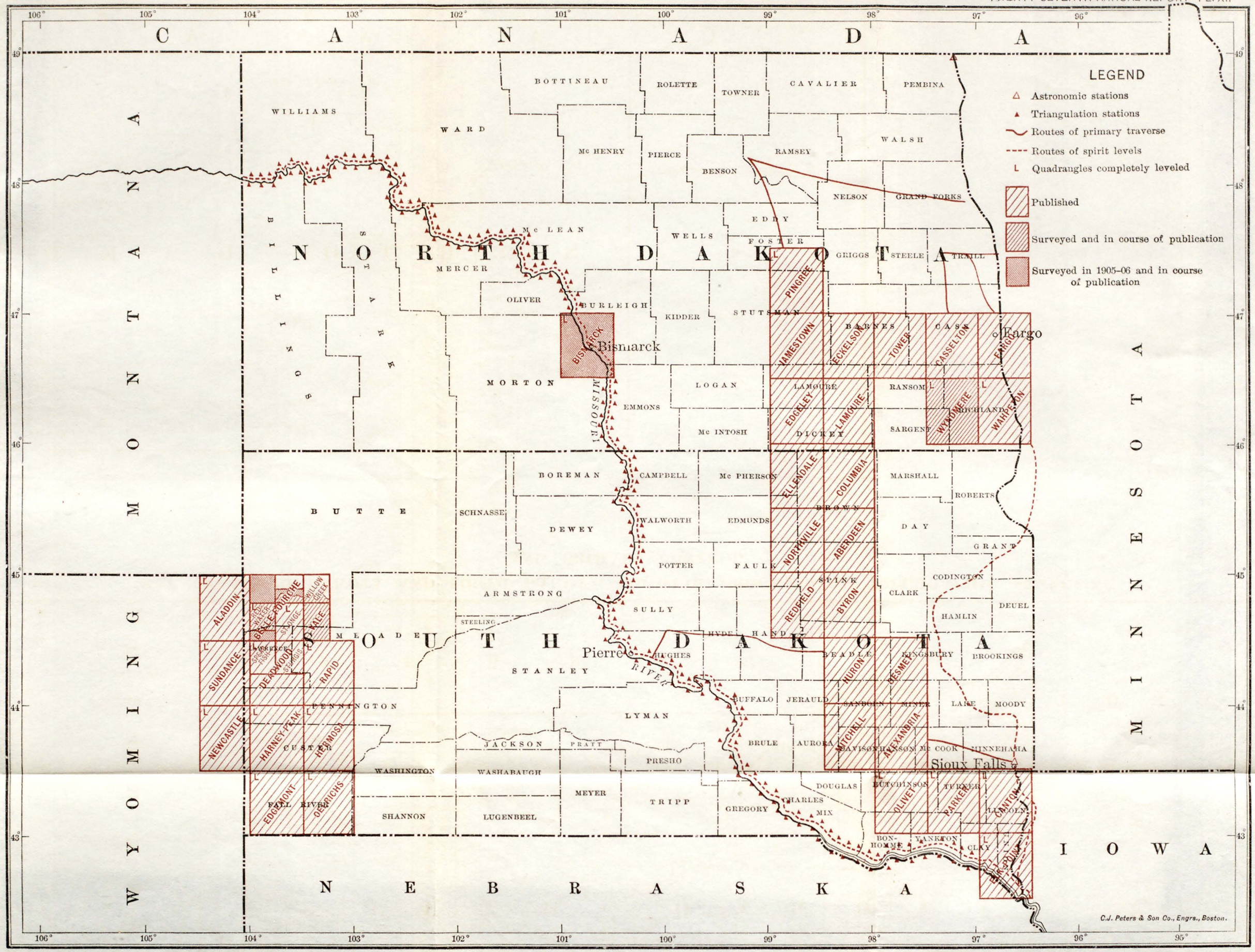
[a] 234 square miles for publication on scale of 1:48,000.
[b] 5 square miles Mitchell Butte sheet in Idaho and 100 square miles in Oregon mapped by Reclamation Service for publication on scale of 1:125,000; also 75 square miles in Arizona for publication on scale of 1:62,500.
[c] 45 square miles resurvey for publication on scale of 1:24,000.
[d] 3,008 square miles in California and 7,232 square miles in Nevada for publication on scale of 1:250,000, and 54 square miles resurvey in Nevada for publication on scale of 1:24,000.
[e] 22 square miles resurvey for publication on scale of 1:24,000.

GENERAL TOPOGRAPHIC WORK, BY STATES.

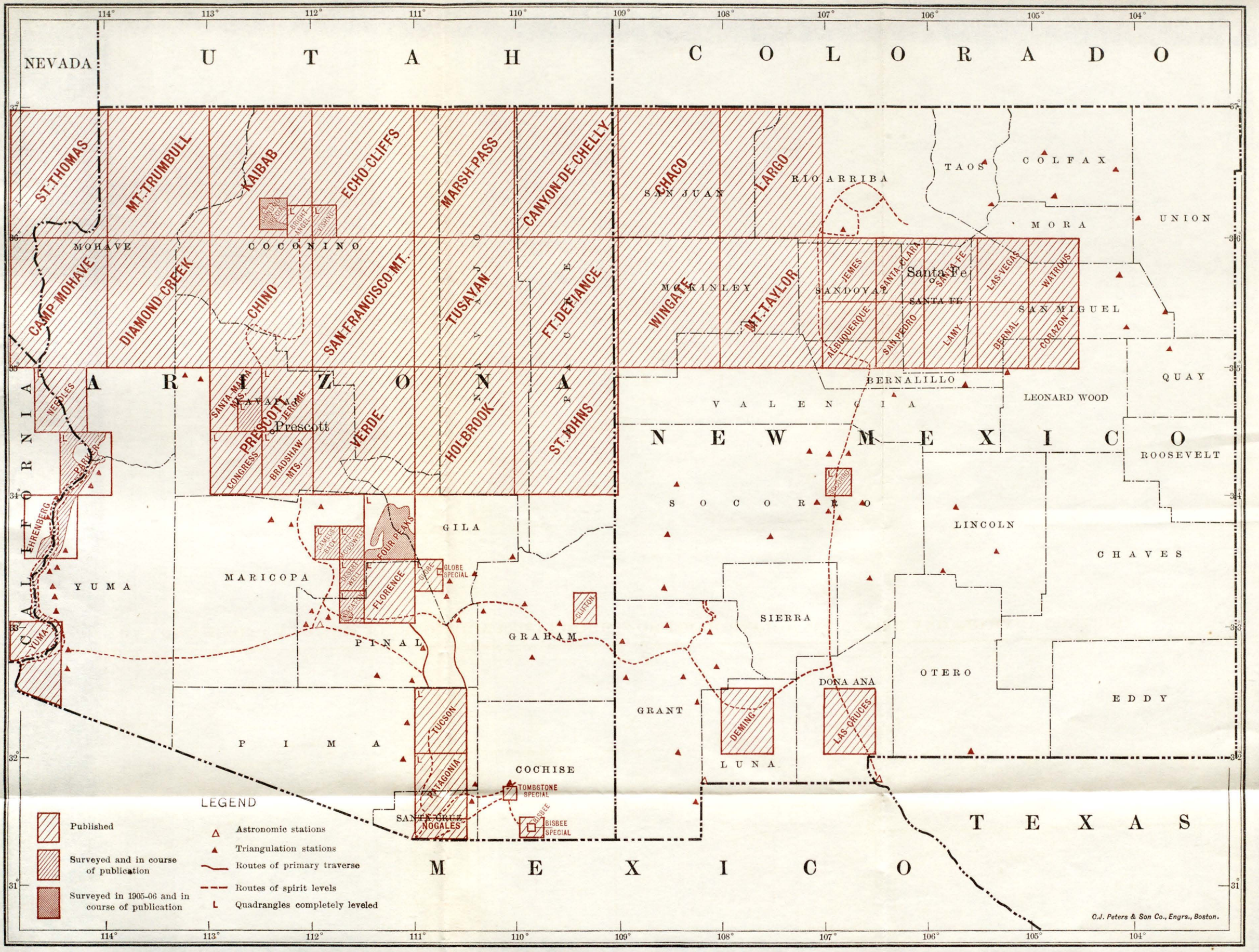
Arizona.—One party was engaged in the completion of the survey of the Sacaton quadrangle, in Pinal and Maricopa counties. The area surveyed was 45 square miles, for publication on the scale of 1:62,500, with a contour interval of 50 feet. In addition, 75 square miles of this quadrangle were previously mapped by the Reclamation Service.

California.—Part of the topographic work in California was carried on under a renewal of the agreement of previous years between the Director of the United States Geological Survey and the State board of examiners, the amount allotted by each being $15,000.

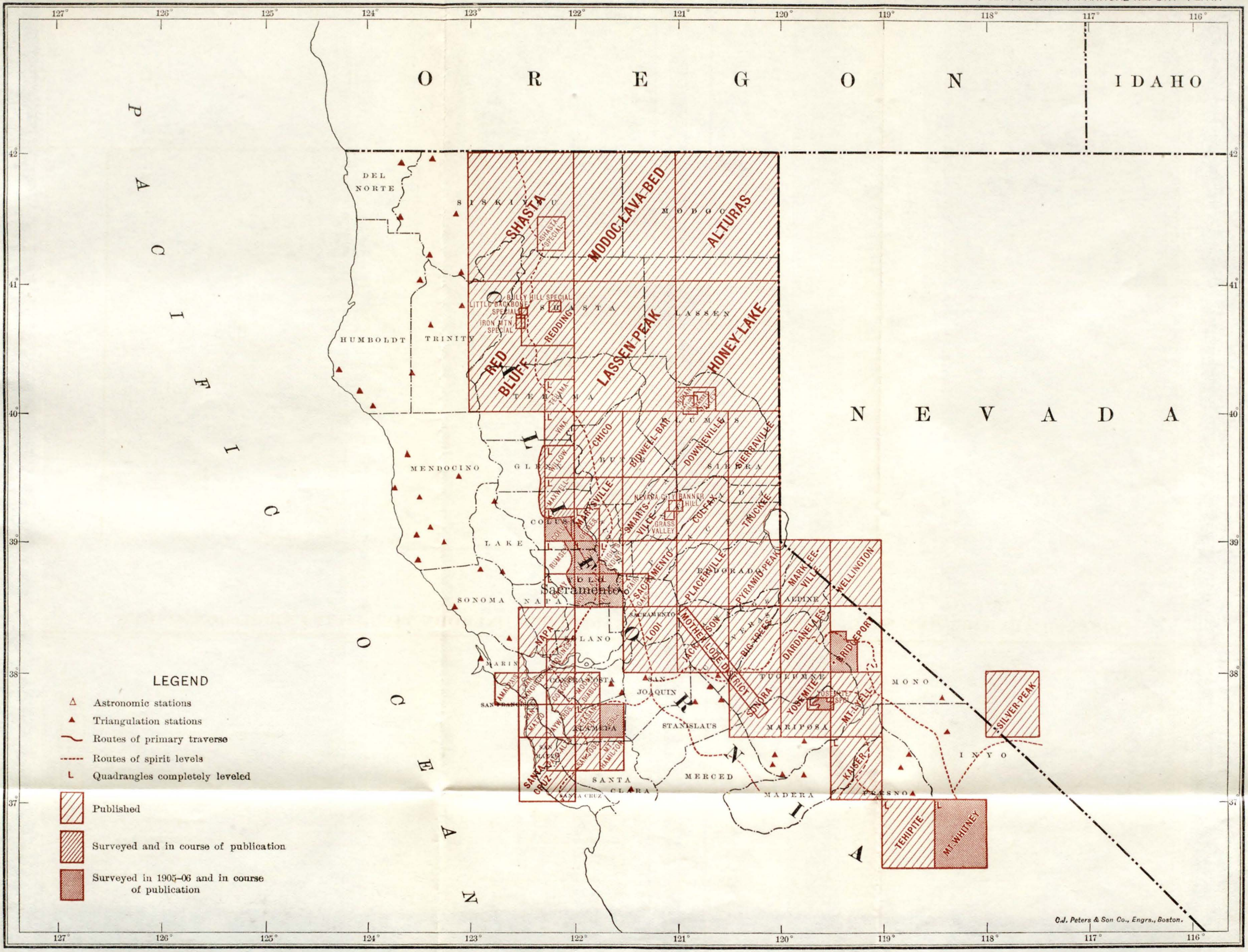
The cooperative work was principally in the Sacramento Valley, where the Woodland, Davisville, Dunnigan, and Colusa quadrangles, in Yolo, Sacramento, Sutter, and Colusa counties, were completed. These quadrangles comprise an area, mapped this year, of 788 square miles, and in connection with the survey of the Davisville quadrangle 46 miles of levels were run and 9 permanent bench marks established. In addition, four quadrangles, the Rumsey, Capay, Grimes, and Knights Landing, were partially surveyed, the area covered being 164 square miles, in Colusa, Sutter, and Yolo counties. In connection with the survey of the Knights Landing quadrangle 10 miles of levels were run and 3 permanent bench marks established. In this locality, for the control of future sketching, 106 miles of levels were run and 23 permanent bench marks established; 40 miles of check levels also were run. All of the Sacramento Valley work was mapped



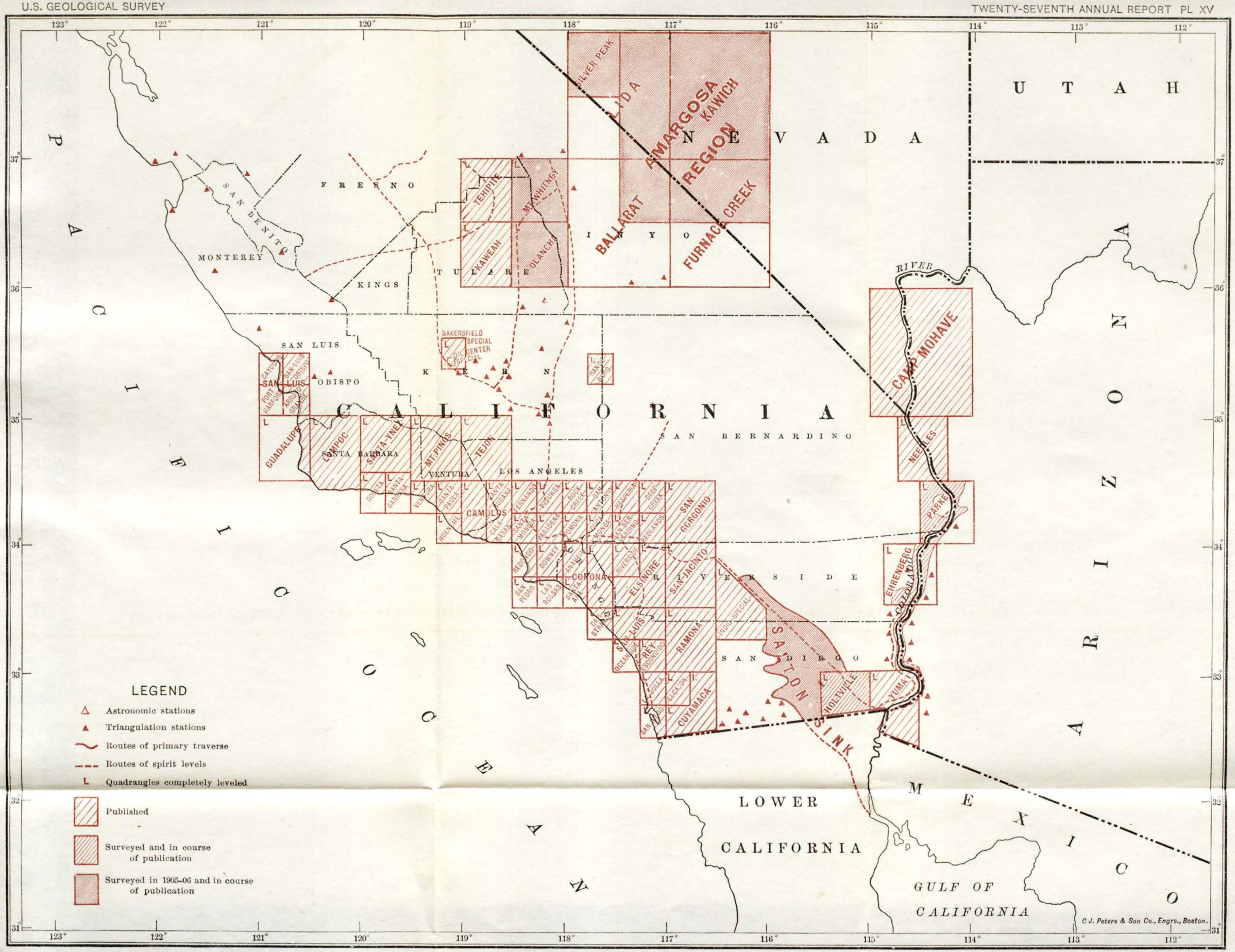
MAP OF NORTH DAKOTA AND SOUTH DAKOTA, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL



MAP OF ARIZONA AND NEW MEXICO, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL



MAP OF NORTHERN CALIFORNIA, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL



MAP OF SOUTHERN CALIFORNIA, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL

for publication on the scale of 1:62,500, with a contour interval of 5 feet, the field surveys being on a scale of 2 inches to the mile; a limited edition of the maps was published on this scale also.

As part of the cooperative work, a special map of the Yosemite National Park, in Mariposa County, was commenced. The area mapped was 45 square miles, for publication on the scale of 1:24,000, with a contour interval of 100 feet. In connection with this work 218 miles of traverse were run.

In addition to the cooperative work, two parties were engaged in the survey of the Tesla quadrangle, in Alameda and San Joaquin counties, and of the Holtville quadrangle, in San Diego County, which was completed. Of the Tesla quadrangle 196 square miles were mapped for publication on the scale of 1:62,500, with a contour interval of 50 feet, in connection with which 54 miles of levels were run, 8 permanent bench marks established, and 274 miles of traverse line run. Of the Holtville quadrangle 100 square miles were mapped for publication on the scale of 1:125,000, with a contour interval of 20 feet, in connection with which 53 miles of traverse line were run. The revision of a small area in the Santa Cruz quadrangle was also completed, 31 square miles being mapped for publication on the scale of 1:125,000, with a contour interval of 100 feet, for which 122 miles of traverse line were run.

As a basis for future topographic work, leveling was commenced by two parties from Keeler northward and southward for the control of the Death Valley and other adjoining regions. The work of the combined parties consisted of 234 miles of level lines, in connection with which 42 permanent bench marks were established, 54 miles of check line in addition being run.

One party was engaged in a reconnaissance survey of the Imperial Valley and Salton Sink, in San Diego and Riverside counties. The area mapped was 1,685 square miles, for publication on the scale of 1:500,000, with a contour interval of 50 feet, in connection with which 277 miles of traverse line were run.

A summary of work done under the appropriation for topography in California is as follows: 3,009 square miles mapped; 450 miles of levels run; 104 miles of check levels run; 85 permanent bench marks established; 1,034 miles of traverse line run. This summary does not include an area of 1,323 square miles, embracing a portion of Death Valley, surveyed in connection with work in Nevada and reported elsewhere.

Colorado.—One party was engaged in topographic work, and completed the mapping of the Mount Olympus quadrangle, consisting of 228 square miles, and parts of the Loveland and Fort Collins quadrangles, the area mapped being 209 square miles. The work was for publication on the scale of 1:62,500, with a contour interval of 20 feet,

except the Mount Olympus quadrangle, where a contour interval of 100 feet was used. All of this work is in Boulder, Larimer, and Greeley counties, and in connection with it 1,578 miles of traverse were run. For the control of this and other areas 383 miles of levels were run and 98 permanent bench marks were established.

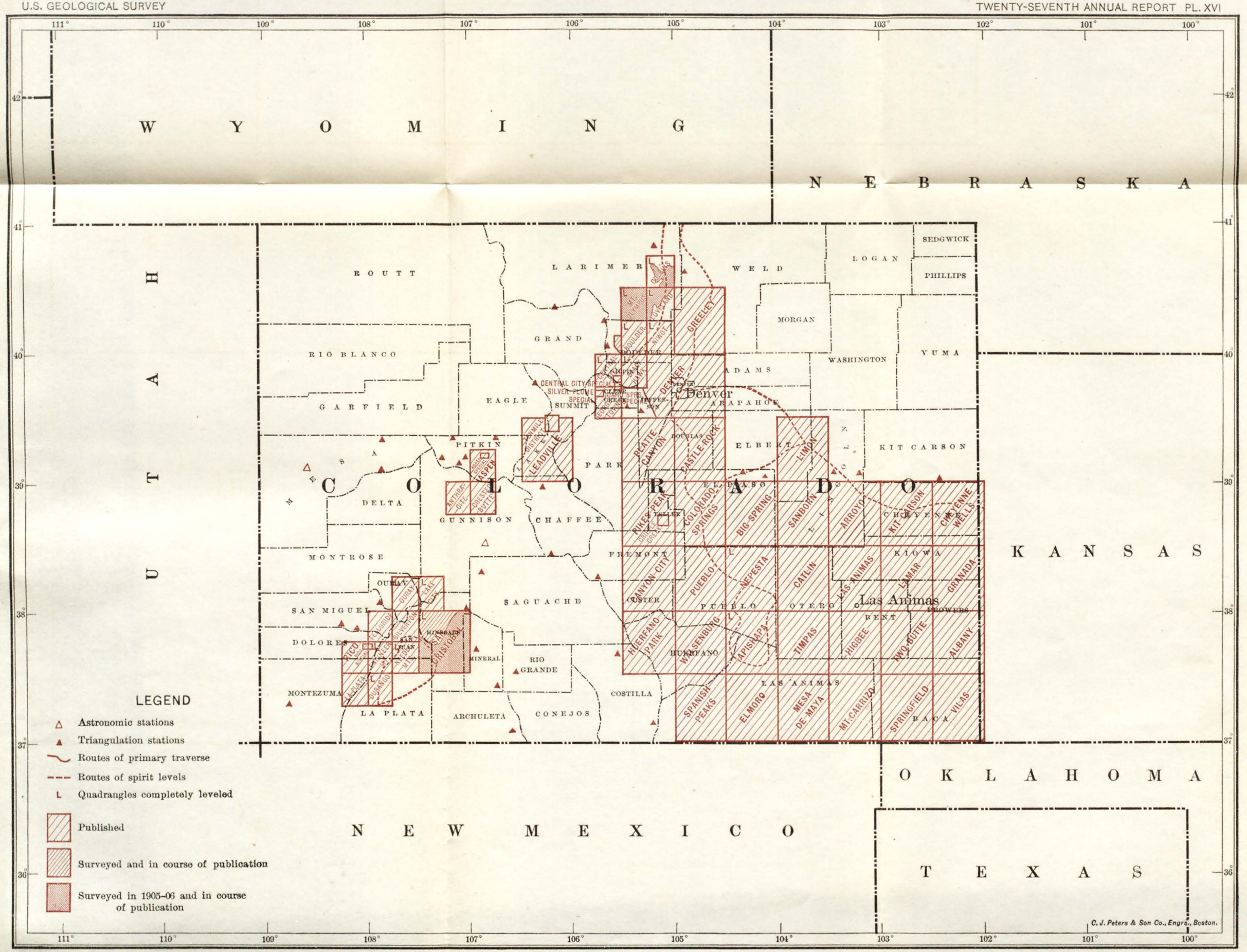
Montana.—For the control of the Moccasin Mountain and adjoining quadrangles, in Fergus County, a system of level lines, 111 miles in length, with 33 permanent bench marks, was run from a bench mark on Missouri River.

Nevada.—Two parties were engaged in the survey of the Goldfield and Bullfrog Special quadrangles, in parts of Nye and Esmeralda counties. The area mapped included 31 square miles of the Goldfield and 23 square miles of the Bullfrog Special, for publication on the scale of 1:24,000, with a contour interval of 20 feet. In connection with this work 255 miles of levels were run, 45 permanent bench marks were established, and 176 miles of traverse lines were run.

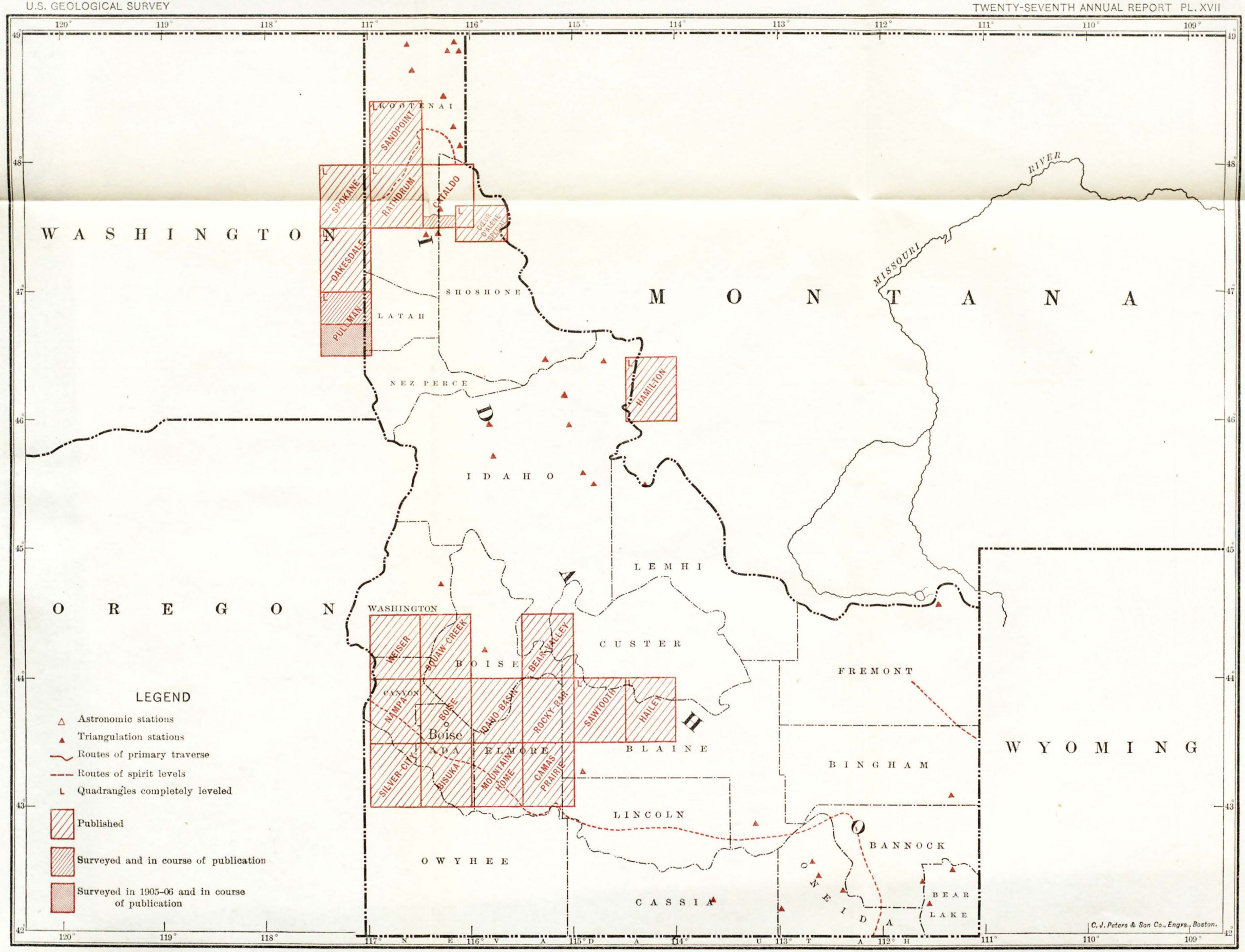
Nevada-California.—One party was engaged in a reconnaissance survey in Esmeralda County, Nev., and Inyo County, Cal. The area mapped, which is called the Amargosa region, was 1,323 square miles in California and 7,232 square miles in Nevada, for publication on the scale of 1:250,000, with a contour interval of 100 feet.

New Mexico.—For completing the vertical control of the Magdalena quadrangle, in Socorro County, 82 miles of level lines were run and 15 permanent bench marks were established. A line of precise levels along the Santa Fe Railway from Albuquerque to El Paso, with a branch line to Silver City, was run, covering 196 miles, in connection with which 79 permanent bench marks were set. By the courtesy of the officials of the Santa Fe Railway Company permission was granted for the use of velocipede cars by the party, which greatly expedited the work. The best record for a single day's standard leveling by an employee of the Geological Survey was made on this line on October 21, when 9 miles of checked line were completed, requiring a total run of a trifle over 18 miles.

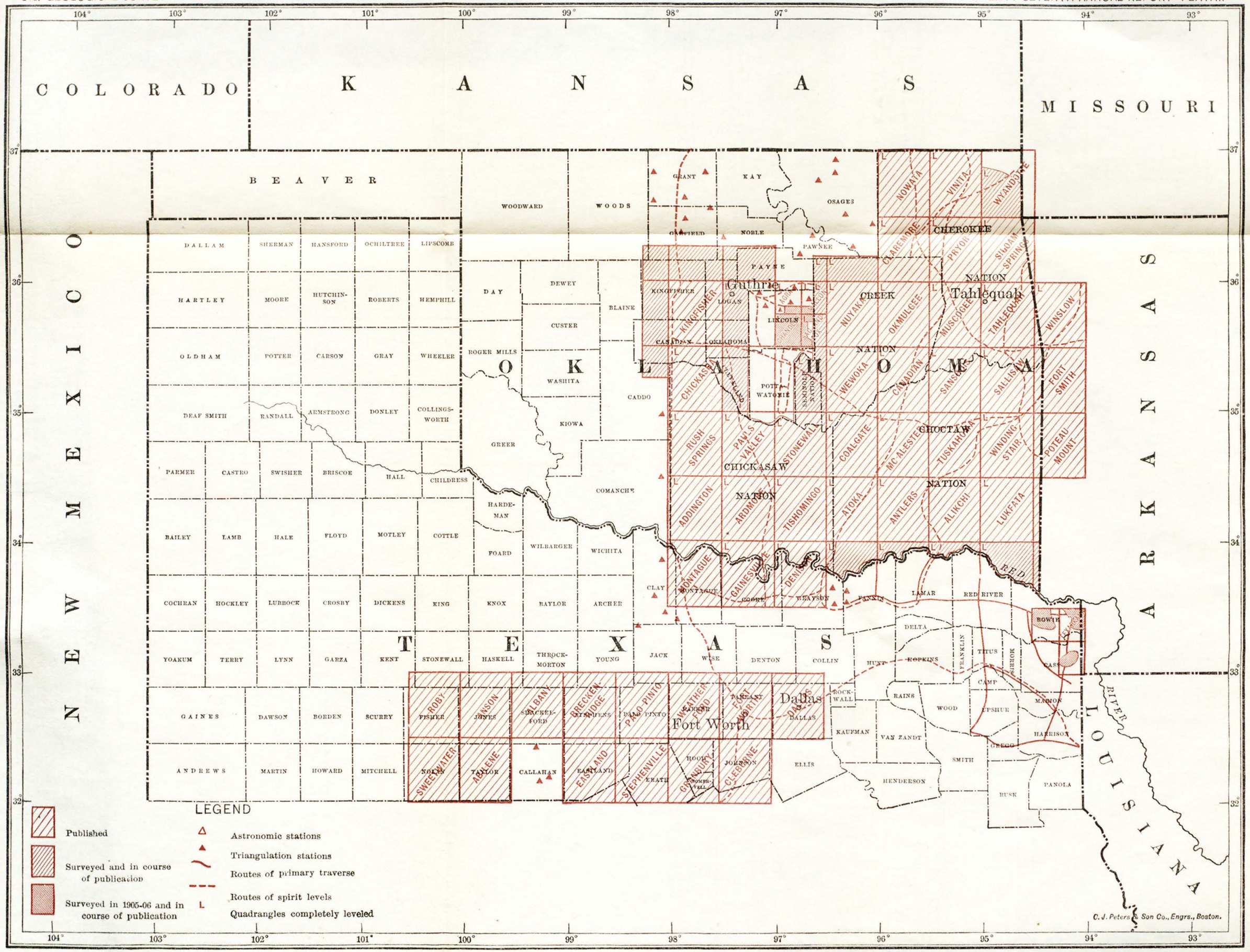
Oklahoma.—Topographic work in Oklahoma was carried on under an agreement between the Director of the United States Geological Survey and a survey commission of the Territory of Oklahoma consisting of Governor T. B. Ferguson, Attorney-General P. C. Simons, and the secretary of the board of agriculture, C. A. McNabb. By the terms of the cooperative agreement, to the $5,000 appropriated by the Territory was added an equal amount from the Federal appropriation for the Geological Survey, thus making the sum of $10,000 available for cooperative work. Topographic surveys were carried on by one party over the entire Chandler quadrangle and parts of the Mallon, Agra, and Sac and Fox quadrangles, all in Lincoln County. The total area surveyed was 356 square miles, for publication on the



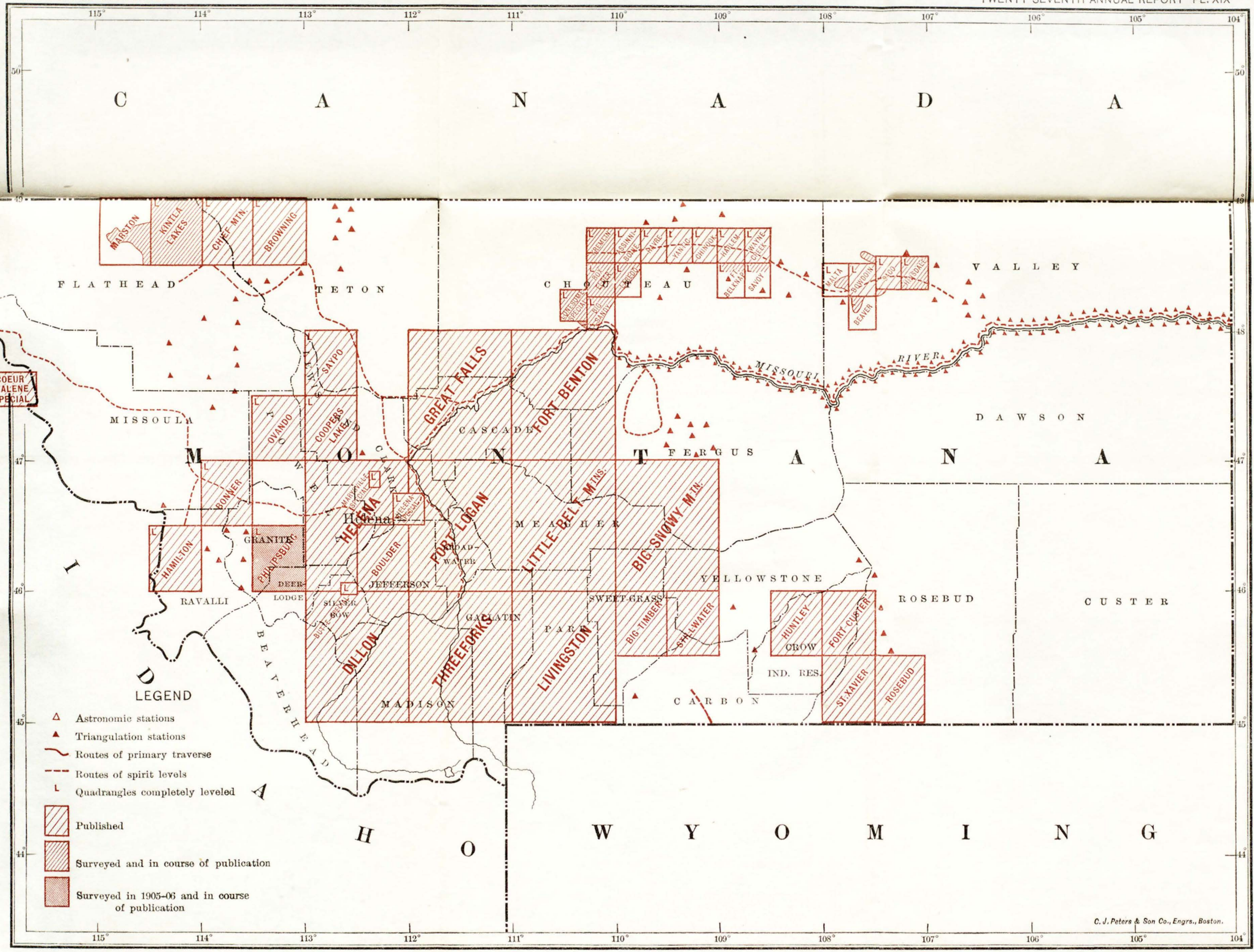
MAP OF COLORADO, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL



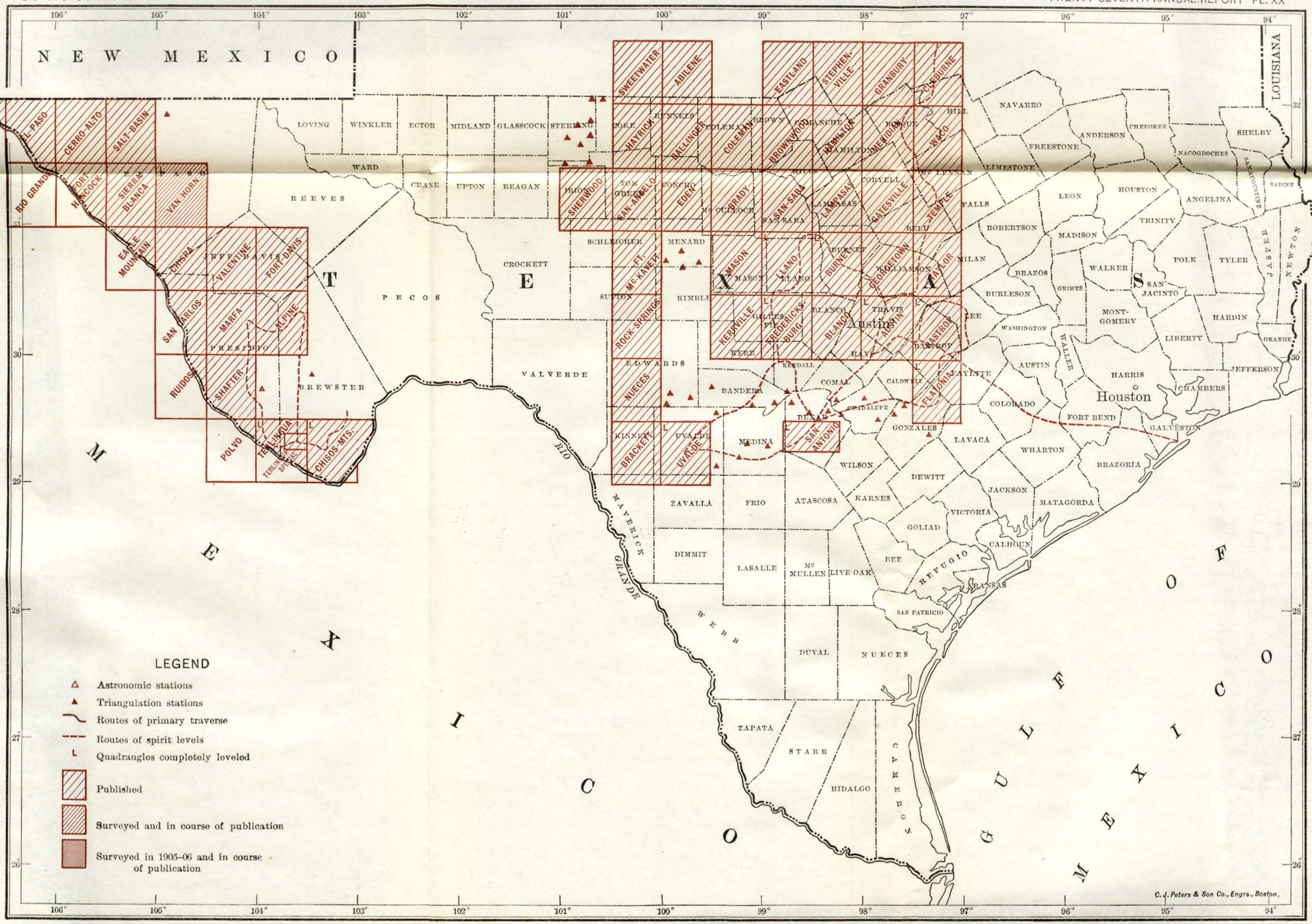
MAP OF IDAHO, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL



MAP OF OKLAHOMA AND NORTHERN TEXAS, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL



MAP OF MONTANA, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL



MAP OF SOUTHERN TEXAS, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL

scale of 1:62,500, with a contour interval of 20 feet, in connection with which 426 miles of traverse were run. For the control of this and adjoining areas 516 miles of levels were run and 157 permanent bench marks were established.

Oregon–Idaho.—Part of the topographic work in Oregon was carried on under an agreement between the Director of the United States Geological Survey and the State engineer, by which an appropriation of $2,500 by the State was met by an allotment of $3,000 from the Geological Survey for cooperative work. Under this agreement one party was engaged in mapping the Mitchell Butte quadrangle, in Malheur County, Oreg., and Canyon and Owyhee counties, Idaho, for publication on the scale of 1:125,000, with a contour interval of 50 feet. The area mapped was 759 square miles, of which 30 were in Idaho. This area was supplemented by 105 square miles previously mapped by the Reclamation Service, thus completing the quadrangle, namely, 864 square miles. For the control of this and adjoining areas 150 miles of levels were run, 35 permanent bench marks were established, and 1,097 miles of traverse were run.

South Dakota.—Topographic work was carried on by one party in South Dakota in the Indian quadrangle, the Redwater quadrangle, which was completed, and the Two Top quadrangle, all in Butte County. The total area surveyed was 329 square miles, for publication on the scale of 1:62,500, with a contour interval of 20 feet, in connection with which 1,009 miles of traverse were run.

Texas.—Topographic work was carried on by one party in the Texarkana quadrangle, in Cass County, for publication on the scale of 1:125,000, with a contour interval of 20 feet. The area mapped was 321 square miles, in connection with which 1,113 miles of traverse and 22 miles of levels were run and 4 permanent bench marks were established.

Utah.—Topographic work in Utah was carried on by two parties in the Iron Springs, Frisco, and Cottonwood Special quadrangles, the last two being completed. The Cottonwood Special, in Summit, Wasatch, Utah, and Salt Lake counties, was surveyed for publication on the scale of 2,000 feet to the inch, with a contour interval of 50 feet, the area mapped being 22 square miles. The Iron Springs Special, consisting of 204 square miles in Iron County, and the Frisco Special, consisting of 93 square miles in Beaver County, were surveyed for publication on the scale of 1:62,500, with a contour interval of 50 feet. In connection with this work 79 miles of levels were run, 18 permanent bench marks were established, and 698 miles of traverse were run.

Washington.—One topographic party completed the survey of the Blaine quadrangle, in Whatcom and San Juan counties. The area mapped was 191 square miles, for publication on the scale of 1:62,500,

with a contour interval of 20 feet, in connection with which 769 miles of traverse lines were run. A level party carried forward control for this quadrangle and adjoining areas, running 188 miles of levels and establishing 39 permanent bench marks.

Washington–Idaho.—One party was engaged in the completion of the Pullman quadrangle, in Whitman and Garfield counties, Wash., and Latah and Nez Perces counties, Idaho, for publication on the scale of 1:125,000, with a contour interval of 50 feet. The area mapped was 382 square miles, 68 square miles being in Idaho and 314 square miles in Washington.

FOREST RESERVES.

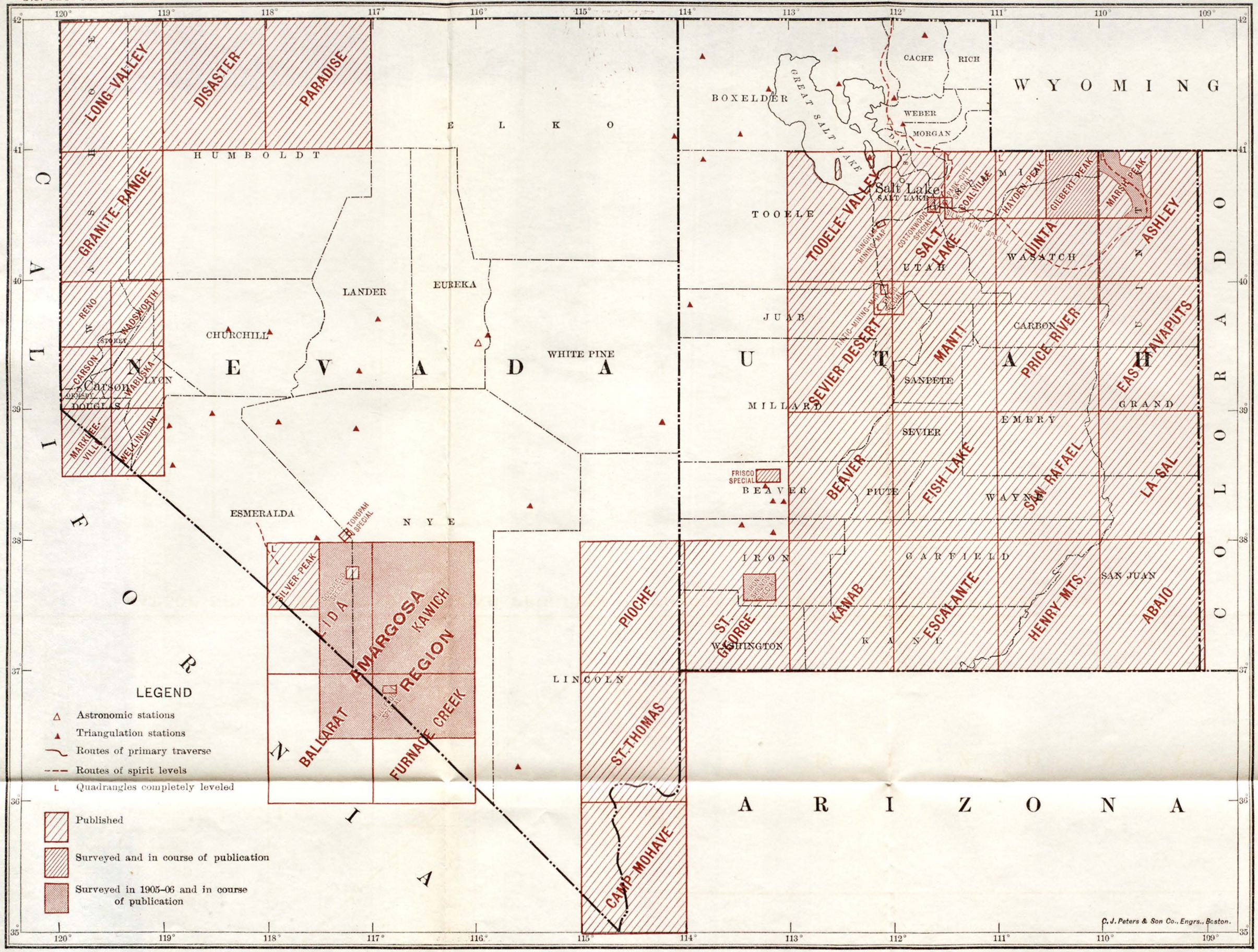
TOPOGRAPHIC SURVEYS OF FOREST RESERVES.

Arizona, Tonto Forest Reserve.—One party was engaged in the survey of parts of the Four Peaks and Livingston quadrangles, in Maricopa and Gila counties, for publication on the scale of 1:125,000, with a contour interval of 100 feet. The area completed was 655 square miles, in connection with which 160 miles of traverse lines were run. For the control of this and adjoining areas 143 miles of levels were run and 44 permanent bench marks were established.

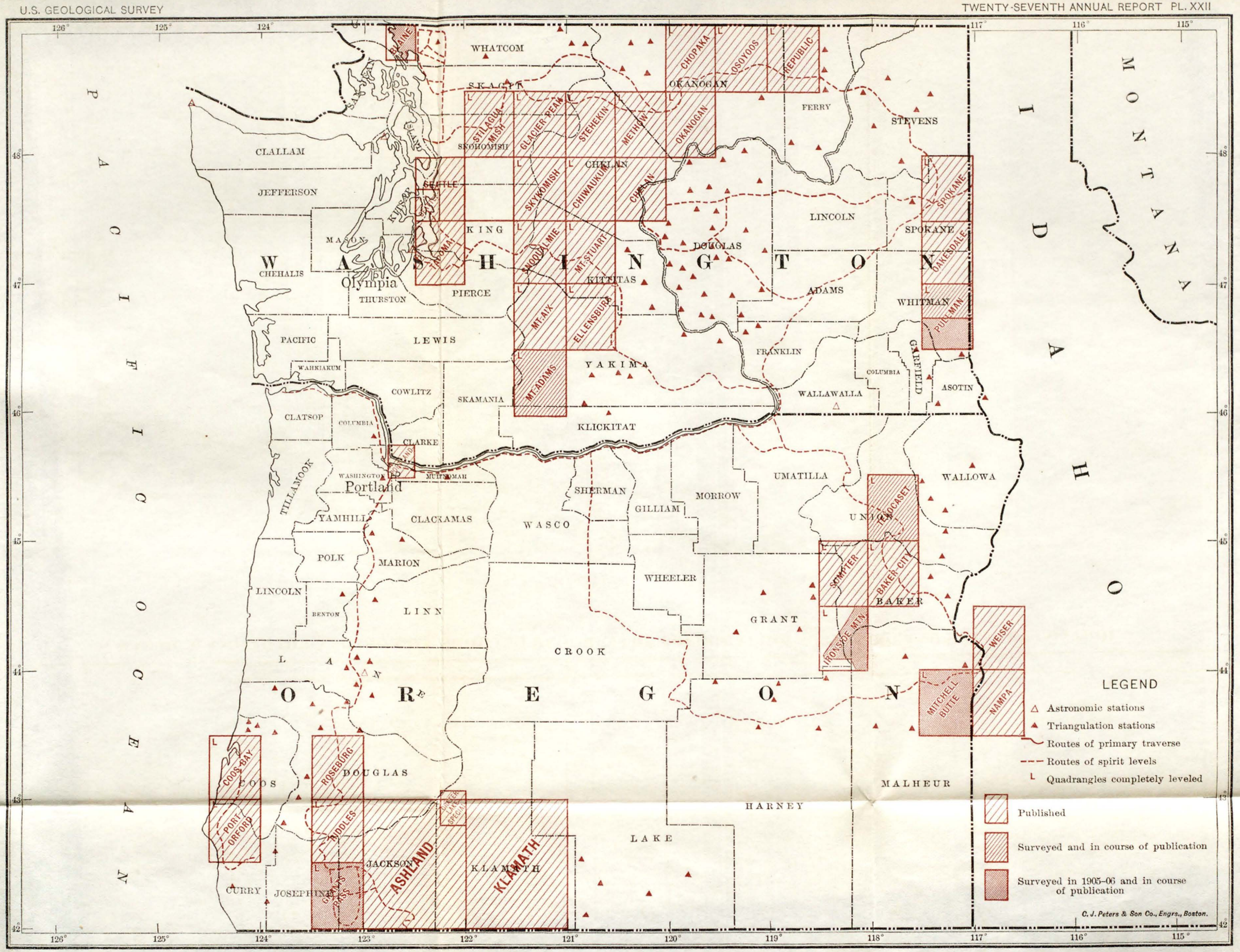
Arizona, Grand Canyon Reserve.—Another party completed the survey of the Shinumo quadrangle, consisting of 234 square miles in Coconino County, for publication on the scale of 1:48,000, with a contour interval of 50 feet. In connection with this mapping 432 miles of traverse were run; 28 miles of levels were also run, and 7 permanent bench marks were established. In addition, for the control of the Grand Canyon Reserve, one party carried a line of checked levels from Ash Fork nearly to Jerome Junction, the distance covered being 22 miles, in connection with which 8 permanent bench marks were established.

California, Sierra Reserve.—Two parties were engaged in the topographic survey of the Olancha and Mount Whitney quadrangles, in Tulare, Inyo, and Fresno counties. The area surveyed was 1,920 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet, in connection with which 1,418 miles of traverse were run. For the control of these and adjoining areas 332 miles of levels were run, in connection with which 72 permanent bench marks were established. In addition, 238 miles of check levels were run.

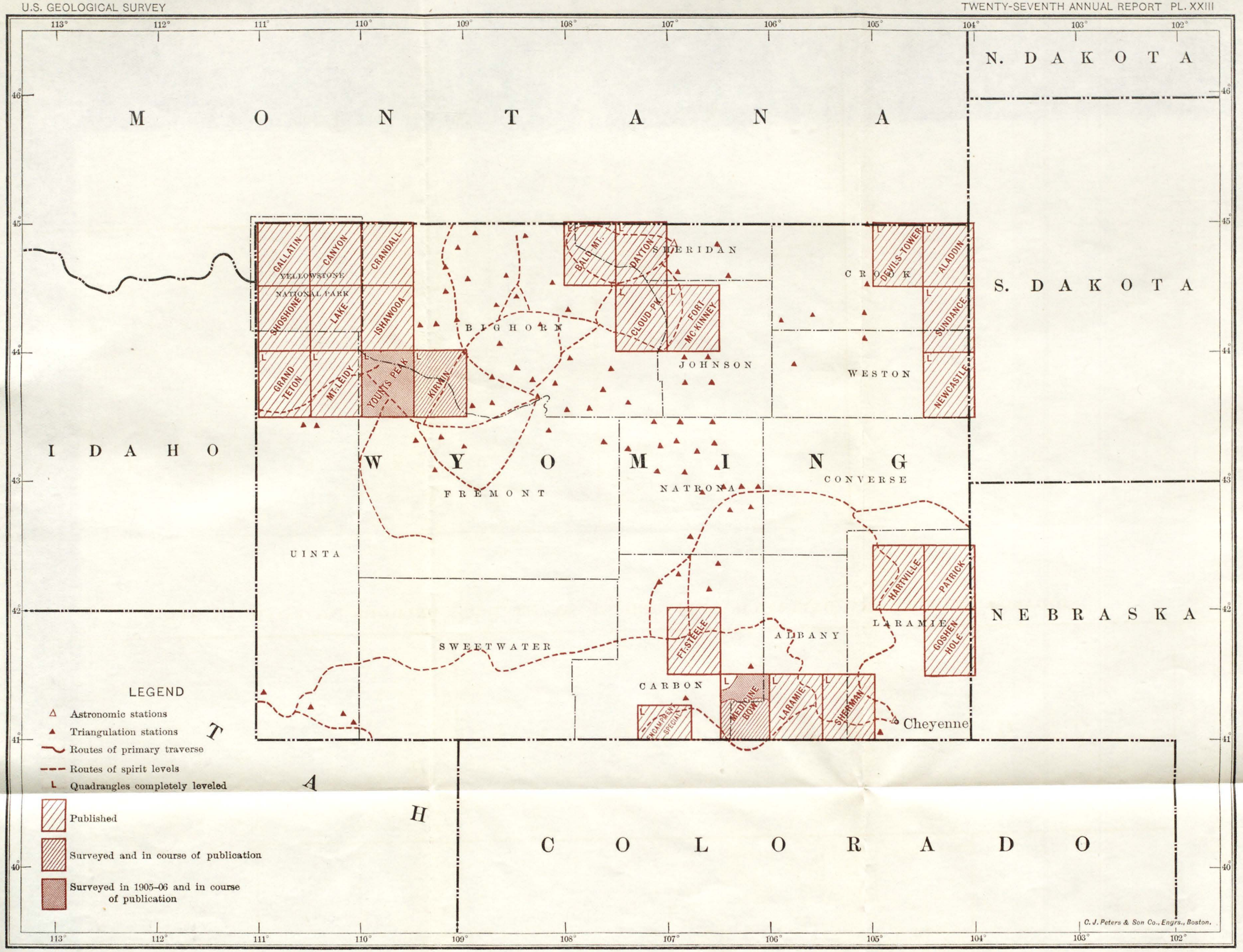
California, Stanislaus Reserve.—One party was engaged in the topographic survey of the southwest quarter of the Bridgeport quadrangle, comprising an area of 265 square miles in Mono and Tuolumne counties, for publication on the scale of 1:125,000, with a contour interval of 100 feet. In connection with this work 168 miles of traverse lines were run.



MAP OF NEVADA AND UTAH, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL



MAP OF WASHINGTON AND OREGON, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL



MAP OF WYOMING, SHOWING PROGRESS OF TOPOGRAPHIC SURVEYING AND PRIMARY CONTROL

California, Trinity Reserve.—For the control of this reserve 159 miles of levels were run, in connection with which 49 permanent bench marks were established.

Colorado, San Juan Reserve.—One party was engaged in the completion of the topographic survey of the San Cristobal quadrangle, in Hinsdale, Mineral, San Juan, and La Plata counties, for publication on the scale of 1:125,000, with a contour interval of 100 feet. The area surveyed was 784 square miles, in connection with which 735 miles of traverse lines were run and 4 permanent bench marks were established by vertical angulation.

Idaho, proposed reserve.—One party was engaged in the topographic survey of the Cataldo quadrangle, in Kootenai and Shoshone counties. The area mapped was 160 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet, in connection with which 195 miles of traverse lines were run. For the control of this quadrangle and adjoining areas 120 miles of levels were run and 19 permanent bench marks were established.

Idaho, Priest River Reserve.—One party secured partial control for this reserve by running 14 miles of levels and establishing 8 permanent bench marks.

Montana, Hellgate Reserve.—One party was engaged in the topographic survey of the Philipsburg quadrangle and of a small adjoining area in the Anaconda quadrangle, in Deerlodge and Granite counties. The area mapped was 856 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet, in connection with which 615 miles of traverse lines were run. For the control of this work 216 miles of levels were run and 61 permanent bench marks were established.

New Mexico.—One party was engaged in running levels in two localities in New Mexico, in one for the control of a proposed reserve including the Gallina quadrangle, and in the other, which was along the Santa Fe Railway, for securing control for the Gila River Reserve. The total distance was 415 miles of levels, in connection with which 144 permanent bench marks were established.

Oregon, proposed reserves.—One party was engaged in the topographic survey of the Grants Pass quadrangle, in Jackson and Josephine counties, the area mapped being 885 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet, in connection with which 320 miles of traverse were run. Another party was engaged in the topographic survey of part of the Ironside Mountain quadrangle, in Baker, Malheur, Grant, and Harvey counties, the area mapped being 541 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet, in connection with which 584 miles of traverse were run. For the control of

the Ironside Mountain and adjoining quadrangles 152 miles of levels were run, in connection with which 39 permanent bench marks were established. In addition, one party secured leveling control for the Susanville quadrangle, 87 miles being run and 26 permanent bench marks established. A line of check levels, consisting of 16 miles, was run in the Telocaset quadrangle.

Utah, Uinta Reserve.—One party was engaged in the resurvey of the Marsh Peak quadrangle, in Uinta County. The area mapped was 410 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet. In connection with this work 115 miles of levels were run, 31 permanent bench marks were established, and 391 miles of traverse were run. A resurvey of 16 square miles of the Gilbert Peak quadrangle, in Summit and Wasatch counties, was also made, in connection with which 120 miles of traverse were run.

Washington, Washington Reserve.—For the control of this reserve one party ran a line of 57 miles of levels and established 17 permanent bench marks.

Wyoming, Yellowstone Reserve.—One party was engaged in the topographic survey of the Younts Peak quadrangle, in Bighorn and Fremont counties. The area surveyed was 864 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet, in connection with which 191 miles of traverse were run. For the control of this and adjoining areas 409 miles of levels were run and 153 permanent bench marks were established.

Wyoming, Medicine Bow Reserve.—One party was engaged in the survey of the Medicine Bow quadrangle, in Albany and Carbon counties, which was not finished. The area mapped was 234 square miles, for publication on the scale of 1:125,000, with a contour interval of 100 feet, in connection with which 433 miles of traverse were run.

BOUNDARY SURVEYS OF FOREST RESERVES.

California, Sierra and Stanislaus Reserves.—The survey of a portion of the boundaries of these reserves adjacent to the Yosemite National Park was commenced about the first of June, and work was continued until early in November, when 125 miles of lines were completed, 5 miles being retraced. In connection with this work, and according to instructions received from the Secretary of the Interior, a survey of the SW. ¼ NE. ¼ sec. 18, T. 2 S., R. 20 E., was made and certain corners in the same township and range were established. The latter work was carried on with funds supplied by the General Land Office.

California, Santa Barbara Reserve.—Work on the survey of the boundary of this reserve was in progress at the close of the last annual report and was continued until the middle of January, 1906, operations covered by this report beginning May 1. During the year 184

miles of boundary were surveyed and marked with 406 iron posts, in connection with which 11 miles of supplemental lines and 7 miles of retracement lines were surveyed.

Utah, Logan Forest Reserve.—Between June 3 and 18 corrections were made of certain portions of the boundary established the previous year.

Utah, Payson Forest Reserve.—Work on the boundary of this reserve, which was begun the previous year, was completed about July 22, when 18 miles of line had been run and marked with 22 iron posts and 4 miles of supplemental line.

OFFICE DRAFTING.

Arizona.—The drafting of the Sacaton sheet was completed, for engraving on the scale of 1:62,500, with a contour interval of 50 feet, and 80 per cent of the Shinumo sheet was completed, on the scale of 1:48,000. About 70 per cent of the drafting of the Four Peaks and 1 per cent of the drafting of the Livingston sheets were also completed, on the scale of 1:125,000, with a contour interval of 100 feet.

California.—The drafting of the following sheets was completed: Colusa, Davisville, Dunnegan, and Woodland, for engraving on the scale of 1:62,500, with a contour interval of 10 feet; Tesla, for engraving on the scale of 1:62,500, with a contour interval of 20 feet; Holtville, Mount Whitney, and Olancha, for engraving on the scale of 1:125,000, with a contour interval of 20 feet for the Holtville and 100 for the Mount Whitney and Olancha. The drafting of the Salton Sink reconnaissance map was completed, for engraving on the scale of 1:500,000, with a contour interval of 50 feet. About 60 per cent of the drafting of the Yosemite Special sheet was completed, on the scale of 1:24,000, with a contour interval of 100 feet; 30 per cent of the Bridgeport, on the scale of 1:125,000, with a contour interval of 100 feet, and about 15 per cent of the Knights Landing, 10 per cent of the Rumsey and Capay, and 40 per cent of the Grimes, all on the scale of 1:62,500, with a contour interval of 100 feet.

Colorado.—The drafting of the Mount Olympus and San Cristobal sheets was completed and about 50 per cent of the Loveland and Fort Collins sheets. The Mount Olympus sheet is being engraved on the scale of 1:62,500 and the San Cristobal on the scale of 1:125,000, both having a contour interval of 100 feet.

Montana.—The drafting of the Philipsburg sheet was completed and about 1 per cent of the drafting of the Anaconda, both for engraving on the scale of 1:125,000, with a contour interval of 100 feet.

Nevada.—The drafting of the Bullfrog and Goldfield specials was completed, both for engraving on the scale of 1:24,000, with a contour interval of 20 feet.

Nevada-California.—The drafting of the reconnaissance map of the Amargosa region was completed and has been engraved on the scale of 1:250,000, with a contour interval of 100 feet.

Oklahoma.—The drafting of the Chandler sheet was completed, for engraving on the scale of 1:62,500, with a contour interval of 20 feet; also about 15 per cent each of the Agra and Mallon and 20 per cent of the Sac and Fox sheets on the same scale and with the same contour interval.

Oregon.—The drafting of the Grants Pass sheet was completed and about 60 per cent of that of the Ironside Mountain sheet, both on the scale of 1:125,000, with a contour interval of 100 feet.

Oregon-Idaho.—The final drafting of the Mitchell Butte sheet was completed, for engraving on the scale of 1:125,000, with a contour interval of 50 feet.

South Dakota.—The drafting of the Indian and Redwater sheets was completed, for engraving on the scale of 1:62,500, with a contour interval of 20 feet; and about 50 per cent of the Two Top, on the same scale and with the same contour interval; also the manuscript was prepared for the Belle Fourche sheet, for publication on the scale of 1:125,000, with a 50-foot contour interval.

Texas.—About 33 per cent of the drafting of the Texarkana sheet was completed, on the scale of 1:125,000, with a contour interval of 20 feet.

Utah.—The drafting of the Frisco and Iron Springs specials was completed, for engraving on the scale of 1:62,500, with a contour interval of 50 feet; also of the Cottonwood special, for engraving on the scale of 1:24,000, with a contour interval of 50 feet, and of the Gilbert Peak sheet, for engraving on the scale of 1:125,000, with a contour interval of 100 feet. About 50 per cent of the Marsh Peak sheet was completed, on the scale of 1:125,000, with a contour interval of 100 feet.

Washington.—The drafting of the Blaine sheet was completed, for engraving on the scale of 1:62,500, with a contour interval of 20 feet.

Washington-Idaho.—The drafting of the Pullman sheet was completed, for engraving on the scale of 1:125,000, with a contour interval of 50 feet.

Wyoming.—The drafting of the Younts Peak sheet was completed, for engraving on the scale of 1:125,000, with a contour interval of 100 feet; and 95 per cent of the Medicine Bow sheet was completed, on the same scale and with the same contour interval.

Forest-reserve boundaries.—The drafting of the plat of the boundary of the Logan Forest Reserve, Utah, was completed, in connection with which 5 subdivision plats were made.

The drafting of the plat of the boundary of the Payson Forest

Reserve, Utah, was completed, in connection with which 6 subdivision plats were made.

The drafting of about 50 per cent of the plat of the exterior boundary of the Yosemite National Park, California, which is also part of the boundaries of the Sierra and Stanislaus forest reserves, was completed, in connection with which 2 subdivision plats were made.

Triplicate copies of about 500 pages of forest reserve boundary notes were typewritten.

TRIANGULATION AND COMPUTING SECTION.

FIELD WORK.

EASTERN DIVISION.

Primary triangulation, primary traverse, and precise leveling were carried on at various times by seven parties. This work was distributed over portions of 18 States—Alabama, Arkansas, Iowa, Indiana, Kentucky, Louisiana, Maine, Missouri, Illinois, Michigan, Nebraska, North Carolina, Ohio, Pennsylvania, South Carolina, Virginia, West Virginia, and Wisconsin. The total area covered by this primary control was 19,130 square miles, of which 17,315 square miles were controlled by primary traverse. The result of this control was to make available seventy-four 15-minute quadrangles and three 30-minute quadrangles in which to prosecute future topographic surveys. In the progress of this work 38 triangulation stations were permanently marked and their geodetic positions determined, and 3,261 miles of primary traverse were run.

Alabama.—Additional control for the Opelika 30-minute quadrangle, in Chambers and Lee counties, was obtained by 78 miles of primary traverse.

Arkansas.—The Fort Smith 30-minute quadrangle, covering portions of the counties of Crawford and Sebastian, was controlled by 141 miles of primary traverse, so distributed as to furnish control for four 15-minute quadrangles, into which the original 30-minute quadrangle will be subdivided.

Georgia.—The Talbotton 30-minute quadrangle, in Harris, Meriwether, Muscogee, and Talbot counties, was controlled by 122 miles of primary traverse. The Dahlonega special quadrangle, in Lumpkin County, was controlled by 48 miles of primary traverse.

Illinois.—Control for the Belleville, Breeze, Mahomet, Springfield, Tallula, Urbana, and Wheaton quadrangles, in the counties of Champaign, Clinton, Dupage, Madison, Menard, and Sangamon, was secured by 403 miles of primary traverse. A line of precise levels, 87 miles in length, was run in the fall of 1905 from Pekin along the Peoria and Eastern Railway to Champaign.

Indiana.—Portions of the New Albany, Prospect, and River View quadrangles, in the counties of Clark, Floyd, and Harrison, were controlled by 97 miles of primary traverse.

Iowa-Nebraska.—The Nebraska City quadrangle, covering portions of Fremont County, Iowa, and Otoe County, Nebr., was controlled by 68 miles of primary traverse, of which 50 miles are in Nebraska and 18 miles in Iowa. A line of precise levels, 142 miles in length, was run from Council Bluffs to Des Moines, Iowa.

Kentucky.—In Bullitt, Jefferson, Shelby, and Spencer counties 76 miles of primary traverse were run for the control of the Shelbyville and Taylorsville quadrangles.

Louisiana.—The Baton Rouge, Grossetete, and Whitecastle quadrangles, covering portions of Ascension, Berryville, and East Baton Rouge parishes, were controlled by 134 miles of primary traverse.

Maine.—The Lewiston and Poland quadrangles, in Androscoggin and Oxford counties, were controlled by means of 6 occupied and 8 intersected triangulation stations.

Michigan.—The Howell, Leonard, Milford, Pontiac, and Rochester quadrangles, in Lapeer, Livingston, and Oakland counties, were controlled by 201 miles of primary traverse.

Mississippi.—The Jackson, Florence, Raymond, and Terry 15-minute quadrangles, in Copiah, Hinds, Madison, and Rankin counties, were controlled by 149 miles of primary traverse.

Missouri.—The Atlanta, Macon, Shelbyville, and Shelbina quadrangles, in Macon, Monroe, and Randolph counties, were controlled by 137 miles of primary traverse.

North Carolina.—The Beckford, Winton, Four Oaks, Salemburg, Charlotte, and Matthews 15-minute quadrangles, in the counties of Bertie, Cabarrus, Gates, Hertford, Mecklenburg, Pasquotank, Johnston, and Sampson, were controlled by 410 miles of primary traverse. During the season of 1905 two lines of precise levels were run; the first from Durham along the Southern Railway northward to the Virginia State line, a distance of 50 miles; the second from Greensboro along the Southern Railway to Madison, thence along the Norfolk and Western Railway to the Virginia State line near Price, a distance of 42 miles.

Ohio.—Primary-traverse control was carried on in two areas. In the northwestern portion of the State, in the counties of Defiance, Fulton, Henry, Williams, Lucas, and Wood, nine quadrangles were controlled by 289 miles of primary traverse; and in the central portion of the State, in the counties of Coshocton, Fairfield, Licking, Muskingum, and Perry, eight quadrangles were controlled by 369 miles of traverse. A line of precise levels was run along the Norfolk and Western Railway from Chillicothe to Columbus, a distance of 52 miles.

Pennsylvania.—In Warren County two 15-minute quadrangles were controlled by locating 10 triangulation stations. In Berks, Lancaster, and York counties three quadrangles were controlled by 179 miles of primary traverse.

South Carolina.—The Sharon and Rockhill quadrangles, in the counties of Chester and York, were controlled by 139 miles of primary traverse.

Virginia.—The lines of precise levels previously mentioned under the heading of North Carolina were extended into Virginia—the first line to Clarksville, a distance of 6 miles, and the second line from Price to Buchanan, a distance of 100 miles.

West Virginia.—A reconnaissance triangulation was extended over the Horton and Elkins quadrangles, in Randolph and Tucker counties; signals were erected on 9 stations, and observations completed at 4 of them.

Wisconsin.—The La Crosse and Sparta quadrangles, in Monroe County, were controlled by 8 triangulation stations. The Cross Plains, Clyman, Delavan, Hartford, Janesville, Shopiere, Port Washington, Waukesha, and West Bend quadrangles, in Dodge, Iowa, Madison, Monroe, Milwaukee, Ozaukee, Rock, Walworth, and Washington counties, were controlled by 221 miles of primary traverse.

WESTERN DIVISION.

Triangulation was carried on at various times during the year by eleven parties and primary traverse by one party. This work was distributed over portions of eight States and Territories—California, Montana, New Mexico, Oklahoma, Oregon, Utah, Washington, and Wyoming. The total area covered by this primary control was 32,300 square miles, of which 400 square miles were controlled by primary traverse. The result of this control was to make available five 15-minute quadrangles, twenty-four 30-minute quadrangles, and seven special maps in which to prosecute future surveys. In the progress of this work 290 new triangulation stations were selected, permanently marked, and their geodetic positions determined, and 63 miles of primary traverse were run.

California.—Four 15-minute quadrangles, in the counties of Colusa, Sacramento, and Yolo, were controlled by 63 miles of primary traverse, and the Yosemite Special quadrangle, in Mariposa County, was controlled by locating 10 triangulation stations.

Montana.—Portions of three quadrangles, in Fergus County, were controlled by occupying 9 triangulation stations and locating 12 points by intersections.

Nevada-California.—Control for the Amargosa Special map, covering an area of 7,000 square miles in Inyo County, Cal., and Esmeralda and Nye counties, Nev., was secured by two triangulation parties; 18 stations were occupied and 7 points were located by intersections.

Oklahoma.—Five quadrangles, in Lincoln, Logan, Pawnee, and Payne counties, were controlled by one triangulation party, which occupied 20 new stations and located 20 points by intersections.

Utah.—An area of 1,000 square miles, including the Iron Springs Special quadrangle, in Beaver and Iron counties, was controlled by the location of 7 triangulation stations.

Washington.—Triangulation control for portions of four quadrangles, in Skagit and Whatcom counties, was secured by one party, which occupied 17 new stations and located 15 additional points by intersections.

TRIANGULATION OF FOREST RESERVES.

California, Sierra Reserve.—Triangulation control for this reserve was completed by the occupation of 17 primary stations and the location by intersection of 16 secondary points by one party. Another party located 5 triangulation stations for the control of the Bridgeport quadrangle, in Mono County.

California, Trinity Reserve.—Four 30-minute quadrangles, in Del Norte and Siskiyou counties, were controlled by 15 triangulation stations.

Idaho, Priest River Reserve.—Triangulation control for an area of 800 square miles in Kootenai County was partly completed by the occupation of 3 old and 2 new stations.

Montana, Hellgate Reserve.—An area of 1,200 square miles in Granite and Ravalli counties was controlled by occupying 9 new stations and locating 25 points by intersections.

New Mexico, proposed reserves.—One 30-minute quadrangle in Rio Arriba County was partly controlled by one party, which occupied 10 triangulation stations and located several points by intersections. An area of 1,000 square miles in Socorro County was triangulated by another party, which occupied 5 new stations and located 6 points by intersections.

Wyoming, Yellowstone Reserve.—An area of 4,500 square miles in Bighorn, Fremont, and Natrona counties was controlled by one triangulation party, which selected, occupied, and monumented 25 new stations and located 13 secondary points.

OFFICE WORK.

The office computation of triangulation, primary traverse, and adjustment of level circuits was carried on in this section as heretofore. The results of primary triangulation and primary traverse in 26 States were summarized and published in Bulletin No. 276.

The results for spirit leveling in the State of New York for the years 1896–1905, inclusive, were published in Bulletin No. 281; and the results of leveling in Pennsylvania for the years 1899–1905, inclusive, were published in Bulletin No. 288. The triangulation and leveling plats of all States were brought up to date, as well as the card catalog of triangulation and primary traverse stations. The preparation of triangulation and leveling data for chiefs of field parties and in reply to requests of persons not connected with the Survey required the time of a considerable portion of the office force.

During the year the following results were computed:

EASTERN DIVISION.

Alabama.—For the control of the Opelika 30-minute quadrangle, in Chambers and Lee counties, 623 latitudes and departures and 58 geographic positions were computed. Level circuits in the Birmingham and Leeds quadrangles, in Jefferson County, were adjusted.

Arkansas.—In the Fort Smith quadrangle, in Crawford and Sebastian counties, 691 latitudes and departures and 117 geographic positions were computed. Level circuits in the Harrison quadrangle, in Boone and Carroll counties, were adjusted.

Delaware.—The results of leveling in Kent, Newcastle, and Sussex counties were revised and rearranged.

Georgia.—For the Dahlonega quadrangle, in Lumpkin County, 831 latitudes and departures and 40 geographic positions were computed. In the Talbotton quadrangle, in Harris, Meriwether, Muscogee, and Talbot counties, 993 latitudes and departures and 99 geographic positions were computed. Level circuits in the Griffin and Talbotton quadrangles were also adjusted.

Illinois.—For the Springfield, Tallula, Urbana, Mahomet, Belleville, Breese, and Wheaton quadrangles, in Champaign, Clinton, Dupage, Madison, Menard, and Sangamon counties, 1,411 latitudes and departures and 336 geographic positions were computed. Level circuits in the Breese, Belleville, Eldorado, Mahomet, New Haven, Springfield, and Urbana quadrangles, in Champaign, Clinton, Gallatin, Madison, Menard, Sangamon, Saline, and White counties, were adjusted, and the office computation of the precise line from Pekin to Champaign was made.

Indiana.—For the New Albany, Prospect, and River View quadrangles, in Clark, Floyd, and Harrison counties, 758 latitudes and departures and 80 geographic positions were computed.

Iowa.—Level circuits in the Des Moines quadrangle, in Polk County, were adjusted, and office computation of the precise line from Council Bluffs to Des Moines was completed. For the portion of the Nebraska City quadrangle lying within Fremont County, Iowa, 60 latitudes and departures and 10 geographic positions were computed.

Kentucky.—For the Shelbyville and Taylorsville quadrangles, in Bullitt, Jefferson, and Oldham counties, 654 latitudes and departures and 66 geographic positions were computed. Level circuits in the Calhoun, Pineville, Sebree, and Sutherland quadrangles, in Bell, Daviess, and McLean counties, were adjusted.

Louisiana.—For the Baton Rouge, Grossetete, and Whitecastle quadrangles, in Ascension, Iberville, and East Baton Rouge parishes, 656 latitudes and departures and 135 geographic positions were computed. Level circuits in the Baton Rouge quadrangle were adjusted.

Maine.—The geodetic positions of 11 triangulation stations for the control of the Lewiston and Poland quadrangles, in Androscoggin and Oxford counties, were computed.

Maryland.—Results of leveling in Baltimore, Caroline, Cecil, Dorchester, Harford, Queen Anne, Talbot, Somerset, Wicomico, and Worcester counties were revised and rearranged for publication.

Michigan.—For the Howell, Leonard, Milford, Pontiac, and Rochester quadrangles, in Lapeer, Livingston, and Oakland counties, 720 latitudes and departures and 178 geographic positions were computed. The level circuits in the Marquette quadrangle, in Marquette County, were adjusted.

Minnesota.—Level circuits in the Lake Minnetonka quadrangle, in Carver, Hennepin, and Wright counties, were adjusted.

Mississippi.—For the Florence, Jackson, Raymond, and Terry quadrangles, in Copiah, Hinds, Madison, and Rankin counties, 1,542 latitudes and departures and 132 geographic positions were computed and level circuits in the same area were adjusted.

Missouri.—For the Atlanta, Macon, Shelbina, and Shelbyville quadrangles, in Macon, Monroe, and Randolph counties, 520 latitudes and departures and 137 geographic positions were computed and level circuits in portions of the same area were adjusted.

Nebraska.—For the Nebraska City quadrangle, in Otoe County, 200 latitudes and departures and 43 geographic positions were computed and levels in the same area were adjusted.

New Hampshire.—Level circuits in the Claremont, Hanover, and Sunapee quadrangles, in Grafton and Sullivan counties, were adjusted.

North Carolina.—For the Beckford, Charlotte, Four Oaks, Matthews, Salemburg, and Winton quadrangles, in Bertie, Cabarrus, Gates, Hertford, Johnston, Pasquotank, and Sampson counties, 2,605 latitudes and departures and 323 geographic positions were computed. Level circuits were adjusted in the Beckford, Dunn, Four Oaks, and Winton quadrangles; and office reductions were made of precise lines from Durham north to State line and from Greensboro to Price.

North Dakota.—Level circuits in the Bismarck 30-minute quadrangle, in Burleigh and Morton counties, were adjusted.

Ohio.—For 17 quadrangles in the counties of Coshocton, Defiance, Fairfield, Fulton, Henry, Lucas, Licking, Muskingum, Perry, Williams, and Wood 2,828 latitudes and departures and 650 geographic positions were computed. Level circuits were adjusted in the following counties: Ashtabula, Crawford, Clinton, Clark, Darke, Gallia, Greene, Hamilton, Huron, Madison, Miami, Montgomery, Pickaway, Portage, Preble, Putnam, Ross, Sandusky, Trumbull, and Wyandot. The office reduction of the precise-level line Chillicothe to Columbus was made.

Pennsylvania.—The geodetic coordinates of 10 triangulation stations in the Warren and Youngsville quadrangles, in Warren County, and 1,061 latitudes and departures and 152 geographic positions in the New Cumberland, New Holland, and Middletown quadrangles, in Berks, Lancaster, and York counties, were computed. Levels in the same areas were adjusted and prepared for publication, together with the results of spirit leveling in the rest of the State.

South Carolina.—For the Sharon and Rockhill quadrangles, in Chester and York counties, 990 latitudes and departures and 106 geographic positions were computed and level circuits in the same area were adjusted.

Tennessee.—Level circuits for the Maynardsville and Pineville quadrangles, in Claiborne and Hancock counties, were adjusted.

Virginia.—The geodetic positions of 8 triangulation stations in the Stuart quadrangle, in Floyd and Patrick counties, were computed; level circuits in the Buchanan quadrangle were adjusted, and office computation of precise-level lines near Clarksville and from Price to Buchanan was made.

West Virginia.—The preliminary computation of triangulation in the Horton and Elkins quadrangles, in Randolph and Tucker counties, was made, and level circuits in the Glenwood, Point Pleasant, Ravenswood, Ripley, Spencer, and Thornton quadrangles, in Calhoun, Jackson, Mason, Wood, and Wirt counties, were adjusted. The lists of levels thruout the State were also revised and rearranged for publication.

Wisconsin.—The geodetic positions of 6 triangulation stations in the La Crosse and Sparta quadrangles, in Monroe County, were computed and also 760 latitudes and departures and 174 geographic positions in eight quadrangles in Dodge, Iowa, Madison, Milwaukee, Ozaukee, Rock, Shopiere, Walworth, and Washington counties. Level circuits in the Cross Plains, Denzer, La Crosse, Mazomanie, Richland Center, Sparta, and Sun Prairie quadrangles, in Dane, Iowa, La Crosse, Monroe, Richland, and Sauk counties, were adjusted.

WESTERN DIVISION.

Arizona.—Level circuits in the Four Peaks and Globe quadrangles, in Gila and Maricopa counties, were adjusted, and the office reduction of the precise-level line in Yuma, Maricopa, and Pinal counties was completed.

California.—The following groups of level circuits were adjusted: The Imperial project, in San Diego County; the Sonoma and Yosemite quadrangles, in Mariposa County; the Freeman, Keeler, Mount Whitney, and Tehipite quadrangles, in Fresno, Inyo, and Kaweah counties, and the special maps in the Sacramento Valley. The office computation of the precise line from Mohave to Laws and from Alvord to Lida was completed. Results of primary traverse and triangulation were computed at the suboffice at Sacramento as follows: 370 latitudes and departures and 58 geographic positions in Colusa, Sacramento, and Yolo counties for 4 special sheets. The geodetic coordinates of 15 triangulation stations in Del Norte and Siskiyou counties, the geodetic coordinates of 10 triangulation stations in Mariposa County for the Yosemite Special map, 5 geodetic coordinates in the Bridgeport quadrangle, in Mono County, and the geodetic coordinates of 33 triangulation stations in seven 30-minute quadrangles in Inyo and Mono counties were computed.

Colorado.—Level circuits in the Fort Collins, Livermore, and Mount Olympus quadrangles. in Larimer County, were adjusted.

Idaho.—The positions of 5 triangulation points in Kootenai County were computed and level circuits in the Cataldo and Sand Point quadrangles in Kootenai and Shoshone counties were adjusted.

Montana.—The geodetic positions of 21 triangulation stations in Fergus County and of 34 stations in Granite and Ravalli counties were computed. Level circuits were adjusted in quadrangles in Boulder, Deerlodge, Granite, Powell, and Silverbow counties.

Nevada.—The geodetic positions of 20 triangulation stations in Esmeralda and Nye counties were computed, and level circuits in the same area were adjusted.

New Mexico.—The geodetic coordinates of 22 triangulation stations in Rio Arriba and Socorro counties were computed and level circuits in one 30-minute quadrangle in Rio Arriba County were adjusted. A computation was made of the precise line of levels thru Valencia, Socorro, Sierra, Donna Ana, Luna, and Grant counties.

Oklahoma.—The triangulation for five quadrangles in Lincoln, Logan, Pawnee, and Payne counties was adjusted by least squares, and the geodetic coordinates of 40 stations were computed. The level circuits within the same area were adjusted.

Oregon.—Level circuits in the Ironside Mountain, Mitchell Butte, Susanville, and Telocaset quadrangles, in Baker, Grant, Malheur, and Union counties, were adjusted.

Texas.—The results of leveling in seven 30-minute quadrangles in Bexar, Burnett, Bastrop, Caldwell, Fayette, Gonzales, Gillespie, Medina, and Uvalde counties were revised and rearranged for publication.

Utah.—The geodetic coordinates of 7 triangulation stations in Beaver and Iron counties were computed.

Washington.—The geodetic coordinates of 32 triangulation stations in four 30-minute quadrangles in Skagit and Whatcom counties were computed and level circuits in two quadrangles in the same counties were adjusted.

Wyoming.—Least-square adjustment of triangulation in Fremont, Bighorn, and Natrona counties was made and geodetic coordinates of 25 triangulation stations were computed. Levels in five 30-minute quadrangles in the same counties were adjusted.

SECTION OF INSPECTION OF TOPOGRAPHIC SURVEYING AND MAPPING.

During the field season inspection of topographic mapping, completed or in progress, was carried on in various parts of the United States for the purpose of maintaining a uniformity of style and system in the expression of topographic features. Localities visited were as follows: Rockland, Me.; Ogdensburg, Depew, and Angelica, N. Y.; Duncannon, Johnstown, and Punxsutawney, Pa.; Mount Sterling, Ohio; Elizabeth, W. Va.; Denton and Barclay, Md.; Highland, N. C.; Campobello, S. C.; Columbus and Washington, Ga.; Birmingham, Ala.; Jackson, Miss.; Baton Rouge and Bayou Sara, La.; Sebree and Sutherland, Ky.; Chandler, Okla.; Belle Fourche, S. Dak.; Kirwin and Laramie, Wyo.; Philipsburg, Mont.; Cedar City, Utah; Creede, Colo.; Socorro, N. Mex.; Phoenix, Mesa, and Tombstone, Ariz.

During the office season careful attention was given to the final drawing of map sheets for the elimination of personal mannerisms and minor errors of expression, and the preparation and final drawing of new material for revision of the base map of the United States was continued in the office during the year.

SECTION OF INSTRUMENTS AND TOPOGRAPHIC RECORDS.

The systematic overhauling of all instruments was continued, the work being done in the shop of the Survey except in cases requiring extensive repairs, when the articles were sent to the makers. Purchases were made from time to time to cover losses occasioned by wear and tear. Except for a few levels of the Coast Survey type and a few telescopic alidades fitted with the special stadia attachment, no extensive purchases were made. The special purchases were made in order that the experimentations begun the previous year might be continued.

The filing of the original records under the existing card system was continued. The number of pieces filed was about 1,900, comprising triangulation, level, and topographic notebooks and plane-table sheets. In addition about 100 pieces of miscellaneous material were catalogued and filed.

DIVISION OF GEOGRAPHY AND FORESTRY.

The preparation of a fourth edition of the Dictionary of Altitudes was completed, and it was published early in the autumn as Bulletin No. 274. A Gazetteer of Colorado was undertaken early in the year, and it has been completed and published as Bulletin No. 291. Gazetteers of New York and California were undertaken and are well advanced.

An outline map of North America, on a scale of 1:5,000,000, was undertaken and completed, and is now engraved. The revision of the three-sheet map of the United States, on a scale of 1:2,500,000, is well advanced. All the atlas sheets published by the Survey have been reduced and are ready for the engraver. On the unsurveyed areas the county lines and railroads have been revised and are also ready for engraving. The preparation of a map in sheets on a scale of 1:1,000,000 has progressed rapidly, but as the work has been going on in various parts of the country it is difficult to measure the progress. Several sheets are complete and ready for the engraver.

The geographer in charge of the division was occupied mainly with the following duties:

Assisting the Forest Service, particularly in matters relating to geography and topography and in the organization of its reserve force.

His work as chairman of the Board on Geographic Names took considerable time, especially after the Presidential order of January 23, 1906, which extended materially the powers of the Board.

Much time was devoted to assisting the committee on Department methods, first in the investigation of the Bureau of Statistics of the Department of Agriculture, and second in the investigation in the Departments and bureaus of the Government of the organization for carrying on scientific and routine processes.

The editing of the report of the Eighth International Geographic Congress, published by the Public Printer, required considerable time during the first three months of the year.

For several years the Census Office and the Land Office have been publishing areas of States which differ from one another, and the Survey geographer, in cooperation with representatives of those two bureaus, is bringing these figures into accord. This work is well advanced.

HYDROGRAPHIC BRANCH.

ORGANIZATION.

The work of the hydrographic branch was divided into three parts—hydrography, hydrology, and hydro-economics—each composing a division. The division of hydrography has to do with the distribution of the surface waters of the United States; it determines the quantity

and fluctuations of the flow of rivers, mainly those having importance for water power, irrigation, municipal supplies, or other industrial purposes. The division of hydrology investigates the currents of water under ground, particularly those reached by deep wells; and it is studying the geology of the earth's surface in so far as it concerns the distribution and amount of underground water, especially that having industrial importance. The division of hydro-economics studies the qualities of water as affecting its industrial and municipal uses.

DIVISION OF HYDROGRAPHY.

LOCAL OFFICES.

The field work of the division of hydrography was supervised thru several local offices, each office being in charge of a hydrographer who was responsible for the work of his district. These districts and offices were as follows:

Hydrographic districts and offices.

District.	Office.
New England	6 Beacon street, Boston, Mass.
New York	75 Arcade, Utica, N. Y.
Middle Atlantic States	Washington, D. C.
South Atlantic and Gulf States	409 Temple court, Atlanta, Ga.
Mississippi Valley	876 Federal Building, Chicago, Ill.
Montana district (Montana, North Dakota, and northern Wyoming).	Billings, Mont.
South Dakota	Bellefourche, S. Dak.
Denver district (Colorado, Kansas, Nebraska, and southern Wyoming).	Chamber of Commerce Building, Denver, Colo.
New Mexico district (New Mexico, Oklahoma, and Indian Territory).	Carlsbad, N. Mex.
Texas	Austin, Tex.
Arizona	Phoenix, Ariz.
Utah	Salt Lake City, Utah.
Nevada	Carson, Nev.
Idaho	Sonna Building, Boise, Idaho.
Oregon district (Oregon and Washington)	351 Washington street, Portland, Oreg.
California	1108 Union Trust Building, Los Angeles, Cal.

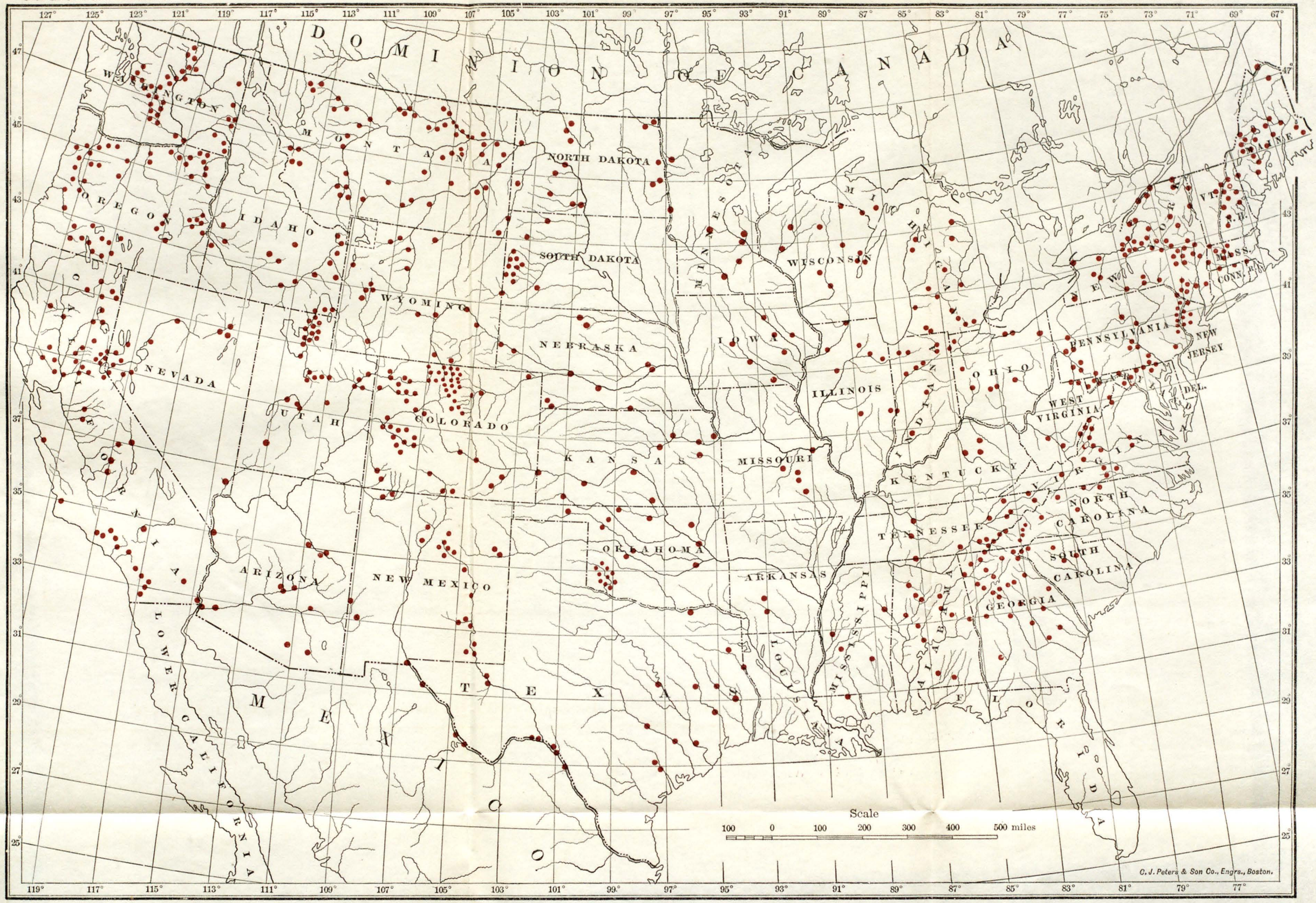
STREAM GAGING.

The work of the division of hydrography continued along lines previously developed. River stations for obtaining records of stage and discharge were maintained in all sections of the country. The locations of the principal river stations maintained during the year are given in the following list and are shown on Pl. XXIV.

Gaging stations, by States, maintained during fiscal year 1905–6.

River.	Station.
ALABAMA.	
Alabama	Selma.
Black Warrior	Cordova.
Black Warrior	Tuscaloosa.
Black Warrior (Locust Fork).	Palos.
Cahaba	Centerville.
Choccolocco	Jenifer.
Choctawhatchee	Elba Junction.
Clear Creek	Elk.
Conecuh	Beck.
Coosa	Riverside.
Elk	Elkmont.
Pea	Elba.
Pea	Pera.
Tallapoosa	Sturdevant.
Tombigbee	Epes.
ARIZONA.	
Chevelon Fork	Winslow.
Clear Creek	Winslow.
Colorado	Hardyville.
Colorado	Yuma.
Colorado (Little)	Holbrook.
Colorado (Little)	St. Johns.
Colorado (Little)	Woodruff.
Gila	Dome (Gila City).
Gila	San Carlos.
Salt	McDowell.
Salt	Roosevelt.
San Pedro	Charleston.
Santa Cruz	Tucson.
Silver Creek	Canyon, Snowflake.
Silver Creek	Snowflake.
Verde	McDowell.
ARKANSAS.	
Ouachita	Arkadelphia.
Ouachita	Malvern.
CALIFORNIA.	
Alamo	Rockwood.
Alamitos Canal	Calexico.
American	Fairoaks.
Arroyo Seco	Soledad.
Ash Creek	Adin.
Bear	Wheatland.
Big Pine Creek	Big Pine.
Big Pine and Owens River Canal	Bishop.
Birch Creek	Tinemaha.
Bishop Creek	Bishop.
Bishop Creek Canal	Bishop.
Boundary Canal	Calexico.
Cache Creek	Lower Lake.
Cache Creek	Yolo.
Chino Creek	Rincon.
Collins (Geo.) Canal	Bishop.
Collins (A. O.) Canal	Bishop.
Cottonwood Creek	Jamul.
Dell Creek	Bishop.
Donner Creek	Truckee.
East Side Canal	Citrus.
Farmers Canal	Bishop.
Feather	Oroville.
Feather	Prattville.
Hemlock Canal	Calexico.
Grizzly Creek	Beckwith.
Hillside Canal, north	Bishop.
Hillside Canal, south	Bishop.
Holt Canal	Calexico.
Holt Canal, new	Calexico.
Imperial Canal	Yuma.
Independence Creek	Hobart Mills.
Independence Creek	Independence.
Indian Creek	Crescent Mills.
Kaweah	Three Rivers.
Kern	Bakersfield.
Kings	Sanger.

River.	Station.
CALIFORNIA—continued.	
Little Truckee	Boca (Pine Station).
Los Angeles	Los Angeles.
Lost	Clear Lake.
McCloud	Gregory (Baird).
Main Canal	Calexico.
McNalley Canal	Bishop.
Malibu Creek	Calabasas.
Merced	Merced Falls.
Merced	Yosemite Valley.
Modesto Canal	Lagrange.
Mohave	Victorville.
Mokelumne	Clements.
New	Calexico.
Oak Creek	Independence.
Owens	Round Valley (Bishop).
Owens	Citrus (Independence).
Owens River Canal	Bishop.
Pine Creek	Round Valley (Bishop).
Pine Creek	Jamul.
Pit	Bieber.
Pit	Canby.
Powers Canal	Bishop.
Prosser Creek	Hobart Mills.
Puta Creek	Guenoc (Middletown)
Puta Creek	Winters.
Rawson Canal	Bishop.
Rock Creek	Round Valley (Bishop).
Sacramento	Red Bluff.
Sacramento	Sacramento.
Salton Lake	Mecca.
San Diego	Lakeside.
San Gabriel	Azuza.
Sanger Canal	Alvord.
San Joaquin	Herndon.
San Luis Rey	Pala.
Santa Ana	Mentone (Warm Springs).
Santa Ana	Rincon.
Santa Maria	Santa Maria.
Santa Ynez	Santa Barbara.
Santa Ysabel	San Pasqual Valley.
Stanislaus	Knights Ferry.
Stanislaus Water Company's Canal.	Knights Ferry.
Stevens Canal	Citrus.
Stony Creek	Fruto.
Susan	Susanville.
Sweetwater	Descanso.
Tamarack Canal	Imperial.
Temecula Creek	Temecula.
Tenaya Creek	Yosemite Valley.
Triumfo Creek	Calabasas.
Truckee	Mystic.
Truckee	Tahoe City.
Tule	Portersville.
Tuolumne	Lagrange.
Turlock Canal	Lagrange.
West Carson	Woodfords.
West Valley Creek	Likely.
West Walker	Coleville.
Willow Creek	Merrillville.
Willow Creek	Standish.
Wisteria Canal	Calexico.
Yosemite Creek	Yosemite Valley.
Yuba	Smartsville.
COLORADO.	
Animas	Durango.
Arkansas	Canyon City.
Arkansas	Pueblo.
Blue	Kremmling.
Canadian Creek	Cowdrey.
Cimarron	Cimarron.
Clear Creek	Forkscreek.
Conejos	Magote.
Eagle	Eagle.



MAP OF UNITED STATES, SHOWING LOCATION OF PRINCIPAL RIVER STATIONS MAINTAINED DURING 1905-06

Gaging stations, by States, maintained during fiscal year 1905–6—Continued.

River.	Station.
COLORADO—continued.	
East	Almont.
Elk	Trull.
Elkhead Creek	Craig.
Fortification Creek	Craig.
Frazer	Granby (Coulter).
Grand	Glenwood Springs.
Grand	Hot Sulphur Springs.
Grand	Kremmling.
Grand	Palisades.
Grand (North Fork)	Grandlake.
Grand Lake (North Inlet)	Grandlake.
Grand Lake Outlet	Grandlake.
Grizzly Creek (Big)	Hebron.
Grizzly Creek (Little)	Hebron.
Gunnison	Cimarron.
Gunnison	Cory.
Gunnison	Portal of Tunnel.
Gunnison	Whitewater.
Gunnison (North Fork)	Hotchkiss.
La Plata	Hesperus.
Laramie	Glendevey.
Marvine Creek	Buford.
McIntyre	Gleneyre.
Michigan Creek	Cowdrey.
Michigan Creek	Walden.
Milk Creek	Axial.
Muddy	Kremmling.
North Platte	Cowdrey.
North Platte	Hebron.
North Platte (North Fork)	Higho.
Purgatory	Alfalfa (Barela).
Purgatory	Trinidad.
Rio Grande	Cenicero (Lobatos).
Rio Grande	Del Norte.
Roaring Fork	Glenwood Springs.
Roaring Fork	Hebron.
South Platte	Denver.
South Platte	Julesburg.
South Platte	Kersey.
South Platte	South Platte.
South Platte (South Fork)	South Platte.
Taylor	Almont (Summerville Park).
Troublesome	Troublesome.
Uncompahgre	Delta.
Uncompahgre	Colona (Eldredge Siding).
Uncompahgre	Montrose.
White	Meeker.
White	Rangely.
White (North Fork)	Buford.
White (South Fork)	Buford.
Williams	Hamilton.
Williams Fork	Hot Sulphur Springs.
Yampa	Craig.
Yampa	Maybell.
Yampa	Steamboat Springs.
CONNECTICUT.	
Housatonic	Gaylordsville.
Salmon	Leesville.
Shetucket	Willimantic.
GEORGIA.	
Alcovy	Stewart.
Apalachee	Buckhead.
Broad	Carlton.
Cannoochee	Groveland.
Cartecay	Cartecay.
Chattahoochee	Norcross.
Chattahoochee	Westpoint.
Coosa	Riverside.
Coosawattee	Carters.
Etowah	Canton.
Etowah	Rome.
Flint	Albany.
Flint	Montezuma.
Flint	Woodbury.
Ichawaynochaway Creek	Milford.
GEORGIA—continued.	
Kinchafoonee Creek	Leesburg.
Ocmulgee	Flovilla.
Ocmulgee	Jackson.
Ocmulgee	Macon.
Oconee	Dublin.
Oconee	Greensboro.
Oconee	Milledgeville.
Ohoopee	Reidsville.
Oostanaula	Resaca.
Savannah	Augusta.
Sweetwater Creek	Austell.
Soque	Demorest.
Tallulah	Tallulah Falls.
IDAHO.	
Bear	Dingle.
Bear	Preston (Battle Creek).
Bear Lake	Fishhaven.
Blackfoot	Presto.
Boise	Highland.
Cœur d'Alene Lake	Cœur d'Alene.
Fall	Fremont.
Lost (Big)	Chilly Station.
Lost (Big)	Mackay.
Payette	Jerusalem.
Snake	Minidoka.
Snake	Neeley.
Snake (North Fork)	Ora.
Snake (South Fork)	Lyon.
Succor Creek	Homedale.
Teton	St. Anthony
Wood (Big)	Shoshone.
ILLINOIS.	
Des Plaines	Channahon.
Fox	Sheridan.
Illinois	Peoria.
Kankakee	Momence.
Rock	Rockton.
Rock	Sterling.
Sangamon	Decatur.
INDIANA.	
Eel (Lower)	Cataract.
Kankakee	Davis.
St. Joseph	Fort Wayne.
St. Marys	Fort Wayne.
Tippecanoe	Delphi.
Wabash	Logansport.
Wabash	Terre Haute.
White (East Branch)	Shoals.
White (West Branch)	Indianapolis.
Yellow	Knox.
INDIAN TERRITORY.	
Canadian	Calvin.
Grand	Fort Gibson.
Verdigris	Catoosa.
IOWA.	
Cedar	Cedar Rapids.
Des Moines	Des Moines.
Des Moines	Fort Dodge.
Des Moines	Keosauqua.
Iowa	Iowa City.
Red Cedar	Janesville.
Wapsipinicon	Stone City.
KANSAS.	
Arkansas	Arkansas City.
Arkansas	Dodge City.
Arkansas	Hutchinson.
Arkansas	Syracuse.
Blue	Manhattan.
Cimarron	Arkalon.
Kaw (Kansas)	Lecompton.

Gaging stations, by States, maintained during fiscal year 1905–6—Continued.

River.	Station.
KANSAS—continued.	
Osage	Ottawa.
Republican	Junction.
Smoky Hill	Ellsworth.
Missouri	Kansas City.
KENTUCKY.	
Dicks	Danville.
Kentucky	Frankfort.
Salt (Rolling Fork)	Newhaven.
LOUISIANA.	
Bogue Chitto	Warnerton.
Sabine	Logansport.
MAINE.	
Androscoggin	Dixfield.
Aroostook	Fort Fairfield.
Carrabassett	North Anson.
Cold Steam	Enfield.
Dead	The Forks.
Fish	Wallagrass.
Kennebec	North Anson.
Kennebec	The Forks.
Machias	Whitneyville.
Mattawamkeag	Mattawamkeag.
Messalonskee	Waterville.
Moose	Rockwood.
Penobscot	West Enfield.
Penobscot (East Branch)	Grindstone.
Phillips Lake	East Holden.
Piscataquis	Foxcroft.
Roach	Roach River.
St. Croix	Woodland (Baring).
St. John	Fort Kent.
Sandy	Madison.
MARYLAND.	
Antietam Creek	Sharpsburg.
Broad Ceek	Mill Green.
Deer Creek	Churchville.
Georges Creek	Westernport.
Gunpowder Falls (Little)	Belair.
Gunpowder Falls (Great)	Glencoe.
Monocacy	Frederick.
Patapsco	Woodstock.
Potomac	Point of Rocks.
Savage	Bloomington.
Wills Creek	Cumberland.
MASSACHUSETTS.	
Connecticut	Sunderland.
Deerfield	Deerfield.
Quabog	West Warren.
Swift	West Ware.
Ware	Gilbertville.
Ware	Ware.
Westfield	Russell.
Westfield (Little)	Blandford.
MICHIGAN.	
Au Sable	Bamfield.
Escanaba	Escanaba.
Grand	Grand Rapids.
Grand	North Lansing.
Huron	Dexter.
Huron	Flat Rock.
Huron	French Landing.
Huron	Geddes.
Kalamazoo	Allegan.
Manistee	Sherman.
Menominee	Iron Mountain.
Muskegon	Newaygo.
Reed Spring	Albion.
Rifle	Sterling.

River.	Station.
MICHIGAN—continued.	
St. Joseph	Mendon.
St. Joseph	Buchanan.
Thunder Bay	Alpena.
Tittabawassee	Freeland.
MINNESOTA.	
Crow	Dayton.
Minnesota	Mankato.
Mississippi	Anoka.
Mississippi	Sauk Rapids.
Otter Tail	Fergus Falls.
Red Lake	Crookston.
Rum	Anoka.
MISSISSIPPI.	
Pearl	Jackson.
Tombigbee	Columbus.
Yazoo	Yazoo City.
MISSOURI.	
Courtois Creek	Scotia.
Gasconade	Arlington.
Meramec	Eureka.
Meramec	Meramec.
Meramec Spring	Meramec.
MONTANA.	
Agency Ditch	Harlem.
Beaver Creek	Ashfield.
Beaver Creek Overflow	Bowdoin.
Belt Creek	Belt.
Big Blackfoot	Bonner.
Bighorn	Fort Custer.
Bighorn (Little)	Crow Agency.
Bitterroot	Grantsdale.
Cherry Creek	Norris.
Clarke Fork	Fromberg.
Cook Canal	Chinook.
Cut Bank Creek	Cut Bank.
Deep Creek (Smith River)	Truly.
Fort Belknap Canal	Chinook.
Gallatin	Logan.
Gallatin (West)	Salesville.
Harlem Canal	Zurich.
Highwood Creek	Highwood.
Jefferson	Sappington.
Kennedy Creek	Babb.
Madison	Norris.
Marias	Shelby.
Matheson Canal	Chinook.
Milk	Havre.
Milk	Malta.
Milk (North Fork)	Chinook.
Milk (South Fork)	Browning.
Milk (West Fork)	Chinook.
Missoula	Missoula.
Missouri	Cascade.
Missouri	Greatfalls.
Missouri (Little)	Alzada.
Musselshell	Shawmut.
Paradise Valley Canal	Chinook.
Pryor Creek	Huntley.
Rock Creek	Hinsdale.
Rock Creek Canal	Hinsdale.
St. Mary	Dam Site.
St. Mary	International Line.
Sun	Sun River.
Sun (North Fork)	Augusta.
Sun (South Fork)	Augusta.
Swiftcurrent Creek	Babb (St. Marys).
Teton	Belleview.
Teton	Chouteau.
Willow Creek	Augusta.
Yellowstone	Billings.
Yellowstone	Glendive.
Yellowstone	Livingstone.

Gaging stations, by States, maintained during fiscal year 1905–6—Continued.

River.	Station.
NEBRASKA.	
Loup	Columbus.
Niobrara	Valentine.
North Platte	Bridgeport.
North Platte	Mitchell.
North Platte	North Platte.
Platte	Columbus.
Platte	Lexington.
Red Deer Lake	Woodlake.
Republican	Benkelman.
Republican	Bostwick.
Republican (South Fork)	Benkelman.
NEVADA.	
Carson	Empire.
East Carson	Gardnerville.
East Walker	Yerington.
Humboldt	Golconda.
Humboldt	Oreana.
Humboldt	Palisade.
Humboldt (North Fork)	Elburz.
Humboldt (South Fork)	Elko.
Lake Winnemucca Inlet	Wadsworth.
Muddy	Moapa.
Truckee	Vista.
Truckee	Wadsworth.
Walker	Wabuska.
NEW HAMPSHIRE.	
Ammonoosuc	Bretton Woods.
Androscoggin	Shelburne.
Connecticut	Orford.
Contoocook	West Hopkinton.
Israel, above South Branch.	Jefferson Highlands.
Israel, below South Branch.	Jefferson Highlands.
Little	Twin Mountain.
Merrimac	Franklin Junction.
Pemigewasset	Plymouth.
Saco	Center Conway.
Zealand	Twin Mountain.
NEW JERSEY.	
Delaware	Lambertville.
Musconetcong	Bloomsbury.
Passaic	Chatham.
Passaic	Millington.
Ramapo	Mahwah.
Raritan	Boundbrook.
Raritan	Finderne.
Raritan (North Branch)	Pluckemin.
Raritan (South Branch)	Rowland Mills (Stanton).
Wanaque	Wanaque.
NEW MEXICO.	
Animas	Farmington.
Gallinas	Las Vegas Hot Springs.
Gila	Cliff.
Hondo	Roswell.
Hondo	Reservoir Site, Roswell.
La Plata	Laplata.
Mora	Lacueva.
Mora Canal	Lacueva.
Pecos	Avalon.
Pecos	Carlsbad.
Pecos	Dayton.
Pecos	Fort Sumner.
Pecos	Lakewood.
Pecos	Roswell.
Pecos	Santa Rosa.
Penasco	Dayton.
Rio Grande	San Ildefonzo (Rio Grande).
Rio Grande	San Marcial.
NEW MEXICO—continued.	
San Francisco	Alma.
San Juan	Farmington.
Sapello	Los Alamos.
Ute Creek	Logan.
NEW YORK.	
Allegheny	Red House.
Black	Felts Mills.
Canada Creek (East)	Dolgeville.
Canada Creek (West)	Kast Bridge.
Canada Creek (West)	Trenton Falls.
Canada Creek (West)	Twin Rock Bridge.
Catskill Creek	South Cairo.
Chemung	Chemung.
Chenango	Binghamton.
Chittenango	Chittenango.
Delaware (East Branch)	Hancock.
Delaware (West Branch)	Hancock.
Esopus	Kingston.
Genesee	Mount Morris.
Genesee	Jones's Bridge, Mount Morris.
Genesee	Rochester.
Graefenberg Creek	New Hartford.
Honeoye Creek	East Rush.
Hoosic	Buskirk.
Hudson	Fort Edward.
Hudson	Mechanicsville.
Indian River	Indian Lake.
Johnson Brook	Utica.
Kinderhook Creek	Rossman.
Lake George Outlet	Ticonderoga.
Mohawk	Dunsbach Ferry.
Mohawk	Little Falls.
Moose	Moose River.
Oak Orchard Creek	Medina.
Oneida	Euclid.
Onondaga Lake Outlet	Long Branch.
Oriskany	Colemans, Oriskany.
Oriskany	State Dam, Oriskany.
Oswegatchie	Ogdensburg.
Oswego	Minetto (Battle Island).
Racquette	Massena Springs.
Richelieu	Fort Montgomery.
Rondout	Rosendale.
Salmon	Pulaski.
Saranac	Plattsburg.
Schoharie	Prattsville.
Schroon	Warrensburg.
Seneca	Baldwinsville.
Seneca Lake	Geneva.
Skaneateles Outlet	Willow Glen.
Susquehanna	Binghamton.
Wappinger Creek	Wappinger Falls.
NORTH CAROLINA.	
Catawba	Morgantown.
Dan	Madison.
Davidsons	Davidsons River.
French Broad	Asheville.
French Broad	Horseshoe.
Hiwassee	Murphy.
Mills (North Fork)	Pinkbed.
Mills (South Fork)	Sitton.
Nottely	Ranger.
Tennessee (Little)	Judson.
Tuskaseegee	Bryson City.
Valley	Tomotla.
Yadkin	Northwilkesboro.
Yadkin	Salisbury.
NORTH DAKOTA.	
Cannon Ball	Stevenson.
Des Lacs	Foxholm.
Heart	Richardton.
Knife	Broncho.

Gaging stations, by States, maintained during fiscal year 1905–6—Continued.

River.	Station.
NORTH DAKOTA—cont'd.	
Missouri	Bismarck.
Missouri	Nesson.
Missouri	Williston.
Missouri (Little)	Medora.
Mouse	Foxholm.
Mouse	Minot.
Muddy (Little)	Williston.
Pembina	Neche.
Red	Fargo.
Red	Grand Forks.
Sheyenne	Haggart.
OHIO.	
Black	Elyria.
Cuyahoga	Independence.
Great Miami	Dayton.
Licking	Pleasant Valley.
Mad	Springfield.
Mahoning	Youngstown.
Maumee	Sherwood.
Muskingum	Zanesville.
Olentangy	Columbus.
Scioto	Columbus.
Tiffin	Defiance.
OKLAHOMA.	
Arkansas (Salt Fork)	Alva.
Arkansas (Salt Fork)	Tonkawa.
Beaver	Beaver City.
Canadian (North Fork)	Woodward.
Canadian (North Fork)	El Reno.
Cimarron	Garrett.
Cimarron	Waynoka.
Elk Creek	Hobart.
Horse Creek	Mountain Park.
Otter Creek	Mountain Park.
Otter Creek (Dry Fork)	Mountain Park.
Red (Elm Fork)	Mangum.
Red (North Fork)	Granite.
Red (North Fork)	Headrick.
Red (Salt Fork)	Mangum.
Turkey Creek	Olustee.
Washita	Anadarko.
OREGON.	
Ana	Summerlake.
Bear Creek	Silverlake.
Bridge Creek	Silverlake.
Bully Creek	Vale.
Bully Creek	Warm Springs, near Vale.
Chewaucan	Paisley.
Clackamas	Barton.
Deschutes	Lava.
Deschutes	Bend.
Deschutes (East Fork)	Odell.
Deschutes (West Fork)	Lava.
Grande Ronde	Elgin.
Grande Ronde	Hilgard.
Hood	Winans City.
John Day	McDonald.
Klamath	Keno.
Klamath Lake	Pelican.
Link	Klamath Falls.
Lost	Merrill.
Luckiamute	Suver.
McKenzie	Hendricks Ferry.
Malheur Lake	The Narrows.
Malheur	Vale.
Malheur	Ontario.
Malheur	McLaughlins Bridge, Vale.
Malheur	22 miles above Vale.
Malheur (Middle Fork)	Riverside.
Miller Creek	Lorella.
Molalla	Dickey Prairie.
Owyhee	Owyhee.

River.	Station.
OREGON—continued.	
Powder	Baker City.
Rock Creek	Arlington.
Rogue	Gold Ray.
Santiam	Jefferson.
Santiam (North Fork)	Mehama.
Santiam (South Fork)	Waterloo.
Siletz	Siletz.
Silver Creek	Riley.
Silver Creek	Silverlake.
Silver Lake	Silverlake.
Silvies	Burns.
Silvies	Silvies.
Summer Lake	Summerlake.
Sycan	Silverlake.
Tule Lake	Merrill.
Umatilla	Gibbon.
Umatilla	Umatilla.
Umatilla	Yoakum.
Umpqua (North Fork)	Oakcreek.
Umpqua (South Fork)	Brockway.
Walla Walla	Milton.
Walla Walla (South Fork).	Milton.
Wallowa Lake	Joseph.
Wallowa	Elgin.
Wallowa	Joseph.
Wallowa	Wallowa.
Willamette	Albany.
Willamette (Coast Fork).	Goshen.
Willamette (Middle Fork).	Jasper.
Willow Creek	Dell.
Willow Creek	Malheur.
Willow Creek	Arlington.
Yamhill (South Fork)	Sheridan.
PENNSYLVANIA.	
Allegheny	Kittanning.
Blacklick Creek	Blacklick.
Casselman	Confluence.
Juniata	Newport.
Kiskiminitas	Salina.
Laurel Hill Creek	Confluence.
Monongahela	Lock No. 4.
Susquehanna	Harrisburg.
Susquehanna	McCall Ferry.
Susquehanna	Danville.
Susquehanna (West Branch).	Williamsport.
Youghiogheny	Confluence.
SOUTH CAROLINA.	
Broad	Alston.
Savannah	Woodlawn.
Saluda	Waterloo.
Seneca	Clemson College.
Tugaloo	Madison.
Wateree	Camden.
SOUTH DAKOTA.	
Beaver Creek	Edgemont.
Belle Fourche	Bellefourche.
Box Elder Creek	Blackhawk.
Cheyenne	Edgemont.
Corbin and Morse Ditch	Rapid City.
Grand	Seim.
Hat Creek	Edgemont.
Missouri (Little)	Camp Crook.
Owl	Bixby.
Rapid Creek	Rapid.
Red Water	Bellefourche.
Redwater Canal	Minnesela.
Spearfish Creek	Spearfish.
Spring Creek	Rapid.
White	Interior.

Gaging stations, by States, maintained during fiscal year 1905–6—Continued.

River.	Station.
TENNESSEE.	
Duck	Columbia.
Hiwassee	Reliance.
Holston	Rogersville.
Holston (South Fork)	Bluff City.
Nolichucky	Greeneville.
Ocoee	McKays.
Pigeon	Newport.
Tennessee	Chattanooga.
Tennessee	Knoxville.
Tennessee (Little)	McGhee.
Watauga	Elizabethton.
TEXAS.	
Brazos	Richmond.
Brazos	Waco.
Colorado	Austin.
Colorado	Columbus.
Devils	Devilsriver.
Guadalupe	Cuero.
Guadalupe	Victoria.
Marguerretta Flume	Pecos.
Neches	Evadale.
Neches	Emporia.
Pecos	Moorhead.
Pecos	Pecos.
Red	Arthur City.
Rio Grande	Eagle Pass.
Rio Grande	El Paso.
Rio Grande	Langtry.
Rio Grande	Above Presidio.
Rio Grande	Below Presidio.
Rio Grande	Below mouth of Devils River.
Sabine	Longview.
Trinity	Dallas.
Trinity	Riverside.
UTAH.	
American Fork	American Fork.
Bear	Collinston.
Blacksmith Fork	Hyrum.
Blacksmith Fork Aqueduct	Hyrum.
Chalk Creek	Coalville.
Green	Greenriver.
Green	Jensen.
Green	Ouray.
Hobble Creek	Springville.
Indian Creek	Strawberry Valley.
Logan	Logan.
Lost Creek	Croydon.
Price	Helper.
Provo	Mouth of canyon, Provo.
Provo	Above Telluride Power Company's Flume, Provo.
San Pitch	Gunnison.
Sevier	Gunnison.
Sevier	Marysvale.
Spanish Fork	Lake Shore.
Spanish Fork	Spanish Fork.
Strawberry Creek	Strawberry Valley.
Weber	Devils Slide.
Weber	Oakley.
Weber	Plain City.
White	Dragon.
VERMONT.	
Otter Creek	Middlebury.
Winooski	Richmond.
VIRGINIA.	
Appomattox	Mattoax.
Banister	Houston.
Cooks Creek	Mount Crawford.
VIRGINIA—continued.	
Dan	South Boston.
Elk Run	Elkton.
Hawksbill Creek	Luray.
James	Buchanan.
James	Cartersville.
James	Holcomb Rock.
James (North Branch)	Glasgow.
Lewis Creek	Staunton.
New	Radford.
Passage Creek	Buckton.
Roanoke	Roanoke.
Roanoke	Randolph.
Shenandoah (North Branch).	Riverton.
Shenandoah (South Branch).	Front Royal.
South	Basic.
WASHINGTON.	
Asotin Creek	Shelman's ranch, Asotin.
Asotin Creek	Power House, Asotin.
Atanum Creek	North Yakima.
Cedar	Ravensdale.
Clealum	Roslyn.
Clealum Lake	Roslyn.
Chelan Lake	Chelan.
Chelan	Lake Chelan.
Columbia	Julia.
Columbia	Pasco.
Cow Creek	Keystone.
Grande Ronde	Zindel.
Hangman Creek	Tekoa.
Hangman Creek	Poole's ranch, Tekoa.
Hangman Creek (North Fork).	Tekoa.
Kachess	Easton.
Kachess Lake	Easton.
Keechelus Lake	Martin.
Methow	Pateros.
Naches	Nile.
Naches	North Yakima.
Naches	Below mouth of Tieton, near North Yakima.
Palouse	Elberton.
Palouse	Hooper.
Rock Creek	St. John.
Salmon Creek	Malott.
Skykomish (South Fork)	Index.
Snoqualmie	Snoqualmie Falls.
Spokane	Spokane.
Tieton	North Yakima.
Tieton	Dam site, North Yakima.
Wenache	Cashmere.
Yakima	Kiona.
Yakima	Martin (Lake Keechelus).
Yakima	Prosser.
Yakima	North Yakima (Selah Gap).
Yakima	Yakima (Union Gap).
WEST VIRGINIA.	
Cheat	Morgantown.
Greenbrier	Alderson.
Ohio	Wheeling.
Opequon	Martinsburg.
Potomac (North Branch)	Piedmont.
Potomac (South Branch)	Springfield.
Shenandoah	Millville.
WISCONSIN.	
Black	Neillsville.
Chippewa	Eau Claire.
Flambeau	Ladysmith.

Gaging stations, by States, maintained during fiscal year 1905–6—Continued.

River.	Station.	River.	Station.
WISCONSIN—continued.		WYOMING—continued.	
Oconto	Stiles.	Fall Creek	Fayette.
Peshtigo	Crivitz.	Green	Greenriver.
Wisconsin	Merrill.	Laramie	Jelm.
Wisconsin	Necedah.	Newfork	Cora.
Wisconsin	Rhinelander.	North Platte	Alcova.
Wolf	Northport.	North Platte	Guernsey.
Wolf	Shawano.	North Platte	Pathfinder.
		North Platte	Saratoga.
WYOMING.		Pine Creek	Pinedale.
		Piney Creek	Kearney.
Bighorn	Thermopolis.	Pole Creek	Fayette.
Boulder Creek	Boulder.	Shoshone	Cody.
Boulder Creek	Newfork.	Shoshone (South Fork)	Marquette.
Eastfork	Newfork.	Snake (South Fork)	Moran.

The total number of river stations maintained in the fiscal year 1902–3 was 519; in 1903–4, 639; in 1904–5, 754; in 1905–6, 817.

RIVER SURVEYS.

Surveys to determine the slopes of streams were made during the year on the following-named rivers: Penobscot, Moose, and Androscoggin, in Maine; Roanoke, in Virginia; Black, Flambeau, and Wisconsin, in Wisconsin.

SPECIAL INVESTIGATIONS.

Investigations were conducted which led to reports on the following special problems: The flow of water over standard and broad-crested weirs; the use of turbines as water meters; the flow of water under an ice cover; unusual and excessive floods of the year. Progress was made in the investigation of the effect of forestation upon run-off and of the movement and control of the débris of hydraulic mining in the basin of Sacramento River.

COOPERATION WITH STATES.

Cooperative arrangements for hydrographic work were made with eight States. The State Survey Commission of Maine allotted $3,500; the forestry commission of New Hampshire, $300; the State of Wisconsin, $1,250; the State of California, $10,000; the State of Oregon, $2,500; the State geologist of Maryland, a sum sufficient to pay all gage readers in that State; and the State engineers of Nebraska and Nevada, each a sum sufficient to pay for the services of a hydrographer who devoted his time to stream gaging.

PUBLICATIONS.

The following water-supply papers were issued:

124. Report of progress of stream measurements for the calendar year 1904, pt. 1, Atlantic coast of New England drainage.

125. Report of progress of stream measurements for the calendar year 1904, pt. 2, Hudson, Passaic, Raritan, and Delaware River drainages.

127. Report of progress of stream measurements for the calendar year 1904, pt. 4, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.

128. Report of progress of stream measurements for the calendar year 1904, pt. 5, eastern Mississippi River drainage.

129. Report of progress of stream measurements for the calendar year 1904, pt. 6, Great Lakes and St. Lawrence River drainages.

130. Report of progress of stream measurements for the calendar year 1904, pt. 7, Hudson Bay and Minnesota, Wapsipinicon, Iowa, Des Moines, and Missouri River drainages.

131. Report of progress of stream measurements for the calendar year 1904, pt. 8, Platte, Kansas, Meramec, Arkansas, and Red River drainages.

132. Report of progress of stream measurements for the calendar year 1904, pt. 9, western Gulf of Mexico and Rio Grande drainages.

133. Report of progress of stream measurements for the calendar year 1904, pt. 10, Colorado River and Great Basin drainages.

134. Report of progress of stream measurements for the calendar year 1904, pt. 11, the Great Basin and Pacific Ocean drainages in California.

135. Report of progress of stream measurements for the calendar year 1904, pt. 12, Columbia River and Puget Sound drainages.

147. Destructive floods in the United States in 1904.

150. Weir experiments, coefficients, and formulas.

156. Water powers of northern Wisconsin.

165. Report of progress of stream measurements for the calendar year 1905, pt. 1, Atlantic coast of New England drainage.

166. Report of progress of stream measurements for the calendar year 1905, pt. 2, Hudson, Passaic, Raritan, and Delaware River drainages.

167. Report of progress of stream measurements for the calendar year 1905, pt. 3, Susquehanna, Gunpowder, Patapsco, James, Roanoke, Cape Fear, and Yadkin River drainages.

168. Report of progress of stream measurements for the calendar year 1905, pt. 4, Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.

169. Report of progress of stream measurements for the calendar year 1905, pt. 5, lower eastern Mississippi and Ohio River drainages.

171. Report of progress of stream measurements for the calendar year 1905, pt. 8, Hudson Bay and upper eastern and western Mississippi River drainages.

The following papers are in press:

162. Destructive floods in the United States in 1905.

170. Report of progress of stream measurements for the calendar year 1905, pt. 6, Great Lakes and St. Lawrence River drainages.

172. Report of progress of stream measurements for the calendar year 1905, pt. 8, Missouri River drainage.

173. Report of progress of stream measurements for the calendar year 1905, pt. 9, Meramec, Arkansas, Red, and lower western Mississippi River drainages.

174. Report of progress of stream measurements for the calendar year 1905, pt. 10, western Gulf of Mexico and Rio Grande drainages.

176. Report of progress of stream measurements for the calendar year 1905, pt. 12, Great Basin drainage.

178. Report of progress of stream measurements for the calendar year 1905, pt. 14, Columbia River and Puget Sound drainages.

180. Turbine water-wheel tests and power tables.

DIVISION OF HYDROLOGY.

The scope of the activities of this division remained unchanged during the fiscal year, its work including the investigation of the occurrence and development of underground waters. The two sections, the eastern and the western, had the same areas as in the previous year, the field of the first embracing the States east of Mississippi River and those bordering that river on the west, and that of the second including the so-called reclamation States and Territories and Texas.

COOPERATION WITH STATES.

There was less cooperative work with State organizations than in previous years, altho such work was conducted in a number of localities. In Connecticut the State survey aided in the investigation of underground waters by contributing information for a geologic map and otherwise assisting in the work. In Virginia the State survey cooperated in an investigation of the wells and springs, and a preliminary paper is expected to appear as a State report. In North Carolina both State and United States surveys worked on the underground waters under an arrangement whereby duplication of work is avoided. The Geological Survey of Georgia continued to act with this Survey in certain investigations, while a cooperative report was prepared with Alabama. Active field cooperation was continued in Iowa, the detailed investigation of the underground waters being nearly completed at the end of the year. Field cooperation in the study of the underground waters east of St. Louis was begun with the Illinois Geological Survey.

GENERAL INVESTIGATIONS.

The work of collecting well records and samples, the methods of which were described in detail in the report of the last fiscal year, was continued under the same plan. The work was extended during the year to nearly every State and Territory, especial attention being given to wild-cat wells and to wells in relatively little known fields. Borings for oil and gas as well as for water are included in the scope of this work. Nearly 2,000 records have been studied, and upward of 12,000 samples, including sets from about 900 wells and borings, have been examined, classified, labeled, and filed. The furnishing of expert advice to those applying for information concerning the occurrence of oil, gas, and artesian water, and for the interpretation of samples and records, was, as in the previous year, one of the most important parts of the work. The Survey was called upon by numerous State surveys, including Maryland, Alabama, Michigan, Kentucky, Iowa, Missouri, and Illinois, to supply records, and by the Geological Survey of Canada to furnish information as to the methods and appliances for collecting logs and samples.

Statistics of production and value of table and medicinal waters were collected for publication in the annual volume, Mineral Resources of the United States. A report on the occurrence, uses, and output of carbon dioxide was also compiled for publication.

The work on the general bibliography of underground-water papers appearing before 1905 was continued during the year, such time being devoted to it as could be spared from other work. It is hoped that it can be completed during the present fiscal year. In the meantime bibliographies of the current literature are being prepared, one covering all publications appearing in the United States in 1905 having already been submitted for publication.

The compilation of tables relating to the discharge of wells, composition of water, and numerous other problems encountered in underground-water investigation was completed, with the exception of certain discharge tables which are awaiting the results of experimental investigations on the relation of flow to height of jet now being conducted at the laboratories of Cornell University.

A general investigation of the methods of deep drilling in the various States in the East and in Texas, Oklahoma, and Kansas was made during the year, and the results were compiled for publication.

EASTERN SECTION.

WORK BY STATES.

Maine.—The collection of well, spring, and city water-supply statistics was completed and a detailed investigation of the geologic occurrence of water in granites, slates, limestones, and clays was begun.

New Hampshire.—The water supplies of the drift, including clays, river gravels, and drumlins, have been investigated in the southeastern portion of the State.

Massachusetts.—Studies of underground-water conditions in the Cape Cod region were conducted during the year. In the investigation of these certain problems of geologic correlation arose, which demanded the examination of areas outside the limits of the country. To supply this information, two members of the section visited Nova Scotia, Newfoundland, and Labrador, at private expense.

Connecticut.—Special attention was given to the occurrence of waters in the crystalline rocks of the State, with the object of obtaining accurate information on a number of points in regard to which there was general misapprehension on the part of the people. These included the prospects of obtaining water, the quantity and quality of the supply, the head in the wells, the most favorable locations for drilling, the depth to be drilled, etc.

New York.—Work on the mineral springs of the State, begun in 1903, was continued, a considerable amount of additional information was procured by correspondence, and much of the report was prepared.

Virginia.—The data collected in the previous fiscal year were compiled as a statistical report on wells and springs, to be published according to plans of cooperation by the State Geological Survey. A field investigation was also made of the underground waters of the Triassic rocks near Manassas.

North Carolina.—A party spent several months in the fall of 1905 in a study of the artesian waters in the Coastal Plain region about Wilmington and directed drilling operations in that region. A paleontologic study to determine the stratigraphy and structure of the water-bearing deposits was also taken up in June in connection with the work of the geologic branch, while another party investigated the waters of the Piedmont Plateau. Special investigations were also made of the ground-water conditions at Tarboro and Pinehurst.

South Carolina.—Portions of the Coastal Plain region in the northeastern part of the State were examined in connection with the studies of the underground waters of the Wilmington region of North Carolina.

Georgia.—The investigations in this State were limited to an examination of the mineral springs at Austell and of the large springs in Chickamauga Park and at Albany, to the study of blowing wells and springs, and to the investigation of the pollution of the water supply at Fort Oglethorpe in Chickamauga Park.

Florida.—A study of the practise and results of draining wet lands by wells and of the disposal of sewage thru borings was begun.

Alabama.—Field work was completed and a report prepared on the artesian waters of Alabama. This will be published as a State report.

Mississippi.—A report on the artesian waters of the State was completed and submitted for publication.

Tennessee and Kentucky.—A report on the underground waters of the Mississippi embayment area, or the territory lying west of Tennessee River, was finished and will be published as a water-supply paper.

Arkansas.—Field work on the underground waters in northeastern Arkansas was completed and the preparation of a report begun.

Missouri.—The examination of the underground waters was completed early in the fiscal year and a report prepared and submitted for publication.

Iowa.—Considerable work was done on the artesian waters and the waters of the drift during the year. It is expected that it will be possible to complete these studies in 1906.

Minnesota.—Progress was made on the report which is being prepared by a local geologist on the underground waters of the State.

Michigan.—Two reports on the water supplies of the southern peninsula, based on joint work by the glacial division of the geologic branch and the eastern section of hydrology, and a short report on the underground waters of the northern peninsula were prepared.

Illinois.—A detailed study of the ground waters of the district opposite St. Louis was begun, in cooperation with the State Geological Survey, which will contribute a large number of analyses.

PUBLICATIONS.

The following publications were issued:

Water-Supply Paper 145. Contributions to the hydrology of eastern United States.
Professional Paper 44. Underground-water resources of Long Island, New York.

The following papers are in the hands of the printer:

Water-supply papers:
155. Fluctuations of water level in wells.
159. Summary of the underground-water resources of Mississippi.
160. Underground water papers.
163. Bibliographic review and index of underground-water literature published in the United States in 1905.
164. Underground-water resources of Tennessee and Kentucky west of Tennessee River and of an adjacent area in Illinois.
182. Flowing wells and municipal water supplies in the southern portion of the Southern Peninsula of Michigan.
183. Flowing wells and municipal water supplies in the northern and central portions of the Southern Peninsula of Michigan.
Professional paper:
46. Geology and underground waters of northern Louisiana and southern Arkansas.

WESTERN SECTION.

WORK BY STATES AND TERRITORIES.

Arizona.—No new field work was done in this Territory, but progress was made in the preparation of two reports on investigations of previous seasons. One of these relates to the northwest corner of the Territory, and the other to the High Plateau region eastward.

California.—The work in the southwestern portion of this State was continued during a portion of the year, and a detailed investigation was begun of the underground-water conditions in the San Joaquin Valley. The report on the underground-water supplies in Owens Valley was completed and transmitted for publication.

Colorado.—No new field work was done in this State, but several reports presenting results of investigations made during previous seasons were prepared. The most extensive of these relates to the Arkansas Valley artesian area and is now in press (Professional Paper No. 52). It contains maps showing the geology, depths to Dakota sandstone, wells, flow area, intake zone, and other features, and cross sections illustrating the underground relations. In the Nepesta folio,

recently published, there is a special sheet showing depths to water, area of flow, etc., in the region east of Pueblo.

The report on the artesian basin in the San Luis Valley is almost completed.

The report on the detailed investigation made of the underground waters and geologic structure of the Uncompahgre Valley is approaching completion. It will set forth the principal structural features and indicate all geologic conditions bearing on the underground-water problem.

Montana.—The geology of the Bighorn Mountains has been investigated and a report is now in press (Professional Paper No. 51). It has also been ascertained from the results of recent field work in the region north of the Black Hills that an artesian basin of great importance extends down the valley of Little Missouri River in the southeast corner of the State. The underground-water conditions in this area will be set forth in a report on the region north of the Black Hills, soon to be published.

Nebraska.—No new field work was done in this State, but reports on the artesian conditions in the northeastern and south-central portions of the State are being prepared and will soon be transmitted for publication.

New Mexico.—An extensive investigation has been made of the geologic structure in the south-central portion of the State, especially in the Rio Grande Valley and vicinity. Some of the results of this investigation have recently been prepared and transmitted for publication. A report on the Roswell artesian area is in press as Water-Supply Paper No. 158.

North Dakota.—Field work was continued in the Red River Valley artesian area and a portion of the country westward, especially with the view of preparing a general report on the underground waters of the State. The office work on the results has not yet been completed.

South Dakota.—The investigation of the underground-water conditions and geologic structure of the northern Black Hills region was continued and nearly completed. Progress was made in the preparation of the report on the results of this work, but additional data are required before it can be transmitted for publication. Work was also continued in the artesian area of the James River Valley, and the results of this investigation have been prepared for presentation in two folios, one comprising the Aberdeen, Northville, Redfield, and Lake Byron quadrangles, and the other the Elk Point quadrangle. These two folios contain a large amount of information regarding the underground-water conditions and are nearly ready for publication.

Texas.—During the last field season an investigation was made of the geology and underground-water conditions in the western half of the Panhandle. The El Paso folio has been completed and is ready

for publication. It contains a detailed account of the underground-water conditions in a portion of the Rio Grande Valley.

Utah.—The field work in this State consisted of a detailed investigation of the underground-water conditions in the Sevier and San Pete valleys. A report of the results of this investigation is in preparation.

Wyoming.—Three parties continued field work in this State, partly to complete investigations begun in previous seasons and partly to begin investigations in areas which had not before been examined. The study of the structure of the uplifted beds along the flanks of the Bighorn Mountains was continued southward to the end of the range and then westward in the Bridger and Owl Creek mountains to the end of the latter. The results were incorporated in part in the report on the Bighorn Mountains (Professional Paper No. 51) and in part in a report on the Owl Creek Mountains and adjoining regions (published as S. Doc. No. 219, 59th Cong., 1st sess.), which contains a large amount of information relating to the portion of the Shoshone or Wind River Reservation, which is to be opened for settlement this summer.

The examination of the Bighorn basin was continued southward to include all of the area to the foot of the Owl Creek and Bridger ranges, and the results were incorporated in the report prepared last year, which has been transmitted for publication.

An investigation of the geologic structure and its bearing on the underground-water conditions in the Laramie basin was begun and nearly completed, and an examination was made of a portion of the foothills of the Laramie Range west of Cheyenne.

The results of the work of previous seasons in the Wyoming portion of the northern Black Hills were prepared for incorporation in the report on the northern Black Hills region.

PUBLICATIONS.

The following reports were issued:

Water-supply and irrigation papers:

123. Geology and underground-water conditions of the Jornada del Muerto, New Mexico.

136. Underground waters of Salt River Valley.

137. Development of underground waters in the eastern coastal plain region of southern California.

138. Development of underground waters in the central coastal plain region of southern California.

139. Development of underground waters in the western coastal plain region of southern California.

142. Hydrology of San Bernardino Valley, California.

148. Geology and water resources of Oklahoma.

149. Preliminary list of deep borings in the United States, second edition.

154. The geology and water resources of the eastern portion of the Panhandle of Texas.

157. Underground waters in the valleys of Utah Lake and Jordan River, Utah.

The following publications are in press:

Water-supply papers:

158. Geology and water resources of the Roswell artesian basin, New Mexico.
181. Geology and water resources of Owens Valley, California.

Professional papers:

51. Geology of Bighorn Mountains.
52. Geology and underground waters of the Arkansas Valley in eastern Colorado.
53. Geology and water resources of the Bighorn basin in Wyoming.

DIVISION OF HYDRO-ECONOMICS.

The investigations and reports of this division are confined to the quality of water and its suitability for domestic and industrial uses. The waters in by far the greater part of the country contain ingredients varying in amount, character, and degree of harmfulness. To secure the highest development of water resources it is necessary to determine these characteristics and to classify the waters according to their favorable or unfavorable effects upon different kinds of manufactured products and upon the health of the people.

WORK BY STATES.

Maine.—Analyses were made of daily samples of water from Androscoggin River for study of the effect of sulphite pulp wastes upon the water.

Massachusetts.—Investigations were made to determine the best methods of treatment of sulphite wood pulp wastes and strawboard wastes. The work was done in cooperation with the laboratory of sanitary research of the Massachusetts Institute of Technology.

New York.—The study of interstate pollution in the Hoosick drainage area was completed and investigation was made of the character of ground waters in the central part of the State.

Pennsylvania.—Unpolluted samples were collected in the eastern part of the State and examined for the purpose of constructing a normal chlorine map; in the Allegheny and Monongahela drainage areas a study was made of stream pollution and of the quality of water available for domestic and industrial purposes.

New Jersey and Delaware.—Unpolluted waters were collected and examined in order to obtain data for a normal chlorine map.

Maryland, Virginia, and West Virginia.—An investigation was made of the causes and effects of stream pollution in the Potomac River basin, and unpolluted waters were collected and sampled in order to determine the normal chlorine content.

Ohio.—Under cooperative agreement with the Ohio State board of health, investigations were carried on to ascertain the damage caused by various industrial wastes upon the water-supply resources of the State, and experiments were made to determine the best methods of purifying and recovering valuable ingredients in acid-iron wastes, dye

wastes, and distillery slops. Investigations were made, also, of the efficiency of sewage-disposal plants and of the effects of the effluents upon streams and of the persistence of such ingredients in various rivers.

Kentucky.—Underground waters of the Blue Grass region were analyzed in order to determine their adaptability for household and industrial uses.

Illinois.—Preliminary investigations and negotiations were carried on preparatory to the execution of a cooperative agreement with the State water survey, the State board of health, the State Geological Survey, and the engineering experiment station of the University of Illinois.

Iowa.—An investigation was made of the character of ground waters from various water-bearing strata thruout the State for the purpose of determining the suitability of the waters for use in boilers and for manufacturing purposes. This work included a study of the methods of treatment necessary to make such water satisfactory for domestic and industrial purposes.

Minnesota.—Under a cooperative agreement with the State board of health, the field work for an investigation of the character of surface waters was completed and the report has been prepared in part.

Louisiana.—Analyses have been made of daily samples of water taken from Mississippi River above New Orleans for the purpose of determining the total amount of denudation in the Mississippi River system.

California.—Under a cooperative agreement with the State board of examiners and under an appropriation provided by the California general assembly, daily samples of water from the principal streams of the State were examined. The purpose of the work was to determine the amount and variability of the objectionable ingredients in the waters of the State, to ascertain the best methods of treatment, and to determine the seasons of the year during which the waters may best be impounded for domestic and manufacturing purposes.

PUBLICATIONS.

The following water-supply papers were issued:

144. The normal distribution of chlorine in the natural waters of New York and New England.

151. Field assay of water.

152. A review of the laws forbidding pollution of inland waters in the United States, second edition.

The following papers are in press:

161. Quality of water in the upper Ohio River basin and at Erie, Pa.

179. Prevention of stream pollution by distillery refuse.

PUBLICATION BRANCH.

EDITORIAL DIVISION.

SECTION OF TEXTS.

There were engaged in the work of the textual section of the editorial division about the same number of persons as last year—7 all of the time and 2 others much of the time—and the amount of work done was approximately the same, viz:

Manuscript pages edited, 35,131 (last year, 37,026), consisting of 1 Survey annual report, 1 Reclamation annual report, parts of 2 mineral resources annuals, 1 monograph, 8 professional papers, 24 bulletins, 30 water-supply papers, 15 geologic folios, and miscellaneous matter.

Proof read, final pages, 17,936 (last year, 18,382), consisting of 1 Survey annual report, 1 Reclamation annual report, parts of 2 mineral resources annuals, 13 professional papers, 18 bulletins, 41 water-supply papers, 13 geologic folios, and miscellaneous matter. These publications required the handling of 7,861 galley proofs and 32,256 page proofs (handled last year, 7,449 galley proofs and 33,415 page proofs).

Indexes prepared, 15,034 pages (last year, 15,530), for 1 Survey annual report, 2 Reclamation annual reports, 1 mineral resources annual, 12 professional papers, 16 bulletins, 37 water-supply papers, and miscellaneous matter.

In addition to performing the above-noted work on the regular series of publications, this section examined the copy and proofs of all account and record books and blanks, circulars, office cards, etc., and during the last five months of the fiscal year a considerable portion of the editor's time was given to the work of the assistant committee on editorial methods in the Departments.

SECTION OF GEOLOGIC MAPS.

At the beginning of the year work was in progress on 10 folios, all of which have since been published, and 12 others were on file. Four of these (Bald Mountain, Cloud Peak, Dayton, and Fort McKinney) have been combined into two double folios, and the Lancaster, Wis., has been combined with the Mineral Point folio. During the year 12 folios were transmitted to the section for publication, and 14 (Nos. 126 to 139, inclusive), as listed in the following table, were completed and issued:

Geologic folios issued during the fiscal year ending June 30, 1906.

No.	Name of folio.	State.	Mineral products occurring in area of folio.	Limiting meridians.	Limiting parallels.	Area.	Price.
						Sq. miles.	*Cents.*
126	Bradshaw Mountains	Arizona	Gold, silver, copper, iron, building stone, onyx marble.	112°–112° 30′	34°–34° 30′	986	25
127	Sundance	Wyoming, South Dakota.	Gold, tin, silver, lead, coal, gypsum, bentonite, underground water.	104°–104° 30′	44°–44° 30′	857	25
128	Aladdin	Wyoming, Montana, South Dakota.	Underground water, coal, gypsum, lime	104°–104° 30′	44° 30′–45°	849	25
129	Clifton	Arizona	Copper, iron, lead, gold, kaolin	109° 15′–109° 30′	33°–33° 15′	250	25
130	Rico	Colorado	Gold, silver, zinc, lead, building stone, lime	108°–108° 15′	37° 30′–37° 45′	236	25
131	Needle Mountains	do	Gold, silver	107° 30′–107° 45′	37° 30′–37° 45′	236	25
132	Muscogee	Indian Territory	Oil, coal	95°–95° 30′	35° 30′–36°	969	25
133	Ebensburg	Pennsylvania	Coal, clay, shale, building stone, underground water.	78° 30′–78° 45′	40° 15′–40° 30′	228	25
134	Beaver	do	Clay, coal, oil, gas, building stone	80° 15′–80° 30′	40° 30′–40° 45′	227	25
135	Nepesta	Colorado	Cement, iron, oil, gas, gravel	104°–104° 30′	38°–38° 30′	938	25
136	St. Marys	Maryland, Virginia	Clay, gravel, underground water	76°–76° 30′	38°–38° 30′	938	25
137	Dover	Delaware, Maryland, New Jersey.	Clay, marl, gravel, underground water	75° 30′–76°	39°–39° 30′	925	25
138	Redding	California	Gold, silver, copper, chromite, iron, lime, building stone.	122°–122° 30′	40° 30′–41°	906	25
139	Snoqualmie	Washington	Coal, iron, gold, silver	121°–121° 30′	47°–47° 30′	812	25

On June 30, 1906, 7 folios were in process of engraving and 11 were on file awaiting publication. The following tables give the names of these folios and the stage of progress each of those in process of engraving has attained:

Geologic folios in process of engraving, June 30, 1906.

Name.	Stage.
Amity, Pa	Engraving begun.
Bald Mountain-Dayton, Wyo	Maps being printed.
Cloud Peak-Fort McKinney, Wyo	Maps being printed.
Devils Tower, Wyo.-Mont	Engraving begun.
Lancaster-Mineral Point, Wis	Engraving begun.
Milwaukee Special, Wis	Engraving begun.
Nantahala, N. C.-Tenn	Color stones in preparation.

Geologic folios awaiting engraving, June 30, 1906.

Ann Arbor, Mich.
Elk Point, S. Dak.-Nebr.-Iowa.
El Paso, Tex.
Joplin District, Mo.-Kans.
Ouray, Colo.
Patuxent, Md.-D. C.
Penobscot Bay, Me.
Pisgah, N. C.-S. C.
Roan Mountain, N. C.-Tenn.
Rogersville, Pa.
Santa Cruz, Cal.

SECTION OF TOPOGRAPHIC MAPS.

On July 1, 1905, there were in the editor's files 85 atlas sheets and special maps, 21 of which had been edited and approved for engraving. Of the 64 remaining, 2, Massena, N. Y., and Johnstown, Pa., were afterwards withdrawn for additional field work, leaving 62. As a result of the field season of 1905, 97 new maps were received, 2 others, Catatonk, N. Y., and Farmington, Conn., were reduced from published atlas sheets, and Milwaukee Special, Wis., was made by combining parts of 4 contiguous atlas sheets. Of these 162 maps (62+97+3), 94 were edited and approved for engraving, leaving 68 now in hand. Eighty-three unpublished atlas sheets were in the custody of the editor on June 30, 1906, and had not yet been transmitted to the engravers. Fifteen of these were edited and approved.

The detailed proof reading of 109 atlas sheets, engraved and published during the year, was done in this section, as well as the proof reading of the corrections, more or less extensive, to 185 sheets. Sixteen of the latter were extensively corrected and published with new edition dates.

The number of unpublished topographic maps in hand at the close of the year was 115, which is 11 less than last year. Of these, 23 are products of the field season of 1904, but their engraving is well advanced, while 9 of the maps surveyed in 1905 have been published.

The editor of topographic maps is required to revise the geographic nomenclature on all of the maps which go as illustrations into the book

publications of the Survey. During the year 243 of these map illustrations were examined.

The 18 mailing circulars, numbered 9–323, giving information concerning the topographic maps and folios published by the Survey, each illustrated by an index map, were all revised and reprinted during the year. Fourteen of them were revised and reissued twice each, and of the remaining 4, one edition of each was published. Besides these, index maps to illustrate 2 special circulars, showing results of "Cooperative topographic surveys," were prepared and proof read.

The Geographic Dictionary of Alaska, revised in this section and enlarged by more than 3,000 names and descriptions, is now in press as Bulletin No. 299.

DIVISION OF ENGRAVING AND PRINTING.

On July 1, 1905, there were reported on hand for engraving, manuscript atlas sheets and special maps to the number of 126. Two of these were afterwards withdrawn for additional field work, leaving 124. During the year, 97 new sheets were received from the topographic branch. Two were made by reduction and one by combination of published atlas sheets. This gives a total of 224 atlas sheets and special maps, grouped as follows:

Published during the year or in press at its close (double sheets counted as one)	109
In process of engraving at the close of the year	32
Not yet transmitted to the engravers	83

It appears, therefore, that at the close of the year there were in hand 115 unpublished atlas sheets and other maps, 11 less than last year, and that the engraving of 32 of these was in various stages of progress.

In addition to the engraving of new atlas sheets, corrections more or less extensive were made on the plates of 185 sheets. Editions of 298 sheets were printed and delivered during the year. Of these, 117 are new maps and 181 reissues, composed of 172 reprints and 9 maps bearing new edition dates.

During the year 14 geologic folios were published. In this number are 8 folios reported partly finished last year. The number now in hand partly completed is 10.

The need of photolithographic work has continually increased. In addition to that done in connection with the topographic branch, it is being extensively used for the work of the Reclamation Service. There is great need of more space in which to carry on this process and for the installment of additional apparatus.

The practise of making celluloid transfers, mentioned in the Twenty-fifth and Twenty-sixth annual reports, was continued this year, with uniformly satisfactory results.

The combined editions of the 14 geologic folios that were issued amounted to 60,227 copies, which required 2,611,400 printings. Of miscellaneous matter, such as map circulars, press bulletins, various blank forms, etc., there was necessarily a large amount printed, the number of copies being 652,926, which required 1,104,965 printings.

INSTRUMENT SHOP.

The work of the instrument shop consisted in overhauling and repairing surveying, drafting, and engraving instruments and in making copperplates and electrotypes. Upward of 1,200 repairs were made to instruments; 310 new copperplates and 23 electrotypes were finished.

ADMINISTRATIVE BRANCH.

EXECUTIVE DIVISION.

CORRESPONDENCE, RECORDS, APPOINTMENTS, SUPPLIES, AND SHIPMENTS.

Nearly every branch of the business mentioned under this head showed increase in volume.

Mails, files, and records.—There were received during the year 116,420 pieces of first-class mail. The recording and filing of the correspondence required the services thruout the year of two clerks.

Appointments, attendance, etc.—The number of changes of all kinds in the personnel was 1,160; during the preceding fiscal year, 1,114; increase, 46. Among the changes were 224 permanent appointments and 458 promotions.

There are now on the rolls of the Survey and Reclamation Service, of persons holding appointments from the Secretary of the Interior, 1,068 names, a net increase since June 30, 1905, of 76.

The attendance work has kept pace in volume with the development of the Bureau along other lines. Several changes were introduced during the year with a view to perfecting the system of recording absences and to obtaining from the several divisions of the Bureau more complete and reliable returns of attendance. The principal change was the adoption of a new form of record card, substantially the same card that had for some time been in use in most of the other bureaus of the Department.

Of applications for sick leave, there were 648, and of applications for leave without pay, 187, a total of 835, as compared with 800 handled during the previous year.

Property accountability.—The system of property accounting of the Geological Survey and the Reclamation Service underwent no radical change during the year, but an improvement tending to more accurate accounting was introduced.

On December 8, 1905, a committee was appointed, with the chief clerk as chairman, to pass upon the validity of affidavits pertaining to lost property in the field. This committee has placed before it the body of the affidavits only, the name of the affiant and location being omitted, in order that an impartial decision may be rendered. The findings of this committee are subject only to the review of the Director.

During the process of compiling property returns, 34,044 vouchers of disbursing agents were examined, together with the many accompanying subvouchers. An increase over last year of 11,947 vouchers is shown, and an increase in the volume of the work of 54 per cent.

The work connected with the preparation of abstracts of purchase, abstracts of property relieved of, and property returns of the Survey for the last fiscal year increased 6 per cent; for the Reclamation Service the increase was 41 per cent.

The amount of money derived from the sale at public auction of property examined by inspectors and found unserviceable was $4,667.58; during the preceding fiscal year $3,787.49 was received from the same source; increase, $880.09, or 23 per cent.

Preparation of vouchers.—There were 1,774 vouchers prepared for signature—no material increase over last year, a fact due to consolidation of all appropriations, with few exceptions, on one abstract of disbursements, which allows the describing of several appropriations on one voucher.

Purchase and distribution of supplies.—The work of this sort done during the year has been summarized as follows: Applications to Secretary of Interior for authority to purchase (involving an expenditure of $93,478.70), 284; requisitions drawn on Department for miscellaneous supplies, 495; requisitions filled from stock on hand, 662; orders drawn on dealers and others, 2,899; bills received and checked, 3,114.

Express, freight, and registered mail.—During the latter part of the year an improvement was made in the Survey bill of lading by reducing its size and attaching a coupon, to be detached by the consignee, advising the office of the shipment and the amount of the charges. It was also determined to extend the use of these bills of lading to express as well as freight shipments.

The amount of work performed is indicated by the following items: Freight and express, pieces shipped, 1,511; pieces received, 4,437; total, 5,948. Registered mail: Pieces forwarded, 9,305; pieces received, 2,358; total, 11,663. Accounts checked, 534.

The Reclamation freight and express accounts were formerly checked in this section but are now sent to the Reclamation Service direct.

Stationery.—In the stationery room the services of two men are required for the delivery of supplies thruout the office and for the

wrapping and shipping of the same to the field parties. During the year 7,326 requisitions for blanks, blank books, and miscellaneous supplies were filled, and 948 requisitions were drawn on the Department, 564 being for printing and blank books and 384 for stationery supplies.

Miscellaneous.—Miscellaneous work consisted in securing custom-house entries, tracing shipments, issuing bills of lading, obtaining bids for supplies, making mimeograph copies of letters and circulars for the use of all branches of the Survey, etc.

SECTION OF DOCUMENTS.

There were delivered to this section during the year 145 new documents, 129 new maps, and 172 reprints of maps, a total of 446. They were: Twenty-sixth Annual Report; Monographs XXXII (atlas only), XLVII, XLVIII; Professional Papers Nos. 32, 34, 36, 38, 40–45, 47–49; Bulletins Nos. 150 (second edition), 176 (second edition), 208 (second edition), 243, 247, 251, 256, 257, 263, 265–274, 276, 278, 280, 281, 288; Water-Supply and Irrigation Papers Nos. 123–125, 127–154, 157, 165–169, 171; geologic folios Nos. 118, 121–135; Mineral Resources of the United States, 1904, and 42 separates therefrom; 4 separates from Mineral Resources of the United States, 1905; 3 miscellaneous publications; 301 topographic maps, the total combined editions of atlas sheets numbering 699,403; 6 photolithographic maps, the total editions numbering 4,642.

During the year 389,359 volumes, 65,975 folios, and 522,936 maps were sent out.

The total amount received and turned into the Treasury as a result of sales of publications was $17,634.89, an increase of $3,594.89, or more than 25 per cent, over the amount received during the preceding year. The use of Survey publications in schools and colleges seems to be increasing.

During the year 78,976 letters were received and answered (the preceding year 61,251), an increase of about 29 per cent.

DIVISION OF DISBURSEMENTS AND ACCOUNTS.

A summarized statement of disbursements follows. The chief disbursing clerk of the Survey acted also during the year as chief disbursing officer of the Reclamation Service.

Analysis of disbursements.

Geological Survey, 1906:		
Salaries of scientific assistants	$29,122.21	
Skilled laborers and temporary employees	19,997.84	
Salaries Office of Geological Survey	31,161.29	
Paleontology	9,575.42	
Chemical and physical researches	19,188.24	
Preparation of illustrations	16,773.19	
Books for the library	1,605.97	
Gaging streams	175,453.74	
Steel book stacks for library	5,683.35	
		$308,561.25
Geological Survey, 1905–6:		
Topographic surveys	337,568.48	
Geologic surveys	190,925.95	
Mineral resources of the United States	95,347.15	
Mineral resources of Alaska	78,943.25	
		702,784.83
Geological maps of the United States, 1906		98,272.55
Surveying forest reserves, 1905–6		128,196.75
Testing fuel		159,452.07
Testing structural materials		7,144.17
		1,404,411.62

FINANCIAL STATEMENT.

Amounts appropriated for and expended by the United States Geological Survey for the fiscal year ending June 30, 1906.

	Geological Survey, 1906.	Geological Survey, 1905–6.	Geological maps of the United States, 1906.	Surveying forest reserves, 1905–6.	Testing fuel.	Testing structural material.	Total.
Amount appropriated by act of March 3, 1905, and February 27, 1906	$339,920.00	$730,000.00	$100,000.00	$130,000.00			$1,299,920.00
Balance brought forward from previous report					$178,340.31	$7,221.07	185,561.38
Total	339,920.00	730,000.00	100,000.00	130,000.00	178,340.31	7,221.07	1,485,481.38
Amounts expended, classified as follows:							
Services	250,826.99	473,261.25	81,006.13	80,640.89	117,596.49	4,851.80	1,008,183.55
Traveling expenses	25,347.50	84,142.62	141.76	3,917.80	7,027.70	1,013.46	121,590.84
Field expenses, subsistence, and supplies	13,565.12	125,112.29		40,774.69	30,268.07	959.50	210,679.67
Instruments	4,599.45	4,845.18		871.50	2,062.27	13.50	12,391.90
Laboratory material	3,365.45	566.41			970.60	137.85	5,040.31
Photographic material	1,597.90	1,006.17			5.75		2,609.82
Books and maps	1,499.42	279.46			43.74		1,822.62
Stationery and drawing material	837.18	2,825.36		157.47	699.16	103.05	4,622.22
Illustrations for reports	287.25						287.25
Office supplies, repairs, and equipment	5,946.82	349.76		6.96	462.71	40.55	6,806.80
Correspondence	186.46	1,189.95	16.12	171.44	288.58	24.46	1,877.01
Material for engraving and printing maps			17,108.13				17,108.13
Railroad accounts settled by Treasury Department:							
Passenger	193.45	2,382.75		399.77			2,975.97
Freight	308.26	6,823.63	.41	1,256.23	27.00		8,415.53
Total expenditures	308,561.25	702,784.83	98,272.55	128,196.75	159,452.07	7,144.17	1,404,411.62
Balance unexpended July 1, 1906	31,358.75	27,215.17	1,727.45	1,803.25	18,888.24	76.90	81,069.76
Probable amount required to meet outstanding liabilities	31,358.75	27,215.17	1,727.45	1,803.25	18,888.24	76.90	81,069.76

LIBRARY.

Periodicals.—Approximately 300 periodical publications are regularly received. These are recorded on cards as received, and completed volumes, when bound, are entered in the accession book.

Books accessioned.—There were recorded in the accession book, in which is kept the complete and permanent record of books that are permanently added to the library, 2,666 books, making the total number of books entered 61,346.

Cataloguing.—The work of cataloguing the publications of the various State geological surveys has been continued. With the exception of those of New York, Pennsylvania, Kansas, California, and Washington, all these State publications have been catalogued and cards have been printed by the Library of Congress. The publications of the geological surveys of Sweden and Norway have also been catalogued. Some cataloguing has been done on the general geologic works, and the publications of this office have been catalogued as soon as received. All these manuscript cards are sent to the Library of Congress to be printed and distributed. A very large amount of duplication of cataloguing thruout the country is thus saved, the cards being sold at the cost of printing and of administration of the work. The sale of the Geological Survey cards is said to have greatly exceeded expectations. The total number of cards printed since this cooperative work was begun, on April 1, 1905, is 2,170.

Bibliographic work.—The annual bibliography and index of North American geology, paleontology, petrology, and mineralogy for 1904 was printed as Bulletin No. 271, and the regular edition as well as an extra edition of 500 copies is exhausted. The bibliography for 1905 is completed, and this material has been combined with the bibliographies for 1901, 1902, 1903, and 1904, the editions of which are exhausted, and the whole will be published as Bulletin No. 301.

Translations.—Letters in foreign languages received by the office, as well as a number of scientific articles, have been translated by members of the library force.

Purchase of books.—The appropriation of $2,000 for the purchase of material for the library has been fully expended. All purchases are made on the approval of the library committee except occasional material which is urgently needed.

Circular list of new publications.—During the year five lists have been published. An edition of 2,200 is being issued. These lists keep those most interested in the work of the office informed of what is being published and aid materially in thoroly and adequately distributing the publications.

Relations with other libraries.—The cooperative work, in cataloguing and printing cards, with the Library of Congress has been continued,

and books are borrowed from and loaned to other Government libraries. Conferences have been had with other librarians as to methods to prevent duplication of work and unnecessary duplication of purchases of books. It is expected that definite plans will be adopted in the near future.

Foreign and domestic exchanges.—The greater part of the publications received in the library are obtained by exchange. All the book publications of this office are regularly sent to 400 foreign and 350 domestic exchanges. Four hundred and fifty sets of the map publications are also distributed. Considerable additions to the library are received from those to whom circular lists of new publications are sent and who select the particular publications desired. The lists, containing more than 3,000 addresses, are kept up to date in the library.

New steel book stacks and map cases.—Double-floor steel stacks, having a capacity of 20,000 books, and map cases to contain all the foreign and domestic reference maps have been installed and the books and maps are now in place. All the wooden stacks and map cases have been removed from the library. On account of the indemnity of $10 a day for nonperformance of contract there remained a balance of $1,018 of the appropriation unexpended. Contracts are now being made for additional pamphlet stacks and book and card stacks, which will require the expenditure of the greater part of this balance.

Committee work.—The librarian was appointed a member of one of the assistant committees to the committee on department methods—that on libraries—and spent considerable time on that work.

Field work.—From July 1 to October 10 the librarian was engaged in geologic field work in the West. During the winter months considerable time was given to the preparation of a report on the springs of New York State, which is now ready to be submitted for publication.

DIVISION OF ILLUSTRATIONS.

PHOTOGRAPHIC LABORATORY.

The increase in the output of the laboratory over last fiscal year is as follows: Glass negatives, 7½ per cent; lantern slides, 185 per cent; map prints, 4 per cent; mat prints, 2½ per cent.

Experiments have been started on collodion emulsion to replace and cheapen the wet-plate process at present used. The making of printing-out gelatine prints has been discontinued and developing paper substituted. By this means the uncertainty of sunlight is eliminated from the printing and prompt delivery insured.

A process has been introduced and improved for mounting prints dry by an electrically heated press, by which curling of the mount is entirely obviated. This process will be of great advantage in mounting the 6,000 prints which are to form the nucleus of the general geologic collection.

SECTION OF GRAPHIC ILLUSTRATIONS.

Illustrations to the number of 4,854, to accompany 74 publications, were prepared during the year, viz: Maps, 424; sections and diagrams, 941; paleontologic drawings, 2,740; photographs, 549; miscellaneous, 200.

At the close of the year the material to accompany 20 reports and papers was in hand, and a large number of the illustrations for these reports had been prepared.

Proofs to the number of 2,882 were received and examined critically, and the full printed editions of 176 plate inserts were examined at the Government Printing Office after delivery there by the contractors.

During the year 61 electrotypes were furnished to outside applicants.

INDEX.

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