Circular 56

# Geologic Research in New Mexico During 1959

by Frank E. Kottlowski

**NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY**

**E. J. Workman, President**

**STATE BUREAU OF MINES AND MINERAL RESOURCES**

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1960

STATE BUREAU OF MINES & MINERAL RESOURCES NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY

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## ABSTRACT

Geologic research projects pursued in New Mexico during 1959 totaled (with considerable grouping) 189, involving 159 workers and 41 organizations. Areal geologic mapping and ground-water studies led with 35 projects each, followed by stratigraphic investigations (19), and studies of metallic deposits (18). The northwestern quarter of the State was the most intensively studied, followed in order by the southwestern, southeastern, and northeastern quarters. Of the 159 geologists reporting, 79 were based within New Mexico, and 80 came from areas as far away as California and New York; the largest of these out-of-State workers were Federal employees from Denver. As shown by a survey of the major geologic journals (see bibliography), this geologic research resulted in at least 87 papers and 44 abstracts relating to facets of New Mexico geology.


## INTRODUCTION

This up-to-date compilation of geologic research "in process" in New Mexico is a response to many requests. Walter A. Mourant, U. S. Geological Survey Ground-Water Branch, initiated formal suggestions for this report, and Dr. Carlyle Gray, State Geologist of Pennsylvania, provided information as to the procedure and questionnaires used by the Pennsylvania Geological Survey in its annual report on geological research in that State.

Questionnaires sent throughout the State and nation were generously and promptly returned, literally by the hundreds. All facts and figures are due to the individuals and organizations that responded so adequately. Some research workers may not have been included in the survey, but this oversight was not intentional -- with numerous agencies and individuals working in New Mexico, based in places from California to New York, and from Denver to Mexico City, obviously someone may have been overlooked.

Among the responses some research projects in mining technology and other fields not closely related to geologic research were listed. To have covered the various nongeologic fields of research relating to mining and mineral resources would have required another new series of questionnaires and would have been beyond the scope and emphasis of this compilation; thus only geologic and closely related research are noted.

Many of our coworkers doing research for petroleum and mining companies could not, or did not, report their projects because their results will be confidential. We can but hope that basic principles discovered in these studies will eventually be released. Whereas geologists from governmental agencies, both State and Federal, dominate this report, it is common knowledge that much important and basic geologic research is being done by the no less competent geologists of mining and petroleum companies.

The various geologic research projects have been grouped under 18 classifications ranging in alphabetical order from Areal Geologic Mapping to Structural Geology, each project being listed under the classification that appears to be most appropriate. For further reference, the projects are indexed by (1) name of worker, (2) subject, and (3) area. The order of listing within each classification depends directly upon the date of receipt of the worker's completed questionnaire. Many of the references cited are chiefly from the questionnaires. A bibliography of New Mexico geology for 1959 is beyond the scope of this compilation; however, included in the references are papers on New Mexico geology published in the major journals during 1959.

Comments, criticisms, and suggestions are welcome. If this report is found to serve a widespread need, the preparation of similar annual or biennial tabulations for New Mexico will be encouraged.

## AREAL GEOLOGIC MAPPING

1-1 Charles H. Hewitt, The Ohio Oil Company Research Center, Littleton, Colorado, completed mapping of the Virden quadrangle in Grant County, the report being published as Bulletin 60 by the N. Mex. Bur. Mines and Mineral Res.

1-2 William A. Fischer, Alaskan Branch of the U. S. Geol. Survey, did geologic mapping of the Corona 7 1/2-minute quadrangle (Lincoln and Torrance Counties), using color aerial photographs. This work was in part experimental to compare the usefulness of color photographs with less costly black-and-gray photos.

1-3 Roy L. Griggs, U. S. Geol. Survey, Denver, is mapping the geology and studying the uranium mineralization of thirteen 15-minute quadrangles in the Tucumcari-Sabinoso area of Quay, Harding, San Miguel, and Guadalupe Counties.

1-4 Frank E. Kottlowski, N. Mex. Bur. Mines and Mineral Res., is revising a geologic examination of the sedimentary and igneous rocks, structure, and mineral deposits of the Las Cruces 15-minute quadrangle, as well as preparing reconnaissance geologic maps of the Las Cruces and Cambray 30-minute quadrangles in Dona Ana and Luna Counties.

1-5 William R. Muehlberger, Univ. of Texas, supported by the N. Mex. Bur. Mines and Mineral Res. , is in charge of geologic mapping and stratigraphic and structural studies of the Chama and Brazos Peak quadran-

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glen, Rio Arriba County, aided by Univ. of Texas graduate students G. E. Adams, E. Leslie Trice, Jr., T. E. Longgood, Jr., B. E. St. John, and J. H. Davis.

1-6 John Eliot Allen, Portland State College, Portland, Oregon, is completing the text of a report on the geology and mineral resources of the Capitan quadrangle, Lincoln County; field work was done as a project of the N. Mex. Bur. of Mines and Mineral Res.

1-7 Philip T. Hayes, U. S. Geol. Survey, Denver, has completed field work and is finishing up laboratory work involving geologic mapping and stratigraphic studies (surface and subsurface) of the southeastern New Mexico Permian units in the Carlsbad Caverns East (Hayes 1957), Carlsbad Caverns West (Hayes and Koogle, 1958), and Texas Hill 15-minute quadrangles, and in parts of the Bandanna Point and El Paso Gap 15-minute quadrangles, Eddy and Otero Counties.

1-8 Arthur Montgomery, Lafayette College, John P. Miller, Harvard University, and Patrick K. Sutherland, Oklahoma University, have mapped a 30-minute quadrangle in the rugged Truchas Peaks or Cowles-TesuqueEmbudo-Velarde-Tres Ritos area, encompassing parts of Rio Arriba, Taos, Mora, San Miguel, and Santa Fe Counties in the southern Sangre de Cristo Mountains; the report will be published by the N. Mex. Bur. Mines and Mineral Res,

1-9 Sam Thompson III, Humble Oil and Refining Company, McCamey, Texas, has 'completed a study of the geology of the southern Fra Cristobal Mountains, Sierra County, and plans publication as a bulletin with Vincent C. Kelley, Univ. of New Mexico.

1-10 John McCleary, Univ. of New Mexico graduate student, is working on a thesis problem involving areal geologic mapping and the study of structural geology in the northern Fra Cristobal Mountains, Sierra and Socorro Counties, under Professor Vincent C. Kelley.

1-11 George B. Griswold and Frank E. Kottlowski, N. Mex. Bur. Mines and Mineral Res., are completing a geologic map of the Tres Hermanas Mountains, Luna County. Most of the mapping was done by the late Dr. Robert Balk prior to his untimely death in 1955; present work includes mapping of outlying outcrops of igneous rocks and subdivisions of the Paleozoic and Cretaceous sedimentary rocks.

1-12 Robert B. Bullock, Univ. of New Mexico graduate student, as a thesis study directed by Professor Vincent C. Kelley, is mapping the geology of the Peralta and Bland areas, Jemez Mountains, Sandoval County.

1-13 William R. Jones and Walden P. Pratt, U. S. Geol. Survey, Denver, have completed geologic field investigations of the West Hurley 7 1 /2 minute quadrangle and have begun mapping in the Silver City 7 1 /2-minute quadrangle, in the Silver City-Central mining districts, Grant County.

1-14 George 0. Bachman, U. S. Geol. Survey, Denver, is continuing laboratory work on a southern Oscura Mountains-northern San Andres Mountains geologic mapping and stratigraphic study project involving the Mockingbird Gap, Salinas Peak, and Capitol Peak quadrangles. Field work has been recessed temporarily owing to Bachman's administrative duties in Denver.

1-15 Dan Turner and Associates, Inc. , consulting geologists, Denver, Colorado, have completed areal geologic mapping reports of the stratigraphy, oil and gas possibilities, and mineral economics of the Black Mesa Basin area. Included in San Juan, McKinley, and Valencia Counties are the Shiprock, Flora Vista, Crozier, Stony Butte, Tohatchi, Zuni, Hosta Butte, and Thoreau 30-minute quadrangles.

1-16 Hugh H. Doney, Del Mar College, Corpus Christi, Texas, is completing geologic mapping of the Cebolla and eastern part of the Tierra Amarilla 15-minute quadrangles in Rio Arriba County as a Univ. of Texas thesis problem directed by Professor William R. Muehlberger.

1-17 Robert A. Zeller, Jr. , Hachita, is completing a study of the geology and ore deposits of the Hachita quadrangle, Grant and Hidalgo Counties, emphasizing areal mapping and the metallic mineral deposits.

1-18 Robert A. Zeller, Jr. , Hachita, has completed areal mapping of the Big Hatchet Peak quadrangle, Hidalgo County, and is revising a final manuscript on the stratigraphy of the area for publication by the N. Mex. Bur. Mines and Mineral Res.

1-19 Allen M. Alper, Corning Glass Works, Corning, New York, and Robert A. Zeller, Jr. , Hachita, are finishing a manuscript on the geology of the Walnut Wells quadrangle, Hidalgo County, accompanied by a geologic map.

1-20 Wolfgang E. Elston, Univ. of New Mexico, has completed a reconnaissance geologic map of the Virden 30-minute quadrangle in Grant and Hidalgo Counties, sponsored by the N. Mex. Bur. Mines and Mineral Res. and to be published as Geologic Map 15 (1960).

1-21 Carle H. Dane and George 0. Bachman, U. S. Geol. Survey, are continuing compilation of the geologic map of New Mexico. Preliminary maps of northwest and southeast quarters have been published (Dane and Bachman, 1954, 1958), and final work is being done on the other two quarters of the State.

1-22 R. B. Morrison, U. S. Geol. Survey, is in charge of mapping the Safford-Duncan area, the Duncan SE and Steeple Rock SW quadrangles, of the upper Gila River basin in southeastern Arizona and southwestern New Mexico.

1-23 D. G. Wyant, U. S. Geol. Survey, is in charge of compiling a geologic map of the Colorado Plateau; current work is on the 1:250,000-scale Army Map Service maps of the Albuquerque and Shiprock sheets.

1-24 R. J. Hackman, U. S. Geol. Survey, is in charge of photogeologic mapping of the Colorado Plateau intended primarily for use in compilation of a 1:250,000-scale geologic map. Photogeologic maps of the following 15-minute quadrangles are in preparation: Chaco Canyon 1, 3, and 4; Cabezon 1 and 2; Santa Clara 1, 3, and 4; Grants 1, 3, and 4; Laguna 2; Bernalillo 2; and San Pedro 1, 2, 3, and 4.

1-25 Clay T. Smith and Antonius J. Budding, N. Mex. Inst. of Min. and Technology, and Charles W. Pitrat, University of Kansas, have completed areal geologic mapping of the southeastern Chama Basin (the Alire, Echo Amphitheater, Canjilon, Ghost Ranch, Magote Peak, and Canjilon SE 7 1/2-minute quadrangles), Rio Arriba County, and are preparing a report emphasizing the stratigraphic problems of Jurassic and Cretaceous rocks, as well as the structural relations between the Chama Basin and the Rio Grande trough.

1-26 Ming-Shan Sun, N. Mex. Bur. Mines and Mineral Res., is mapping the igneous rocks of the Socorro Mountain area in the Socorro quadrangle.

1-27 Robert H. Weber and Max E. Willard, N. Mex. Bur. Mines and Mineral Res., are completing areal reconnaissance mapping of the northern and western parts of the Datil-Mogollon volcanic-rock region, including the Alum Mountain, Mogollon (Weber and Willard, 1959a), and Reserve (Weber and Willard, 1959b) 30-minute quadrangles in Catron County.

1-28 Robert H. Weber, N. Mex. Bur. Mines and Mineral Res., has completed detailed geologic mapping of the Carrizozo 15-minute quadrangle, in southwestern Lincoln County; emphasis is on the petrology and petrography of the Tertiary and Recent igneous rocks, stratigraphy of the Tertiary sedimentary and igneous rocks, and the structure relationships of this area, which is near the boundary of the Basin and Range and High Plains provinces.

1-29 Richard H. Jahns, Calif. Inst. Tech., is mapping the geology and mineral deposits of the Ojo Caliente district, Rio Arriba and Taos Counties, at a scale of 6 inches to the mile, with more detailed mapping of several pegmatite bodies. Outcrops are chiefly Precambrian rocks with flanking Tertiary sediments.

1-30 Richard H. Jahns, Calif. Inst. Tech., supported by the N. Mex. Bur. Mines and Mineral Res., is mapping the Winston 15-minute quadrangle, Sierra and Socorro Counties, at a scale of 3 inches to the mile, with more detailed mapping of selected areas. Also being investigated are the deposits of beryllium, tungsten, copper, lead, zinc, gold, and silver in the quadrangle.

1-31 Clay T. Smith and Antonius J. Budding, N. Mex. Inst. Min. and Technology, have mapped the Little Black Peak quadrangle, Lincoln County, and adjacent areas (Smith and Budding, 1959), and are studying the intrusive alkalic igneous rocks, the ground-water problems, and the karst topography of the area.

1-32 Ward S. Motts, U. S. Geol. Survey, Roswell, has prepared an areal geologic map of the West Carlsbad 15-minute quadrangle, Eddy County, including cross-sections and a short explanatory text.

1-33 Brewster Baldwin, Middlebury College, Vermont, has prepared (Baldwin, 1959) a report of the geology of Union County, including geologic maps, measured sections of Mesozoic sedimentary rocks and of late Cenozoic sediments and volcanic rocks, and a chapter by Roy W. Foster, N. Mex. Bur. Mines and Mineral Res., on the subsurface stratigraphy.

1-34 Charles E. Stearns, Tufts University, Massachusetts, supported by the N. Mex. Bur. Mines and Mineral Res., is completing work on the geology of the north half of the Pelona 30-minute quadrangle, Catron County, including the southern part of the Plains of San Augustine.

1-35 Frederick J. Kuellmer, N. Mex. Bur. Mines and Mineral Res., has completed most of the geologic mapping, scale 1:31,680, of the Hillsboro and Mimbres 15-minute quadrangles, Sierra and Grant Counties.

## COAL PETROLOGY AND PALEOBOTANY

2-1 Roger Y. Anderson, Univ. of New Mexico, has completed a thesis study (Stanford University) of the pollen and spores in the Ojo Alamo, Kirtland, Nacimiento, and Lewis formations, Cretaceous to Tertiary in age, near Cuba, on the eastern side of the San Juan Basin. This study will be published (1960) by the N. Mex. Bur. Mines and Mineral Res. as Memoir 6.

2-2 Roger Y. Anderson, Univ. of New Mexico, and Thomas L. Carter, Univ. of New Mexico graduate student, are studying a florule of Atokan-Desmoinesian spores from the Sandia formation near Santa Fe.

2-3 Charles B. Read, U. S. Geol. Survey, Albuquerque, has essentially completed a study of the genus Tempskya from Cretaceous strata of southwestern New Mexico.

2-4 Charles B. Read, U. S. Geol. Survey, Albuquerque, has completed a manuscript describing the Upper Paleozoic floral zones and floral provinces of North America, including floras from the New Mexico area.

## ENGINEERING GEOLOGY

None reported.

## FUELS (COAL, OIL, AND GAS)

4-1 Al A. Wanek, U. S. Geol. Survey, Denver, Colorado, is preparing a report on "Coking coal of the Raton coal field, Colfax County," including the geology and coal resources of the Ute Creek and Cimarron 15-minute quadrangles.

4-2 Members of the Mineral Classification Branch of the U. S. Geol. Survey -- Thomas F. Stipp and Leon B. Haigler, Roswell, Bruno R. Alto, Carlsbad, and William G. Ryals, Farmington -- are engaged in subsurface studies of oil and gas fields in New Mexico; much of this work is unpublished, being used chiefly as a guide for classification of public lands as to their mineral or nonmineral nature and the geologic problems that arise in the development of oil and gas, potash, and coal. When demanded by public interest, such publications as that by Stipp and Haigler (1957; a structure contour map of southeastern New Mexico) are published.

4-3 William E. Bertholf II, N. Mex. Bur. Mines and Mineral Res. , is assembling an estimate of coal industry trends and possible future coal consumption in New Mexico and related areas.

4-4 Robert A. Bieberman and Roy W. Foster, N. Mex. Bur. Mines and Mineral Res. , are preparing their annual report on petroleum developments in New Mexico.

4-5 Robert A. Bieberman, N. Mex. Bur. Mines and Mineral Res., is compiling an up-to-date pipeline map of New Mexico as part of the revision, in cooperation with the U. S. Geol. Survey, of the oil and gas map of New Mexico.

## GENERAL GEOLOGY

5-1 Will W. Boyer, Santa Fe, is continuing his work (Boyer, 1959) on the geology of the southeastern part of the Espanola Basin in northern Santa Fe County, with emphasis on sedimentation and structural features.

5-2 Arthur Montgomery, Lafayette College, and Patrick K. Sutherland, Univ. of Oklahoma, are completing a Trail Guide of the Upper Pecos River region to be published by the N. Mex. Bureau of Mines and Mineral Res. as No. 6 in the series of "Scenic Trips to the Geologic Past."

5-3 Vincent C. Kelley, Univ. of New Mexico, is completing a comprehensive investigation on the geology of the Fra Cristobal Mountains, Sierra and Socorro Counties, including areal mapping, geomorphology, igneous and metamorphic petrology, stratigraphy, and structural geology.

5-4 Arthur Merkle, Univ. of New Mexico graduate student, is working on a thesis study of the geology of the St. Peters Dome area, Jemez Mountains, Sandoval County, under the direction of Professor Vincent C. Kelley.

5-5 George H. Edwards III, Univ. of Kansas graduate student, under the driection of Professor Elliot Gillerman, has as a thesis project the geology of the Little Burro Mountains, Grant County, including parts of the Tyrone and Wind Mountain 7 1/2-minute quadrangles. Description, classification, and correlation of the volcanic rocks will be emphasized.

5-6 No G. Vondenwell, Univ. of Kansas graduate student, is studying the geology of the southern part of the Silver City Range as a thesis project directed by Professor Elliot Gillerman. Emphasis will be placed on the lower Paleozoic rocks.

5-7 G. D. Robinson, U. S. Geol. Survey, is preparing a relatively nontechnical geologic report on the Philmont Boy Scout Ranch area in Colfax County for use by the Boy Scouts. The area was originally mapped by Charles B. Read and Al A. Wanek as part of the Sangre de Cristo Mountains project, and additional field work has been done by Robinson.

5-8 As part of the investigations of the Carrizo Mountains, San Juan County, New Mexico, and Apache County, Arizona, directed by John D. Strobell, Jr. , U. S. Geol. Survey, reports are being prepared on the Pastora Peak and Redrock Valley 15-minute quadrangles along the New Mexico-Arizona State line.

5-9 William R. Muehlberger, Univ. of Texas, has completed (Muehlberger, 1959) a study of the volcanic and associated rocks of the Des Moines 15-minute quadrangle in northwestern Union County, under the sponsorship of the N. Mex. Bur. Mines and Mineral Res.

5-10 Compilation of a geologic map and report on the Sangre de Cristo Mountains of north-central New Mexico by Charles B. Read and Elmer H. Baltz, U. S. Geol. Survey, is in process.

5-11 An investigation of diatremes of the Navajo and Hopi Indian Reservation in northeastern Arizona and northwestern New Mexico by Eugene M. Shoemaker, U. S. Geol. Survey, has been recessed temporarily, although a preliminary summary report has been published (Shoemaker, 1958).

## GEOCHEMISTRY

6-1 Carl F. Austin, N. Mex. Bur. Mines and Mineral Res., and W. F. Slawson, Univ. of Toronto, are studying lead isotope ratios of the galena-barite-fluorite mineralization in the Hansonburg mining district of Socorro County.

6-2 John P. Miller, Harvard Univ. , is preparing a report, sponsored by the U. S. Geol. Survey, on the chemical character of stream waters draining single rock types in the Sangre de Cristo Mountains of north-central New Mexico. Publication will be in Cosmochimica and Geochimica Acta.

6-3 Meyer Rubin, U. S. Geol. Survey, collected samples of caliche near Las Cruces with the aid of the Soil Conservation Service team headed by Robert V. Ruhe , University Park, and hopes to date the caliche by radiocarbon methods, to shed light on caliche genesis.

6-4 H. L. Cannon, U. S. Geol. Survey, is in charge of basic geobotanical research on uranium and associated trace metals carried on for the past several years in experimental plots in Santa Fe. Research is centered on the absorption by various plant groups of trace elements associated with uranium deposits. A report on some occurrences of uranium in the Santa Fe formation is being edited. Field studies of thorium deposits are planned as a contribution to studies by the U. S. Cancer Inst.

6-5 Ming-Shan Sun, N. Mex. Bur. Mines and Mineral Res. , is studying the occurrence and distribution of various elements in the so-called Poison Canyon sandstone of the Jurassic Morrison formation near Grants, New Mexico.

6-6 Carl F. Austin, N. Mex. Bur. Mines and Mineral Res., is determining the distribution of minor and trace elements in the manganese ores of the Luis Lopez mining district and adjoining areas.

## GEOMORPHOLOGY

7-1 John P. Miller, Harvard Univ. , as part of the Truchas Peaks areal mapping with Arthur Montgomery and Patrick K. Sutherland (see Areal Geologic Mapping), is investigating the glacial geology, geomorphology, and Cenozoic deposits of the Cowles-Tesuque-Embudo-Tres Ritos area.

7-2 Jerome Anderson, Univ. of New Mexico graduate student, is doing a thesis study under Professor Vincent C. Kelley on the geology and geomorphology of the Santo Domingo area, Sandoval County.

7-3 William Harrison, Univ. of New Mexico graduate student, is completing a thesis study of the geomorphology of the Albuquerque Basin directed by Professor Vincent C. Kelley.

7-4 Robert C. Shuman, U. S. Soil Conservation Service, University Park, New Mexico, is setting up soil classification of areas in Torrance County based on the relationship of parent material and geomorphic surface to the present soils.

7-5 Robert V. Ruhe, L. H. Gile, F. F. Peterson, and Mrs. D. P. Gartner, U. S. Dept. Agriculture, Soil Conservation Service, University Park, N. Mex., are working on a comprehensive study of the landscapes and soils of the Bear Peak, Las Cruces, Organ Peak, and San Diego Mountain 15-minute quadrangles in Dona Ana County. This investigation, to be published as a U. S. Dept. Agriculture Technical Bulletin, is a study of the evolution of the landforms and landscapes of a desert area, and the relationships of the classification, genesis, and geography of soils.

## GEOPHYSICS

8-1 John M. Gonizla, Univ. of New Mexico graduate student, has as his thesis problem a magnetometer survey of the buried faults of the Albuquerque Basin, Bernalillo County, directed by Professor Vincent C. Kelley,

8-2 G. E. Andreasen, U. S. Geol. Survey, is in charge of preparing a regional magnetic map of the Rowe-Mora area (scale 1:175,000) in north-central New Mexico, and a combined gravity and magnetic study is being made of the crystalline-rock configuration.

8-3 W. J. Dempsey, U. S. Geol. Survey, is in charge of a project correlating magnetic and areal geologic maps. A preliminary report entitled "Aeromagnetic survey of part of Grant County, New Mexico" is being revised for publication.

8-4 Henry R. Joesting, U. S. Geol. Survey, is in charge of regional geophysical studies of the Colorado Plateau. A report by P. Edward Byerly on geothermal measurements over uranium bodies from the Grants district, New Mexico, is in preparation.

8-5 Allan R. Sanford, Research and Development Division of N. Mex. Inst. Min. and Technology, is in charge of a gravity survey of the Rio Grande Valley near Socorro. Parts of the Magdalena, Socorro, San Antonio, and Carthage 15-minute quadrangles are being covered; 800 of about 1,000 stations have been occupied with the aim of determining the structure of the Rio Grande Valley and bordering areas as well as ground-water relationships.

8-6 William E. Sullivan, graduate student at N. Mex. Inst. Min. and Technology, has as his thesis project, directed by Professor Allan R. Sanford, the determination of geologic structure by the use of telluric currents in the Tome NE 7 1 /2-minute quadrangle (east of Belen), Valencia County. A grid network of about 6 square miles is planned, and the telluric field will be measured at the various points for comparison with that of a base station.

## GROUND WATER

9-1 Walter A. Mourant, U. S. Geol. Survey Ground-Water Branch, Roswell, is completing a study of the water resources and geology of the Hondo Valley in Lincoln, Chaves, and Otero Counties. A report, prepared in cooperation with the State Engineer Office, will note the occurrence, movement, and chemical quality of ground and surface water.

9-2 Eugene A. Chavez, State Engineer Office, Santa Fe, has written an account of the ground-water occurrence in the southern Ft. Sumner irrigation-well field, De Baca County.

9-3 Eugene A. Chavez, State Engineer Office, Santa Fe, is completing a reconnaissance study of the ground-water conditions in the Colonias area, along the Pecos River, in Guadalupe County.

9-4 William E. Bertholf II, N. Mex. Bur. Mines and Mineral Res., is preparing a preliminary study of the administration of the supply of water in New Mexico.

9-5 Francis X. Bushman, N. Mex. Bur. Mines and Mineral Res., is studying the change in quality of water (increase in dissolved solids) from irrigation wells in the valley fill of the Rio Grande Valley, based on records for a 7- to 8-year period.

9-6 Fred D. Trauger, U. S. Geol. Survey, Albuquerque, in cooperation with the New Mexico State Engineer and Grant County Commission, is studying the ground-water conditions and geology of Grant County to determine the availability and quality of ground water, especially near towns, mining districts, and areas of potential irrigation.

9-7 Francis X. Bushman, N. Mex. Bur. Mines and Mineral Res., is continuing his investigations of the mechanical and chemical development of water wells in New Mexico.

9-8 Walter A. Mourant, U. S. Geol. Survey, Roswell, in cooperation with the New Mexico State Engineer, is studying the water resources and geology near Hondo, Lincoln County, to determine the occurrence and availability of ground water and its relation to surface water.

9-9 Fred D. Trauger, U. S. Geol. Survey, Albuquerque, in cooperation with the N. Mex. Bur. Mines and Mineral Res. and the New Mexico State Engineer, is doing reconnaissance geologic mapping, with detailed mapping of alluvium, and a study of the occurrence and quality of ground water in Quay County.

9-10 Francis X. Bushman, N. Mex. Bur. Mines and Mineral Res., and Mandi S. Hantush, Research and Development Division of N. Mex. Inst. Min. and Technology, are preparing a report on the ground water in the

Socorro area, including a ground-water inventory, -quantitative analyses of aquifers in the Rio Grande valley fill, determination of ground-water contributions from areas flanking the valley, and a study of quality as compared with depth.

9-11 Ellis D. Gordon, U. S. Geol. Survey, Cheyenne, Wyoming, in cooperation with the New Mexico State Engineer, has studied the geology and ground-water conditions in the Grants-Bluewater area of Valencia County, evaluating the availability of ground water, recharge, quality, and the effects on water levels caused by extensive pumping.

9-12 Fred D. Trauger, , U. S. Geol. Survey, Albuquerque, has studied the geology and ground-water conditions, and Francis X. Bushman, N. Mex. Bur. Mines and Mineral Res. , has investigated the ground-water hydrology of the structural basins west of Tucumcari, Quay County, in cooperation with the New Mexico State Engineer.

9-13 J. B. Cooper, U. S. Geol. Survey, Albuquerque, in cooperation with the New Mexico State Engineer, is studying the ground-water occurrence and geology of southeastern McKinley County to determine the availability and quality of ground water, with emphasis on areas where ground water occurs in beds that contain large bodies of uranium ore.

9-14 Alfred Clebsch, Jr. , U. S. Geol. Survey, Albuquerque, in cooperation with the New Mexico State Engineer, is investigating the geology and water resources of Guadalupe County, describing the occurrence of ground water in relation to the geology, and relating stream flow to ground water.

9-15 Francis X. Bushman, N. Mex. Bur. Mines and Mineral Res., is preparing a report on the ground water in Union County involving an inventory of existing supplies, some quantitative tests, chemical analyses, and interpretation of data. The geology and subsurface stratigraphy have been published separately (Baldwin, 1959).

9-16 Edward R. Cox, U. S. Geol. Survey, Carlsbad, in cooperation with the Pecos River Commission, has studied the ground-water conditions in the McMillan delta area, Eddy County, to appraise the amount of water in the Pecos River valley between Artesia and Major Johnson Springs and to determine the amount of water used by salt cedars in the McMillan delta area; also to determine the amount of ground water that might be salvaged by drains or eradication of the salt cedars.

9-17 Sidney R. Ash, U. S. Geol. Survey, Albuquerque, in cooperation with the New Mexico State Engineer , has compiled a hydrologic atlas of northern Lea County containing geologic, hydrologic, and physiographic maps of the area (showing topography, water levels, saturated thickness, and the base of the Ogallala formation), accompanied by a short text.

9-18 Edward R. Cox, U. S. Geol. Survey, Carlsbad, in cooperation with the Pecos River Commission, has studied the geology and ground water between Lake McMillan and Carlsbad Springs, Eddy County, to appraise

the possible losses to ground water from Lake McMillan that do not entirely return to the Pecos River in Major Johnson Springs.

9-19 Gene C. Doty, U. S. Geol. Survey, Albuquerque, in cooperation with the New Mexico State Engineer, is studying the ground-water conditions in southern Luna County, including relations of the geology to ground water, characteristics of the wells, the effect of irrigation development on water levels and quality, and the permanence and source of the ground water.

9-20 Edward R. Cox, U. S. Geol. Survey, Carlsbad, in cooperation with the Pecos River Commission, is investigating the feasibility of Queen Lake as a disposal area for brines in Eddy County; included is the drilling and logging of 2 test wells, chemical analyses of the water samples, test pumping, and study of the permeability of the bed of the lake.

9-21 J. S. Havens, U. S. Geol. Survey, Lovington, in cooperation with the New Mexico State Engineer, has made recharge studies on the High Plains of eastern New Mexico in northern Lea County to determine the potential quantity of water available for recharge and the feasibility of artificial recharge through wells or by other methods of inducing recharge.

9-22 Sam W. West, Elmer H. Baltz, Jr., and Sidney R. Ash, U. S. Geol. Survey, Albuquerque, in cooperation with the Jicarilla Apache tribe, have studied the geology and ground-water resources of the southern part of the Jicarilla Apache Indian Reservation, Rio Arriba and Sandoval Counties. The availability and quality of ground water were appraised, with special emphasis on irrigation water, and the uppermost Cretaceous and Tertiary rocks in the area were mapped.

9-23 Frank B. Titus, Jr. , U. S. Geol. Survey, Albuquerque, in cooperation with the New Mexico State Engineer and the N. Mex. Bur. Mines and Mineral Res., is studying the ground-water resources and geology of eastern Valencia County, east of longitude 107°15' W.

9-24 Sam W. West, U. S. Geol. Survey, Albuquerque, in cooperation with the New Mexico State Engineer, has studied the geology and ground-water resources of the Gallup area, McKinley County, to appraise the availability and quality of ground water.

9-25 Frank B. Titus, Jr., U. S. Geol. Survey, Albuquerque, in cooperation with the New Mexico State Engineer and the N. Mex. Bur. Mines and Mineral Res. , is studying the geology and ground-water resources of the Sandia and Manzanita Mountains area, especially the eastern slopes, Bernalillo and Sandoval Counties.

9-26 H. 0. Reeder, U. S. Geol. Survey, Albuquerque, in cooperation with the New Mexico State Engineer, is preparing a progress report on ground-water resources of northern Lea County, including availability and development of ground water, character of the water-bearing materials, a map of the base of the Ogallala formation, thickness of saturated materials, and expected future lowering of water levels.

9-27 A. Nicholson, Jr., and Alfred Clebsch, Jr., U. S. Geol. Survey, Albuquerque, in cooperation with the N. Mex. Bur. Mines and Mineral Res. and the New Mexico State Engineer, are making a reconnaissance study of the geology, and an appraisal of the ground-water resources, of southern Lea County.

9-28 H. 0. Reeder, U. S. Geol. Survey, Albuquerque, is investigating the use of tritium as a tool to determine recharge rates and movement of water in the Ogallala formation of the High Plains in Lea County; an initial phase is to obtain background information, followed by a "spiking" of ground water with tritium in an area of intensive study, and then following the movement of water through the aquifer.

9-29 L. J. Bjorklund and Ward S. Motts, U. S. Geol. Survey, Albuquerque, in cooperation with the New Mexico State Engineer, are studying the geology and water resources of the Carlsbad area, Eddy County, to determine the quantity and quality of water in limestone and valley fill and their relation to the Pecos River, as well as the effects of pumping on migration of saline water into areas having good water, and to locate areas of possible development of additional potable water.

9-30 R. W. Mower, U. S. Geol. Survey, Albuquerque, in cooperation with the New Mexico State Engineer, is appraising the potential salvage of ground water in the Pecos Valley between Acme and Artesia, Chaves and Eddy Counties.

9-31 L. J. Bjorklund and B. W. Maxwell, U. S. Geol. Survey, Albuquerque, in cooperation with the New Mexico State Engineer and the City of Albuquerque, are studying the geology and water resources of the Albuquerque area, Bernalillo and Sandoval Counties, to determine the amount of water available in the. Rio Grande valley between Algodones and Isleta, and to appraise its quality and the long-term effects of pumping on water levels, recharge, and discharge.

9-32 James W. Hood, U. S. Geol. Survey, Roswell, is studying the effects of saline ground-water encroachment, as well as the rate and effects of ground-water use by phreatophytes, in the Roswell basin area, Chaves and Eddy Counties.

9-33 Ward S. Motts, U. S. Geol. Survey, Roswell, in cooperation with the New Mexico State Engineer, is making a recharge study of the Roswell ground-water basin, Eddy, Chaves, and Lincoln Counties, including the general geology and ground-water data.

9-34 Robert L. Borton, New Mexico State Engineer Office, Roswell, is working on the geology and ground-water resources in the northern extension of the Roswell basin, Chaves County; this geologic and hydrologic study will include occurrences and quality of the ground water, areal geologic mapping, inventory of the water wells, determination of the sources of water and of the aquifer coefficients, recharge movement, and discharge of ground water in the area.

9-35 Robert L. Borton, New Mexico State Engineer Office, Roswell, has studied the geology and ground-water occurrences in the Alamosa-Cuchillo-Palomas Rivers area, Sierra and Socorro Counties, an extension and simplification of previous geologic mapping, with the inclusion of a water-table map constructed from 80 inventoried wells.

## IGNEOUS AND METAMORPHIC PETROLOGY

10-1 Joseph G. Wargo, Bear Creek Mining Co. , Santa Fe, is compiling a synthesis of published and unpublished data on the volcanic rocks of southwestern New Mexico and adjoining parts of Arizona.

10-2 Arthur Montgomery, Lafayette College, is studying the Precambrian rocks of the Truchas Peaks region, as a part of areal mapping with John P. Miller and Patrick K. Sutherland (see Areal Geologic Mapping). One of the chief aims is to correlate with the Precambrian rocks of the Picuris Range.

10-3 Richard Lodewick, Univ. of New Mexico graduate student, is doing a thesis study on the Precambrian gneiss of Tijeras Canyon, Bernalillo County, directed by Professor Vincent C. Kelley.

10-4 W. W. Atkinson, Univ. of New Mexico graduate student, under the direction of Professor Vincent C. Kelley, is doing a thesis study on the geology and petrography of the San Pedro Mountains , Santa Fe County.

10-5 William R. Jones, U. S. Geol. Survey, is completing revision of a geologic report on the Santa Rita 7 1 /2-minute quadrangle, Grant County, emphasizing the petrology of the igneous rocks and the metallic mineral deposits of the Santa Rita district.

10-6 Wolfgang E. Elston, Univ. of New Mexico, is completing a study of the igneous rocks in the Capitan 15-minute quadrangle, Lincoln County as a part of John Eliot Allen's (Portland State College, Portland, Oregon) report on this quadrangle, supported by the N. Mex. Bur. of Mines and Mineral Res. This is part of a long-term project on the volcanic and intrusive rocks of New Mexico and surrounding areas, involving the assembling of petrographic, textural, structural, stratigraphic, and chemical data to determine the distribution of these igneous rocks in time and space.

10-7 Clarence S. Ross, U. S. Geol. Survey, is in charge of a team studying the petrology of the Valles (Jemez) Mountains in north-central New Mexico. Field mapping of the fault complex in the Valles caldera, Jemez Springs quadrangle , is continuing. Reports in preparation are welded tuffs , vertical and lateral variations in welded ash flows , replacement of Ordovician volcanic ash by calcite, and geology of an andesite volcanic neck with special reference to its marginal fusion phenomena.

10-8 Antonius J. Budding, N. Mex. Inst. Min. and Technology, is studying the petrology and structure of Jicarilla Mountain, in west-central Lincoln County, as part of the geologic mapping of the east half of the Little Black Peak quadrangle (Smith and Budding, 1959).

10-9 John Carman, graduate student at N. Mex. Inst. Min. and Technology, under the direction of Professor Clay T. Smith, is making a thesis study of the chemical and petrographic properties of some Quaternary( ?)basalts within the Rio Grande trough; variations within a flow unit and within a flow sequence of the Isleta basalts, and the regional variations, based chiefly on olivine, are being considered.

## METALLIC MINERAL DEPOSITS

11-1 John H. Schilling, N. Mex. Bur. Mines and Mineral Res., is making a comprehensive examination of the mineral deposits of Taos County. His report, titled "Mineral Resources of Taos County, New Mexico," will be published by the Bureau in the summer of 1960 as Bulletin 71.

11-2 Roy L. Griggs, U. S. Geol. Survey, Denver, has mapped the geology and mineral deposits of the Steeple Rock district in western Grant County and plans publication of a U. S. Geol. Survey Bulletin in early 1960.

11-3 H. C. Granger, U. S. Geol. Survey, is in charge of the Ambrosia Lake (McKinley County) mining district project designed to determine (1) shapes and geologic controls of the uranium ore bodies, (2) the geochemical processes involved in genesis and localization of the ore bodies, and (3) guides to ore that may be useful in the Ambrosia Lake district and elsewhere.

11-4 Kenneth G. Bell, U. S. Geol. Survey, heads a topical study on the processes of formation and redistribution of uranium deposits of the Colorado Plateau (northwestern New Mexico) and Wyoming, aimed at (1) acquiring new data concerning the geochemical behavior of uranium, (2) providing understanding of processes that form uraniferous mineral deposits, and (3) establishing criteria to aid exploration for uranium ore deposits.

11-5 George B. Griswold, N. Mex. Bur. Mines and Mineral Res. , completed a study of the mineral deposits of Lincoln County, published by the Bureau as Bulletin 67 (Griswold, 1959).

11-6 George B. Griswold, N. Mex. Bur. of Mines and Mineral Res., completed most of the field work in a study of the mineral deposits of Luna County.

11-7 William R. Jones, U. S. Geol. Survey, is completing revision of a report on the geology and mineral deposits of the Fort Bayard 7 1/2 minute quadrangle, Grant County.

11-8 Elliot Gillerman, Univ. of Kansas, is studying the mineral deposits of Grant County under sponsorship of the N. Mex. Bur. of Mines and Mineral Res. Individual deposits and districts will be described, and a county geologic map will be compiled.

11-9 Wolfgang E. Elston, Univ. of New Mexico, is studying the mineral deposits of Hidalgo County under sponsorship of the N. Mex. Bur. of Mines and Mineral Res. All principal mines and prospects will be examined and mapped.

11-10 Saville C. Creasey, U. S. Geol. Survey, Menlo Park, California, is in charge of a study of the porphyry copper ore bodies.

11-11 R. E. Thaden, U. S. Geol. Survey, is in charge of a study of the Grants area in Valencia County. Some of the large uranium ore bodies at Ambrosia Lake were mapped by H. C. Granger and others, of the U. S. Geol. Survey, and samples obtained for analytical purposes.

11-12 Robert H. Moench, U. S. Geol. Survey, Denver, is in charge of studying the uranium ore deposits in the Laguna area, Valencia, Bernalillo, and Sandoval Counties. H. C. Granger and his assistant are engaged in mapping the ore deposits as exposed in the underground mine workings.

11-13 Lowell S. Hilpert, U. S. Geol. Survey, in charge of a regional synthesis of the Colorado Plateau ores, is preparing a report on the uranium resources of northwestern New Mexico.

11-14 Charles B. Read, U. S. Geol. Survey, Albuquerque, is studying the copper deposits in sandstone and associated sediments in the Southwestern United States, including, of course, the "red bed" copper deposits in New Mexico.

11-15 William E. Bertholf II, N. Mex. Bur. Mines and Mineral Res., is preparing a list and description of the State agencies that regulate mineral resources, and a guide for prospectors relating to State and Federal laws for locating claims or acquiring mineral leases.

11-16 Henry S. Birdseye, Albuquerque, is preparing a history of uranium mining in New Mexico, giving a summary of exploration, ore-deposit controls, and exploitation of uranium deposits.

11-17 Carl F. Austin, N. Mex. Bur. Mines and Mineral Res. , is studying the occurrences of tungsten in the Kelly mining district of the Magdalena Mountains, Socorro County.

11-18 Carl F. Austin, N. Mex. Bur. Mines and Mineral Res. , is revising and bringing up to date the Bureau's bulletin (Bull. 8 by S. G. Lasky) describing the ore deposits of Socorro County.

## MINERALOGY AND CRYSTALLOGRAPHY

12-1 Jacques R. Renault, Bear Creek Mining Co. , Denver, Colorado, completed a thesis study (N. Mex. Inst. Min. and Technology) on the growth pressure of fibrous NaC1 from Zuni Salt Lake, Catron County. Growing salt fibers were shown to exert a force of 25 $kg/cm^2$ against an external uniaxial stress; at Zuni Salt Lake, crystallization of salt was found to aid the disintegration of rocks.

12-2 Raymond C. Grant, Lafayette College graduate student, is doing a mineralogical and optical study of tourmaline from the Precambrian rocks of the Truchas Peaks region, under Professor Arthur Montgomery.

12-3 B. L. Allen, Texas Tech. College, Lubbock, Texas, formerly of Eastern New Mexico Univ. , Portales, is describing, as a thesis study at Michigan State Univ., the mineralogy of the soils developed on the basalts of northeastern New Mexico, in Union and Colfax Counties.

12-4 Alice D. Weeks, U. S. Geol. Survey, is in charge of studies of the mineralogy and geochemistry of the Grants area in New Mexico, to be published as a section of a report by R. E. Thaden, U. S. Geol. Survey, on the geology of the Grants area. An abundant ostracod fauna was found in the Todilto limestones and is believed to have produced a reducing environment that may have been a factor in the precipitation of uranium.

12-5 Ming-Shan Sun, N. Mex. Bur. Mines and Mineral Res., is studying the occurrence of native selenium from the Grants area and is experimenting with the determination of selenium by the X-ray spectrographic method.

12-6 Ming-Shan Sun, N. Mex. Bur. Mines and Mineral Res., is describing the occurrence of ilsemannite and jordisite in the so-called Poison Canyon sandstone of the Jurassic Morrison formation near Grants.

12-7 Stuart A. Northrop, Univ. of New Mexico, has completed (Northrop, 1959) a comprehensive volume on the minerals of New Mexico; included are a summary of highlights of New Mexico mineralogy and mining, a review of the economic aspects of New Mexico's mineral industry, and descriptions and records of occurrence of 440 minerals.

12-8 Spencer R. Titley, New Jersey Zinc Co., Tucson, is continuing his research on the geochemical aspects of the sulfide and silicate minerals from the Linchburg mine, Magdalena mining district, Socorro County.

12-9 Frederick J. Kuellmer, N. Mex. Bur. Mines and Mineral Res., is making a study of feldspars from Tertiary porphyries of New Mexico and adjoining Southwestern U. S. areas; variations in and among the porphyry bodies are being examined by petrographic and X-ray techniques.

## NONMETALLIC MINERAL DEPOSITS

13-1 Robert H. Weber and Frank E. Kottlowski, N. Mex. Bur. Mines and Mineral Res., completed and published (Weber and Kottlowski, 1959) a study of the gypsum resources of New Mexico, giving brief descriptions of individual deposits.

13-2 Charles L. Jones, U. S. Geol. Survey, is in charge of studies on the New Mexico potash deposits in Eddy County. In preparation are subsurface maps and cross-sections to show the thickness, chemical and mineralogical composition, and structure of the potash ore, as well as their relation to host rocks; also subsurface maps to show the thickness, composition, and structure of the Castile, Salado, and Rustler formations, and correlation charts of these formations.

13-3 Bruno R. Alto, Carlsbad, and Thomas F. Stipp and Leon B. Haigler, Roswell, members of the Mineral Classification Branch of the U. S. Geol. Survey, are engaged in continuing studies of the potash deposits of southeastern New Mexico.

13-4 Richard H. Jahns, California Inst. Tech. , is making a survey of the pegmatites and nonpegmatite beryllium deposits in NewMexico, stressing detailed geologic mapping and quantitative analysis of the more important deposits. Results of investigations at the Harding mine, Taos County, and in the Petaca district, Rio Arriba County, are included.

## PALEONTOLOGY

14-1 Jan F. Van Sant, Univ. of Kansas, is completing descriptions of the fusulinids from the Whiskey Canyon Pennsylvanian strata (Mud Springs Mountains), having differentiated 28 species from the Desmoinesian, Missourian, and Virgilian equivalents.

14-2 Wendall J. Stewart, Texaco, Inc. , Midland, Texas, is making phyllogenetic studies of fusulinids, including new genera and species, as well as their ranges, from the major exposures of Pennsylvanian rocks in New Mexico and Arizona.

14-3 Don A. Zimmerman, Sun Oil Co., Richardson, Texas, is completing an evolutionary study of Atokan (Derryan) and Lower Desmoinesian fusulinids (with special emphasis on Wedekindellina ancestry) from the Big Hatchet Peak quadrangle, Hidalgo County.

14-4 Patrick K. Sutherland, Univ. of Oklahoma, and Francis H. Harlow, Los Alamos, are making a detailed morphological study of the Pennsylvanian brachiopod faunas of the southern Sangre de Cristo Mountains area

from Pecos north to Taos and west to Nambe Pueblo and Santa Fe. A prolific well-preserved Virgilian (Upper Pennsylvanian) brachiopod fauna collected from the Jemez Springs area in Sandoval County is also being described. It is expected that both reports will be published by the N. Mex. Bur. of Mines and Mineral Res.

14-5 Samuel P. Ellison, Jr. , Univ. of Texas, aided by a grant from the Humble Oil and Refining Co., is studying the stratigraphic distribution of conodonts in Texas, New Mexico, and Arizona. About 4,200 samples collected from classic Paleozoic sections in central Texas, in the Marathon Basin, Sierra Diablo, Guadalupe Mountains, Hueco Mountains, and Franklin Mountains of Texas, and the Sacramento Mountains of south-central New Mexico are being processed to extract the conodonts.

14-6 Donald A. Zimmerman, Sun Oil Co., Richardson, Texas, is examining fusulinids from numerous oil tests drilled in Lea County to tie the fusulinid faunal zones to the various parts of the Pennsylvanian sequence of southeastern New Mexico and to make comparative descriptions of the faunas.

14-7 Garner L. Wilde and John W. Skinner, Humble Oil and Refining Co., Midland, Texas, are studying the fusulinid faunas and Pennsylvanian-Permian stratigraphy of the Big Hatchet Mountains in Hidalgo County. The research is based on detailed collections by Robert A. Zeller, Jr. (now consulting geologist, Hachita; collections made when he was staff member of the N. Mex. Bur. Mines and Mineral Res.) and supplemented by extensive collections by Humble Oil and Refining Co. geologists. This thick, complete, and abundantly fossiliferous Pennsylvanian-Permian section may be one of the faunally classic sequences in the U. S.

14-8 Augustus K. Armstrong, Univ. of Cincinnati and N. Mex. Inst. Min. and Tech, graduate student, is in the final stages of a thesis study on the Mississippian rocks of southwestern New Mexico and southeastern Arizona, including detailed systematic description of the brachiopods, corals, blastoids, and endothyrids from the Escabrosa and Paradise formations.

14-9 John Thomas Dutro, U. S. Geol. Survey, and G. Arthur Cooper, U. S. National Museum, are studying the brachiopods of the Devonian Sly Gap formation and adjacent strata from south-central New Mexico.

14-10 Walter L. Moore, Gulf Oil Corp., Roswell, is revising his thesis study (at Univ. of Wisconsin, directed by Professor M. L. Thompson) on the Upper Pennsylvanian fusulinids from the Mockingbird Gap section, northern San Andres Mountains, Socorro County.

14-11 Rousseau H. Flower, N. Mex. Bur. Mines and Mineral Res., is studying the diverse faunas of the Ordovician strata from southern New Mexico, especially the cephalopod and coral elements.

14-12 M. L. Thompson, Illinois Geol. Survey, is continuing his studies of Pennsylvanian and Permian fusulinid faunas from numerous areas in New Mexico; recent emphasis has been on collections from the Oscura Mountains area.

## SEDIMENTARY PETROLOGY

15-1 Arthur W. Hambleton, N. Mex. Inst. Min. and Technology graduate student, studied the Missourian carbonate rocks from the northern Oscura Mountains, Ojo de Amado, and Mesa Sarca (all three sections in Socorro County), to interpret the paleoenvironment and paleogeography of early Upper Pennsylvanian time (Hambleton, 1959).

15-2 Karl Stauffer, Stanford Univ. graduate student, is completing a thesis study on the petrographic characteristics of the Pennsylvanian and Ordovician carbonate rocks of the Caballo Mountains, Sierra County, comparing these Paleozoic rocks with recent carbonate rock deposits.

15-3 Roger Y. Anderson, Univ. of New Mexico, and Douglas Kirtland, Univ. of New Mexico graduate student, are completing a study of the origin, varves, and cyclic sedimentation patterns of the thinly laminated Todilto (Jurassic) limestone gypsum from the San Juan Basin area.

15-4 Lloyd C. Pray and Alan S. Horowitz, Ohio Oil Co., Littleton, Colorado, are making a detailed study of Mississippian-age bioherms in the United States, including the bioherms in the Sacramento Mountains, Otero County. Carbonate petrography, interpreted from numerous peels and thin-sections, has been discussed in preliminary reports (Pray, 1958; Pray and Horowitz, 1959).

15-5 Carel Otte, Jr. , Pure Oil Co., Crystal Lake, Illinois, is working on the Wolfcampian algal bioherms northeast of Tularosa, in Otero County, as a continuation of his studies of the lower Permian rocks in that area (Otte, 1959).

15-6 Charles J. Mankin, Univ. of Oklahoma, completed a thesis study, directed by Professor William R. Muehlberger (Univ. of Texas) and supported by the N. Mex. Bur. Mines and Mineral Res., on the sedimentary petrology and stratigraphy of the Jurassic and pre-Graneros Cretaceous rocks of northeastern Harding County.

15-7 Max E. Willard, N. Mex. Bur. Mines and Mineral Res., is studying the petrology and mineralogy of the Cretaceous sedimentary rocks near Todilto Park, McKinley County. Use of these features for correlation purposes is being noted, as well as interpretation of the sedimentary environment, maturity of the minerals, paleoclimate, and provenance.

15-8 Douglas Lewis, graduate student at the Univ. of Houston, directed by Professor Robert Greenwood, has as a thesis project the study of the petrology and environment of the Bliss sandstone in the Silver City area, the Silver City and Circle Mesa 7 1/2-minute quadrangles, Grant County. Types and abundance of glauconite will be emphasized.

## SEDIMENTATION

16-1 Luna Leopold, U. S. Geol. Survey, and John P. Miller, Harvard Univ. , are investigating several problems in stream competency in Arroyo de los Frijoles near Santa Fe and various related aspects of water-sediment relationships.

16-2 Lewis M. Cline, Univ. of Wisconsin, is completing a study of cyclical sedimentation of upper Virgil beds in the Sacramento Mountains (Cline, 1959).

## STRATIGRAPHIC AND HISTORICAL GEOLOGY

17-1 P. E. Soister, U. S. Geol. Survey, is leading a study of the geologic history of the Rio Grande trough in northern New Mexico and the tectonic relationship of this trough to the adjacent San Juan Basin. This study will attempt (1) the determination of the source areas of Tertiary sediments, particularly those of pre-Miocene age; (2) the collation of the many stratigraphic units named in this area, along with the synthesis of previous geologic work, and (3) the interpretation of the sedimentary and orogenic history of the Rio Grande trough and the eastern San Juan Basin since Cretaceous time.

17-2 Patrick K. Sutherland, Univ. of Oklahoma, is preparing a biostratigraphic report on the Mississippian and Pennsylvanian rocks in the southern Sangre de Cristo Mountains, from Pecos to Taos, in parts of Rio Arriba, Taos, Mora, San Miguel, and Santa Fe Counties. The study is supported by the N. Mex. Bur. Mines and Mineral Res.

17-3 Frank E. Kottlowski, N. Mex. Bur. Mines and Mineral Res. , has compiled a report on the Pennsylvanian strata of southwestern New Mexico and southeastern Arizona describing over 100 measured sections and oil tests, with a summary of the paleogeography and mineral resources.

17-4 Richard W. Fetzner, Sun Oil Co., Richardson, Texas, has completed a thesis study (Univ. of Wisconsin) of the Pennsylvanian paleotectonics of the Colorado Plateau area, including northwestern New Mexico. Lithofacies analysis of the Pennsylvanian is based on over 300 control points, 30 of these being surface sections, and 72 points occurring in northwestern New Mexico. Publication will be in the American Association of Petroleum Geologists Bulletin.

17-5 George 0. Bachman, U. S. Geol. Survey, Denver, has begun a study of all available data, office and field, on the Pennsylvanian system in New Mexico. The first phase will be published with the paleotectonic map of the Pennsylvanian of the U. S. under the direction of Edward D. McKee, U. S. Geol. Survey, Denver.

17-6 Robert A. Zeller, Jr. , Hatchita, is working on the stratigraphy of the Cretaceous rocks of southwestern New Mexico and adjoining parts of southeastern Arizona and northern Mexico.

17-7 Willis W. Tyrrell, Jr. , Pan American Petroleum Corp. , Ft. Worth, Texas, completed (Tyrrell, 1959) a stratigraphic study of the Dakota formation of the San Juan Basin area.

17-8 Willard D. Pye , Univ. of Arizona, has begun a widespread regional study of the stratigraphy and paleontology of the Arizona, western New Mexico, and northern Sonora areas, including sedimentation and structure of the region, geological evolution, and possible accumulations of oil and gas.

17-9 Robert G. Dickinson, Univ. of Arizona graduate student, as his thesis project prepared insoluble residues from 10-foot units of the El Paso limestone from sections in the Franklin, Florida, Big Hatchet, Peloncillo, and Chiricahua Mountains, and made correlations based on plotted logs.

17-10 Robert L. Harbour, U. S Geol. Survey, Denver, Colorado, is in charge of a project on Paleozoic stratigraphy of southwestern New Mexico, with work being continued in the Organ, Sacramento, Caballo, and Franklin Mountains (Harbour, 1958).

17-11 Philip T. Hayes, U. S. Geol. Survey, Denver, Colorado, is in charge of a study of the stratigraphy of southeastern New Mexico.

17-12 James C. Wright, U. S. Geol. Survey, Denver, is in charge of stratigraphic studies of the Entrada, Curtis, and Todilto formations and their time equivalents in southwestern Colorado and northwestern New Mexico. Emphasis is on lithofacies, paleogeography, correlation, and relations with the vanadium-uranium deposits.

17-13 Larry C. Craig, U. S. Geol. Survey, is in charge of a general stratigraphic study of the Colorado Plateau, including northwestern New Mexico. Stratigraphic information is being compiled on the Paleozoic, Cretaceous, and Tertiary strata, and a report on the Morrison formation is in the final stages.

17-14 John H. Stewart, U. S. Geol. Survey, is in charge of pre-Morrison stratigraphic studies of the Colorado Plateau. Reports in preparation include one on directional primary structures in Upper Paleozoic and Lower Mesozoic strata, and another on the Triassic stratigraphy of the Colorado Plateau.

17-15 Charles B. Read, U< S. Geol. Survey, Albuquerque, is preparing a report on the stratigraphy of the outcropping Permian rocks in parts of northeastern Arizona and northwestern New Mexico.

17-16 Roy W. Foster, N, Mex. Bur. Mines and Mineral Res., has prepared a map of New Mexico, scale 1:500,000, showing outcrops of Precambrian rocks, oil tests that bottomed in the Precambrian, structural

contours on the top of the Precambrian, the formations overlying the Precambrian, and the gross lithologies of the Precambrian rocks. This study is part of the basement-rocks project of the American Association of Petroleum Geologists and will be published by the N. Mex. Bur. Mines and Mineral Res. in 1960.

17-17 Charles B. Read, U. S. Geol. Survey, Albuquerque, is completing a report on the Late Paleozoic red beds of the Sangre de Cristo Mountains, in north-central New Mexico.

17-18 Sherman A. Wengerd, Univ. of New Mexico, is investigating the Pennsylvanian rocks of west-central New Mexico, in Valencia, Catron, and Socorro Counties, a continuing stratigraphic study of the Lucero Basin area with the aim of determining the connections from the Lucero Basin to the Orogrande Basin as based on sedimentational studies.

17-19 M. L. Thompson, Illinois Geol. Survey, is continuing his work on the Pennsylvanian sections in New Mexico; recent emphasis has been on the Pennsylvanian strata and their contained fusulinid faunas in the Oscura area.

## STRUCTURAL GEOLOGY

18-1 Vincent C. Kelley, Univ. of New Mexico, is continuing his areal mapping and studies of the structure , geomorphology, and geophysics of the Rio Grande trough.

18-2 George H. Dixon, U. S. Geol. Survey, is in charge of compiling a structure contour map and tectonic map of the San Juan Basin in northwestern New Mexico. The map has been completed and is being given technical review.

## NEW MEXICO BIBLIOGRAPHY FOR 1959

In addition to geologic papers and abstracts cited in the text, the bibliography that follows contains an incomplete listing of other studies relating to New Mexico geology that were published in 1959, and which appeared under the following auspices: American Association of Petroleum Geologists, American Geophysical Union Transactions, American Journal of Science, American Mineralogist, Economic Geology, Geological Society of America Bulletin, Journal of Geology, Journal of Geophysical Research, Journal of Paleontology, Journal of Sedimentary Petrology, Micropaleontology, Mining Engineering, New Mexico Geological Society, New Mexico Institute of Mining and Technology, New Mexico State Engineer, Oil and Gas Journal, Roswell Geological Society, State Bureau of Mines and Mineral Resources division of New Mexico Institute of Mining and Technology, U. S. Geological Survey, University of New Mexico, and World Oil.

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