



South entrance to the State Bureau of Mines and Mineral Resources. The laboratories and offices of the Bureau occupy the south wing of the Research Laboratory of the New Mexico Institute of Mining and Technology.

NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY

E. J. Workman, President

STATE BUREAU OF MINES AND MINERAL RESOURCES

Alvin J. Thompson, Director

BIENNIAL REPORT
FOR THE FISCAL YEARS ENDING
30 JUNE 1959
and
30 JUNE 1960

Prepared by
the Director

SOCORRO

1960

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NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY

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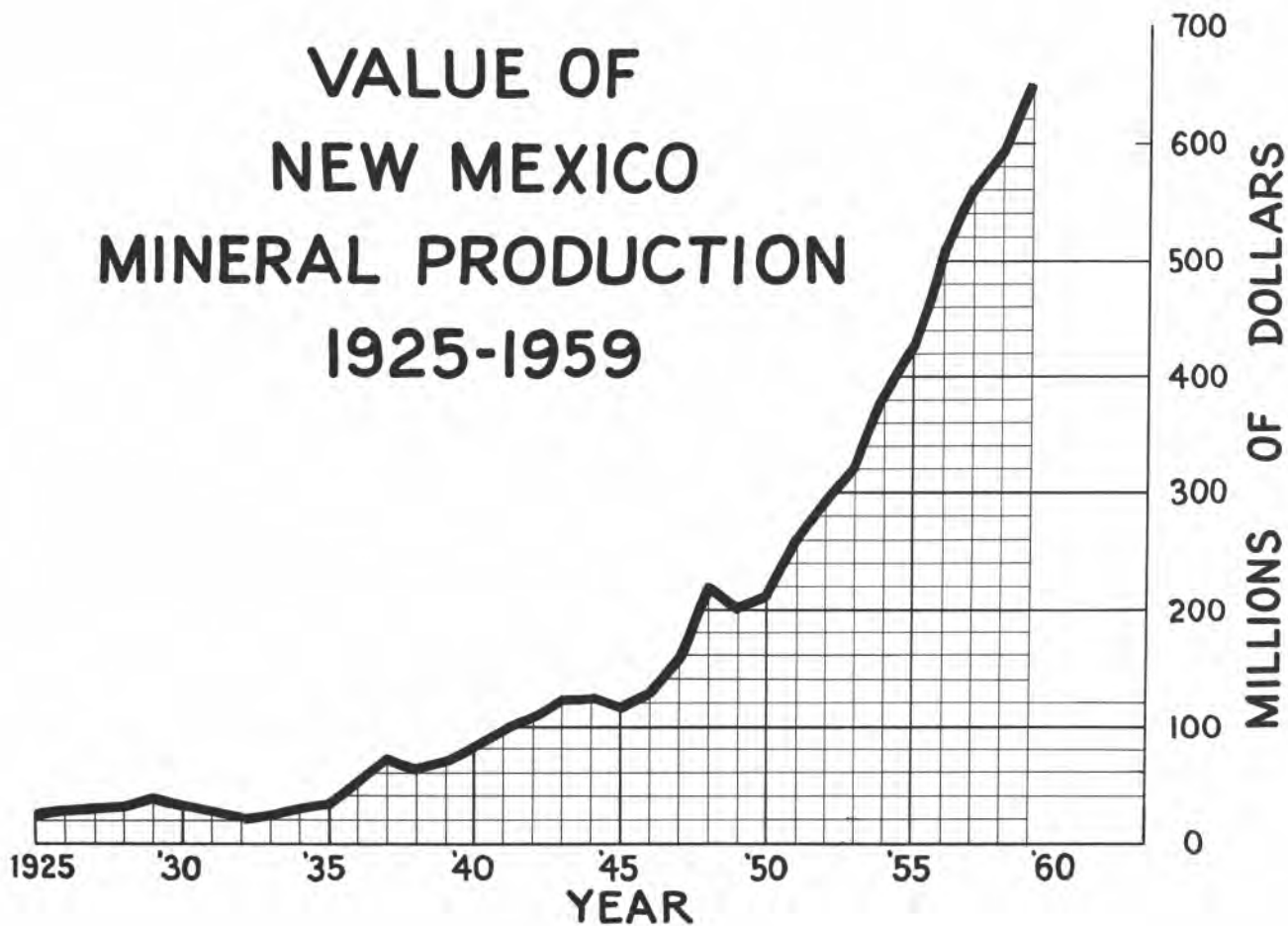
I have the honor of transmitting to you the Biennial Report of the State Bureau of Mines and Mineral Resources for the years ending June 30, 1959, and June 30, 1960, as required by Section 3, Chapter 115, of the session laws of the Eighth State Legislature, approved March 4, 1927.

Respectfully submitted,

E. J. WORKMAN

President

VALUE OF NEW MEXICO MINERAL PRODUCTION 1925-1959



FOREWORD

This biennium witnessed the end of a remarkable decade of mineral production in New Mexico. During the 1950's the State's mineral production increased from an annual rate of around 200 million dollars in 1950 to well over 600 million in 1960. The value of mineral production during these 10 years, amounting in total to 4.2 billion dollars, is about twice the total value of mineral production in all the years prior to this period.

Probably the most important single development during the decade of the fifties was the rise of the uranium industry from a position of nonexistence to one that ranked next to petroleum in terms of the value of the product produced. In the calendar year 1959 the value of the uranium concentrates produced in New Mexico well exceeded 100 million dollars.

Of importance to the mineral economy of the State during the last 2 years has been the establishment of the first cement industry and the first gypsum industry within the State's borders.

The mineral industry as a whole continued, by a wide margin, to be the chief single source of tax revenue for the State.

The activities of the New Mexico Bureau of Mines and Mineral Resources comprised basic and practical studies in the various phases of the minerals industry, including for the first time some rather extensive studies on the beneficiation of low-grade and refractory ores. Details of the Bureau's activities are summarized in this biennial report.

GENERAL STATEMENT

The New Mexico Bureau of Mines and Mineral Resources was established in 1927 by an act of the 8th State Legislature as a division of the New Mexico School of Mines. In establishing the Bureau of Mines the Legislature defined the objectives and duties of this new State agency as follows:

(1) To collect, to compile and to publish statistics relative to New Mexico, geology, mining, metallurgy and oil and natural gas and the refining thereof.

(2) To collect typical geological and mineral specimens and samples of products; to collect photographs, models and drawings of appliances used in the mines, mills, smelters, oil wells, natural gas wells and the refineries of oil and natural gas in New Mexico.

(3) To collect a library and bibliography of literature pertaining to the progress of geology, mining, milling, smelting and the production of oil and natural gas and refining the same in New Mexico.

(4) To study the geological formations of the state with special reference to their economic mineral resources, both metallic and nonmetallic.

(5) To examine the topography and physical features of the state with reference to their practical bearing upon the occupation of the people.

(6) To study the mining, milling, smelting operations and oil and natural gas production and the refining of the same carried on in the state with special reference to their improvement.

(7) To prepare and publish bulletins and reports with the necessary illustrations and maps, which shall embrace both a general and detailed description of the natural resources and geology, mines, mineral deposits, both metallic and nonmetallic, oil wells, natural gas wells, reduction plants, smelters, mills, oil refineries and natural gas refineries.

(8) To make qualitative examinations of rocks and mineral samples and specimens.

(9) To assist in the education of miners and prospectors through lectures and publications.

(10) To consider such other kindred, scientific and economic problems and questions as in the judgment of the Board shall be deemed of value to the people of the state.

(11) To communicate special information on New Mexico geology, mining, both metallic and nonmetallic, oil and natural gas and to serve as a bureau of exchange and information on the mineral, oil and natural gas resources of New Mexico.

(12) To cooperate with the University of New Mexico, with the state mine inspector and with other departments of state government as may be mutually beneficial and to cooperate with the United States geological survey and with the United States bureau of mines in accordance with the regulations of those institutions.

The Bureau of Mines and Mineral Resources is the only State organization charged with the duties of investigating, studying, and reporting on the geology of the entire State, and conducting research on all types of mineral-bearing deposits for the purpose of increasing the State's mineral production and income.

In addition to its independent activities the Bureau gives what assistance it can to other State, Federal, or private agencies which are working in the New Mexico minerals industry field. It helps in the accumulation and publication of data in studies made by professors and students in the geology and engineering departments of the New Mexico Institute of Mining and Technology. Cooperative projects have been completed, and others are in progress, between the Bureau and the U. S. Geological Survey in ground-water surveys and geologic mapping. An active part is taken by Bureau staff members in projects sponsored by engineering and geological professional societies, which it is believed will add to the knowledge of the State's mineral resources and improve its minerals economy.

The Bureau often aids, in a manner and to an extent consistent with general State policy, in projects initiated by private agencies. Geologists and mineral engineers serving with industry or working as consultants have made important contributions to the understanding of New Mexico's geologic features and mineral resources. Consistent with the policies of the private agencies involved, the Bureau endeavors to accumulate and make available to others the information so obtained.

To a degree more significant than in the past, the Bureau has engaged during the current biennium in studies designed to give direction and momentum to the State's mineral growth. To this end, economic studies to anticipate future as well as immediate mineral needs, and investigations of mineral industry trends to determine the probable byproduct aspects of current and future operations, are being undertaken. Reports to provide information of value to persons interested in mineral resources are being compiled and published for the important mineral-bearing counties. Also during this biennium, the Bureau has begun a program of study on the beneficiation of low-grade and refractory ore deposits, which potentially could contribute substantially to the State's mineral economy, if satisfactory treatment methods can be devised.



Zuni Sandstone North of Ramah,
McKinley County

DEPARTMENTAL ACTIVITIES

Geology

Geology is a necessary background for development of mineral resources. Reconnaissance geologic maps, detailed geologic maps, structure contour maps, stratigraphic studies, investigations of ore minerals--these and other types of geologic studies aid in finding and extracting New Mexico's minerals. A large number of the reports published this biennium were geologic or contained geologic material. Separation into pure or applied research is difficult. Prior to 1945 the study of uranium minerals was chiefly pure research; today it is vital to the nation's survival. Reconnaissance geologic mapping of west-central New Mexico is mostly pure research today, but may be economically important tomorrow. Stratigraphic studies, outcrop and subsurface, of the 24 counties in which petroleum production has not yet been achieved may seem to be pure research, but such studies could lead to the finding of oil in these areas.

The vast majority of New Mexico's citizens are not directly concerned with technical geologic investigations but do have a vivid interest in the spectacular landscapes of our State, and seek explanations as to "why is a hill here, and a valley there." The popular guidebooks entitled *Scenic Trips to the Geologic Past*, four of which were published during the biennium, are designed to give some insight into the geologic make up of local areas. Emphasis for the Roswell-Capitan-Ruidoso scenic trip is on the building blocks of the earth seen along the route from the High Plains into the mountainous Sierra Blanca region. Pueblo and Spanish history and the colorful rocks of the timbered southern Zuni Mountains are the blended theme of the scenic trips in that area. For the Silver City-Santa Rita-Hurley area, the mining--from exploration to shining copper--is stressed. The fabulous fishing-hunting-hiking high country of the upper Pecos Valley is explored in the latest "Trail Guide." In preparation is a scenic guide to Albuquerque's popular resort, the rugged, towering Sandia Mountains.

The technical geologic reports issued during the period ranged from the reconnaissance maps of the Geologic Map Series to the detailed studies published in the *Memoirs*, *Bulletins*, and *Circulars*. Exploration for petroleum is aided by such reports as those on the stratigraphy and structure of the Sacramento Mountains, the Permian rocks in the Guadalupe Mountains, the late Pennsylvanian and early Permian strata in the northern Sacramento Mountains, the geology of

Union County, the Pennsylvanian rocks in southwestern New Mexico, carbonate-rock fabrics, the geology of the Dog Springs, Carrizozo, Capitan, Big Hatchet, Las Cruces, Walnut Wells, Cebolla, Ghost Ranch, and Echo Amphitheater quadrangles, clay minerals in Cretaceous rocks, and Precambrian rocks of New Mexico, as well as by a lexicon of geologic names for rocks of Precambrian through Paleozoic age and reconnaissance maps of the Datil, Canon Largo, Playas, Dog Mountain, Foster Canyon, Little Black Peak, Reserve, and Las Cruces quadrangles. Paleontologic studies are useful in the search for oil as they aid in dating and identifying the oil-bearing beds, whether the investigation is of Ordovician corals, Pennsylvanian brachiopods, Mississippian faunas, or Cretaceous-Tertiary fossil plants.

Geologic studies helpful in the exploration for metallic minerals and industrial rocks and minerals range from the investigation of the effect of shaped charges on different rocks to the tabulation of the mineral deposits of a county. Several such studies were published during the biennium, including investigations of lead-zinc gossans, the geology and mineral deposits of the central Peloncillo Mountains, wall-rock alteration in the Cochiti mining district, the geology and mineral deposits of the Big Burro Mountains-Redrock area, the metallogenic provinces of the Southwestern United States and northern Mexico, the mineral deposits of Lincoln and Taos Counties, the gypsum resources of the State, the magnetite-taconite type of rocks near Las Tablas, Iron Mountain tungsten, the geology of the Truchas region, characteristics of feldspars, and the geology and mineral resources of the Lordsburg, Las Tablas, Capitan, Winston, and Mt. Sedgwick quadrangles. Most of the maps of the Geologic Map Series also aid exploration for minerals by showing the location of favorable rock types.

The areal geologic maps and areal reports provide basic information concerning ground water, and such studies as the Memoir on geologic characteristics of high mountain streams aid in determining uses of stream waters.

Areal geologic mapping, basic for all geologic and related studies, was done in only a few areas during 1958-1960, and that chiefly on a reconnaissance basis. Geologic maps published during these 2 years cover, however, about 3,600 square miles mapped in detail and more than 10,100 square miles of reconnaissance mapping, in addition to the 3,800 square miles mapped in Union County and the compilation of a geologic map of Lincoln County. The Bureau's share of the field reconnaissance mapping for the State geologic map was completed; preliminary maps of the northwest and southeast quarters were issued by the compilation agency, the U. S. Geological Survey,

and the map of the southwest quarter is in press. These preliminary maps of the State are on a scale of 1:380,160 (about 6 miles to an inch) and cannot show much more than the generalized geology and structure; maps showing more detail are necessary for most mineral exploration.

Members of the Bureau staff have aided in preparing many of the geologic field conference guidebooks published by the New Mexico, Roswell, Four Corners, and West Texas Geological Societies, contributing articles on the regional geology and laying out some of the road logs. A survey of geologic research projects in progress within the State will aid the planning of future work and help coordinate closely related studies. For the wider dissemination of some reports, articles are published in national scientific journals and talks are given at national technical meetings. Reports on the Precambrian of the State and on the Pennsylvanian strata of southwestern New Mexico were prepared at the request of committees of the American Association of Petroleum Geologists and will be published as part of a map of North America or as a chapter in a national symposium volume.

Petroleum

Although the field mapping and research activities of the Bureau are of value to petroleum exploration, certain direct services to the petroleum industry are also performed by this organization.

Accurate records of over 24,000 test wells drilled in New Mexico are on file in the Bureau offices. These records are made available to interested parties through publications, as well as directly to those who visit, write, or call the Bureau office.

Requests for information are received at the rate of 300 per year. In addition, countless numbers of individuals avail themselves of the information contained in publications that are compiled each year. These publications include information on all test wells drilled, a yearly review of petroleum developments, and maps showing the locations of wells drilled for oil and gas. In addition, copies of drillers logs on more than 7,750 wells are offered for sale.

The well-sample library maintained by the Bureau is probably one of its most important services. This library contains representative samples of the various rocks penetrated during the drilling of test wells. More than 5,200 test wells are represented by the 16,250 boxes of samples in the library. Samples from nearly 300 new tests are added to this library each year. Sample cuttings are an extremely valuable source of subsurface geologic information. From the microscopic study



Recent Wildcat Discovery - San Juan Basin

Production from below 5,500 feet.

of sample cuttings, the depth and character of buried rock formations can be determined. Use is made of such information in the search not only for oil and gas, but for other mineral deposits and water supplies as well. As new techniques of analysis and interpretation are developed, the sample library will be of even more value in the future.

The Bureau is represented on the Basement Rocks Project Committee of the American Association of Petroleum Geologists. This committee is preparing a map of the basement rocks of the United States. As an outgrowth of its work on this project, the Bureau will publish a separate, more detailed map of "The Basement Rocks of New Mexico." The Bureau's files of information from oil and gas well tests have been used extensively for this project.

A report dealing with petroleum exploration in northeast New Mexico was prepared for the 1959 Field Conference Guidebook of the Panhandle Geological Society.

In April 1959 a field conference in the Sacramento Mountains was sponsored jointly by the Permian Basin Section of the Society of Economic Paleontologists and Mineralogists and the Roswell Geological Society. A report on the Precambrian rocks of the Sacramento Mountains was prepared for the guidebook of this conference.

The Bureau is participating with the U. S. Geological Survey in the revision of "The Oil and Gas Map of New Mexico." The compilation of this revised map has been completed, and the published map should be available in the near future.

The Bureau strives to be of assistance to all who are interested in New Mexico's oil and gas resources, including representatives of oil companies, consulting geologists, independent operators, members of U. S. Government and State agencies, businessmen, drillers, lease brokers, and landowners. In serving these various groups, the Bureau assists and encourages the petroleum industry, which is so important to the economy of New Mexico.

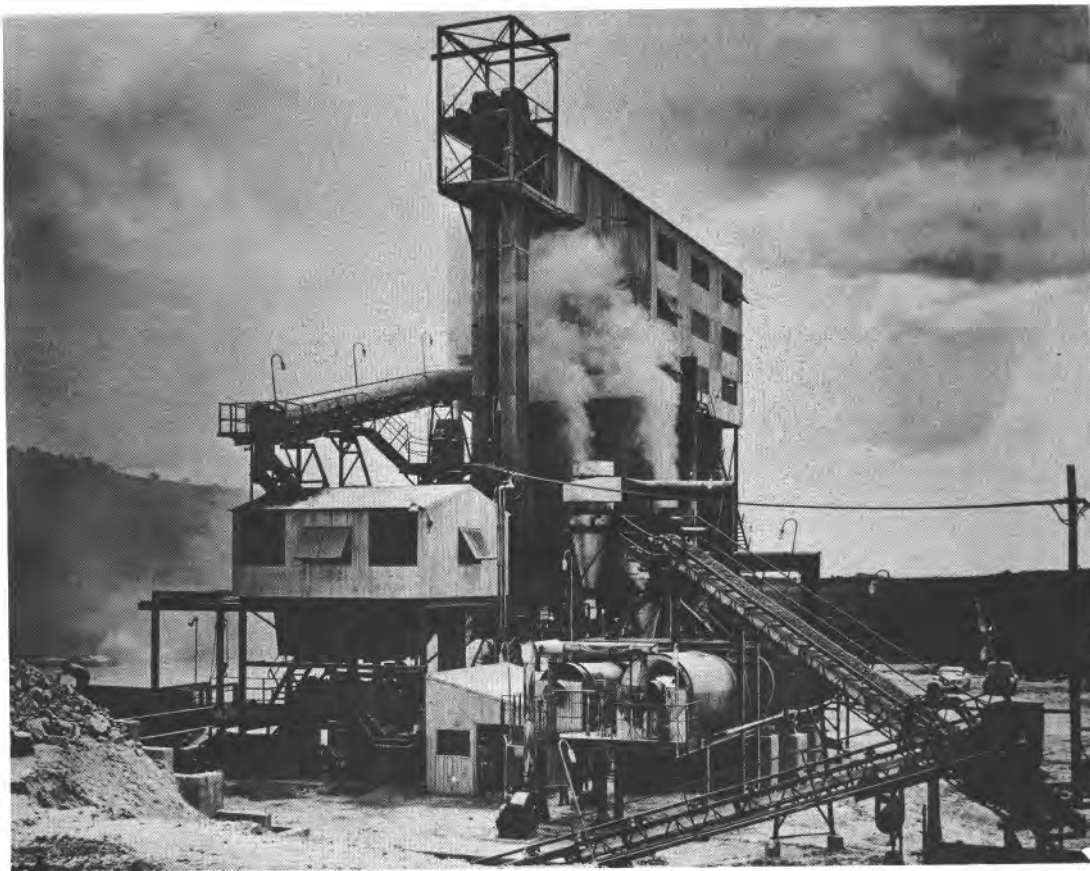
Mining

If New Mexico is to continue as a leading minerals-producing State, its dwindling ore reserves must be replenished through new discoveries. Exploration should be encouraged and assisted wherever economic discovery is promising.

The principal function of the Bureau's mining engineer has been to advise prospectors and small mine operators throughout the State. In spite of the tremendous strides which have been made in the



Portal of an Exploration Adit at a Lead-Barite-Fluorite Prospect



El Grande Crushing and Screening Plant

No Agua, New Mexico, just south of the Colorado-New Mexico State line.

field of exploration, prospectors continue to make an important part of the new discoveries. The recent uranium boom is a good example of the tremendous value of the individual prospector.

The mining engineer gives technical assistance to those prospectors who request aid. This assistance may take the form of giving advice "on the ground" at the prospect, office discussions, or answering the many inquiries received by mail. The more specialized members of the staff frequently assist in this task when the problems deal with a particular area or field in which they are expert.

Considerable headway has been made in the last 2 years toward the investigation of the mineral deposits of the important minerals-producing counties of the State. The Bureau's mining engineer, together with professional workers temporarily employed during the summer, are utilized for this project. Bulletins 67 and 71, covering Lincoln and Taos Counties respectively, were released during the biennium. Bulletin 72, on Luna County, is nearing completion, and field work is in progress in Hidalgo, Grant, and Santa Fe Counties. One project (on uranium deposits in McKinley and Valencia Counties) was cancelled because of a duplication of effort between the Bureau and the U. S. Geological Survey.

A research project on the theory and use of shaped charges in mining was carried through to completion by Dr. Carl F. Austin, who joined the staff in 1958. Dr. Austin's report (Bulletin 69, Lined-Cavity Shaped Charges and Their Use in Rock and Earth Materials) contains the essential results of this research. The author concludes that the shaped charge will have many uses in special mining problems, particularly those which confront miners working in remote areas.

Ground Water

The efforts of many individuals in a number of agencies, private, State, and Federal, are devoted to a better understanding of the occurrence of ground water in New Mexico. The direction of these efforts ranges from research into the techniques of water finding, through inventory studies and the investigation of quality-of-water relationships, to well-site location. The ground-water activities of the Bureau have been directed through much of this range.

Preparation of the inventory-type report on Union County has continued. The well, spring, and chemical analyses records are now tabulated and in final form ready for printing. It is expected that the text and maps will be completed, and the report printed, by the end of the year.



**Installation of Manufactured Wire-Wound Screen
in New City of Socorro Water Well**

Well tested 1,700 gallons per minute with
less than 50 feet of drawdown.

For several years data on the effect of chemical and mechanical development of wells have been collected, resulting in a more formal project. Preliminary evaluation of the change of quality of water from irrigation wells in the Rio Grande valley indicates that in some areas the change in quality bears a linear relationship to the total quantity pumped from the wells. This study requires an extended period of data collection.

Service work commonly consists of preparation of replies to requests for data. Such requests are usually in the form of a letter, but often may be by telephone, and frequently by office visit. Most requests are received from well drillers and private individuals, but some originate with consultants, industries, municipalities, and other government agencies.

Because of the Institute's interest in the community water supply and owing to the convenient accessibility of the Bureau's facilities for research purposes, the ground-water hydrologist aided municipal officials during the planning and construction of a new water well for the City of Socorro.

Discussions and conferences are held frequently with staff members of the other two divisions of the Institute, particularly the Research and Development Division, which has a number of research projects in ground water currently in progress.

During the spring semester of 1959 the ground-water hydrologist taught a course in fluid mechanics at the request of the Director of the College Division.

In addition to the work of the ground-water hydrologist, the resource economist of the Bureau is preparing a preliminary study of the administration of the supply of water in New Mexico, and the geologists of the Bureau in their field mapping usually record conditions pertinent to an evaluation of the supply of ground water. Locations of wells and springs, together with notations regarding the water-bearing properties of formations, may prove to be of great value when later investigations of local or area-wide ground-water conditions are made.

Under the cooperative agreement with the Quality of Water Branch of the U. S. Geological Survey, some 35 water samples have been analyzed annually. Results of these analyses are generally reported directly to individuals, especially in the case of samples of unusual quality, such as some of the so-called poison waters. None of the waters examined to date have shown evidence of toxic constituents capable of killing cattle in a matter of minutes, as is often reported.

The cooperative agreement with the Ground Water Branch of the U. S. Geological Survey continues in effect as in past years.

Metallurgy

In view of the growing importance of the field of extractive metallurgy in the mineral industries, the services of a full-time metallurgist, Dr. Roshan B. Bhappu, were engaged by the Bureau in March 1959.

Under Dr. Bhappu's supervision a metallurgy department was organized to carry out testing and research in this field, and to provide technical assistance to those operators who request aid. A temporary chemical laboratory has been established in the building occupied by the Bureau, whereas the experimental test work is carried out in the metallurgical laboratory of the College Division, when classes are not in session.

During the fiscal years ending 30 June 1959 and 1960, about \$15,000 worth of metallurgical equipment was purchased by the Bureau and put to good use on various projects. This equipment was also made available to the College Division on request.

Additional metallurgical equipment and laboratory supplies were acquired during this period through donations and gifts. The Atomic Energy Commission donated crushing, grinding, and sampling equipment worth \$2,500, and the Haystack Mountain Development Co., a subsidiary of the Atchison, Topeka & Santa Fe Railway Co., furnished sampling and chemical equipment and supplies worth \$4,000. A 4-inch cyclone unit worth \$350 was donated to the department by Equipment Engineers, Inc., Palo Alto, California. The Bureau gratefully acknowledges these generous contributions.

Since the establishment of the Bureau's metallurgical program in March 1959, 60 different ores have been examined and tested for the recovery of valuable metals and minerals. These include refractory and low-grade ores of copper, lead, zinc, iron, gold, silver, manganese, molybdenum, selenium, uranium, tungsten, titanium, zirconium, fluorspar, barite, mica, beryl, perlite, and many minor metals and minerals, all from New Mexico.

The experimental testing of these samples enabled the staff to provide helpful advice and technical assistance to prospectors and mining companies operating in the State. In some cases, further exploration and development of the ore deposits were undertaken on the basis of this preliminary test work. In other instances, improvements and modifications in the existing flow-sheets and plant practices were made, with resulting increase in efficiency and profits for the operators.

In addition to providing these services to the mineral industries of New Mexico, the metallurgy department conducted the following

long-range investigations of possible economic importance to the State:

1. Studies pertaining to the nature of chrysocolla and other copper-silicate minerals and the recovery of copper therefrom.
2. Development of an effective procedure for the separation of galena, barite, and fluorite from complex ores containing these minerals.
3. Recovery of titanium and other rare metals from the Gallup sandstone.
4. Recovery of selenium from low-grade ores found in some localities in the State.
5. Recovery of metal values remaining in old mine dumps and tailing ponds throughout the State.
6. Upgrading of low-grade manganese ore to produce a marketable product.

The results of the above investigations will be published as soon as these projects are completed. It is hoped that such studies will help directly in the development of the mineral industries in New Mexico, with ensuing benefits derived from the exploitation of such strategic low-grade and refractory ore deposits.

The above program of the metallurgy department, it should be noted, was carried out under the considerable handicap of limited space and equipment. As in previous years, the primary need of the Bureau is for space and equipment for testing and research. It is still necessary for those engaged in mining in the State to solicit the aid of outside agencies for research and testing on newly discovered or refractory ores.

The plans drawn up in the fall of 1956 for a \$400,000 Mineral Industries Building to house a metallurgical laboratory and to provide space for other Bureau activities did not materialize during this fiscal period. In recent Institute announcements, however, some mention has been made of the provision of such a building. It is earnestly hoped that funds will be made available for this urgently needed facility. Until a separate laboratory for the Bureau is provided, its activities in the important field of metallurgical research will have to be curtailed greatly.

Any support that the State may provide for such activities of the Bureau will enhance greatly the basic economy of the State and yield returns that will far more than offset the financial outlay required.

Petrology and Mineralogy

The Bureau's mineralogist-petrographer devotes his time to service work and research. Rocks and minerals, including core samples from oil tests, are submitted to the Bureau for identification. The identification is effected by chemical tests, microscopic study, or in some instances by X-ray analysis. The importance of this service is indicated by the large number of samples received. In addition, the mineralogist has carried on independent research on rocks and minerals.

Though many aspects of the study of rocks and minerals are theoretical, much of this work is of direct practical value. Several of the staff members participate in such activity.

Stratigraphy and Paleontology

A primary function of the Bureau's paleontologist is the determination of the proper succession of rock units throughout the State, their regional variation from place to place, and their fossil content, the latter serving to fix the age and permit correlation of units whose continuity is interrupted by erosion or by cover of other formations. Such work is of great practical value to mining and petroleum geologists in their study of the location of mineral deposits. Certain formations are more favorable as locations for petroleum or natural gas accumulations, others for uranium, and still others for various metals and nonmetals.

ACTIVE PROJECTS

In addition to the projects that have been completed by the publication of a final report, as listed under Publications, and those listed as being in press or preparation, the Bureau of Mines has 35 active projects:

- Carrizozo quadrangle, Lincoln County, by R. H. Weber.
- Capitan quadrangle, Lincoln County, by J. E. Allen.
- Stratigraphic study of the Sacramento Mountains area, by L. C. Pray.
- Winston and Sugarloaf Mountain quadrangles, by R. H. Jahns.
- Big Hatchet Peak quadrangle, by R. A. Zeller, Jr.
- Las Cruces quadrangle, by F. E. Kottlowski.
- Pelona NE and Pelona NW quadrangles, by C. E. Stearns.
- Ojo Caliente area, Rio Arriba County, by R. H. Jahns, C. T. Smith, and W. R. Muehlberger.
- Iron Mountain tungsten, Sierra County, by R. H. Jahns.
- Pennsylvanian stratigraphy, by L. M. Cline.
- Pennsylvanian stratigraphy and paleontology, Mud Springs Mountains, by J. L. Gehrig.
- San Diego Mountain quadrangle, by F. E. Kottlowski.
- Walnut Wells quadrangle, by Allen Alper.
- Engle NE quadrangle, by Eugene Cserna.
- Cebolla NW and Cebolla SW quadrangles, by W. R. Muehlberger.
- Bueyeros area, Harding County, by C. J. Mankin.
- Truchas region, by Arthur Montgomery, J. P. Miller, and P. K. Sutherland.
- Clay minerals in Cretaceous rocks, by M. E. Willard.
- Pennsylvanian sections in New Mexico, by M. L. Thompson.
- Exsolution of feldspars, by F. J. Kuellmer.
- Mimbres quadrangle, by F. J. Kuellmer.
- Florida Mountains, by C. L. Balk.
- Geology and ground-water resources of Union County, by F. X. Bushman and B. Baldwin.
- Geology and ground-water resources of Quay County, by C. F. Berkstresser, Jr.
- Ground water in the structural basin west of Tucumcari, by F. X. Bushman and Frederick Trauger.
- Geology and ground-water resources of southern Lea County, by Alexander Nicholson.

- Geology and ground-water resources of eastern Valencia County, by F. B. Titus, Jr.
- Mineral deposits of Grant County, New Mexico, by E. Gillerman.
- Mineral deposits of Hidalgo County, New Mexico, by W. E. Elston.
- Mineral deposits of Santa Fe County, New Mexico, by W. E. Elston.
- Mineral deposits of Luna County, New Mexico, by G. B. Griswold.
- Study of petroleum developments in New Mexico during 1959, by R. W. Foster, R. A. Bieberman, and R. R. Chaves.
- Stratigraphy and oil tests of southwestern New Mexico, by R. W. Foster.
- Preliminary geologic and relief map of the Precambrian of New Mexico, by R. W. Foster and T. F. Stipp.
- Geology of the Socorro quadrangle, Socorro County, New Mexico, by M.-S. Sun.



Publications Distribution Office

PUBLICATIONS

The publications issued during the biennium make available to the public the results of projects undertaken by the staff and associates of the New Mexico Bureau of Mines and Mineral Resources. They summarize the accomplishments of the Bureau during the past several years.

During the biennium the Bureau issued 13 bulletins, 1 memoir, 4 circulars, 2 guidebooks, and (in the map series) 5 geologic maps. In addition staff members have prepared a large number of technical papers for outside publication in various professional journals and guidebooks.

Bulletins

Bulletins of the New Mexico Bureau of Mines and Mineral Resources are the main medium of publishing technical reports. The format established in 1953 has been followed with only minor modifications.

Published during the biennium:		Counties covered
46	Topical Study of Lead-Zinc Gossans, by W. C. Kelly	
50	Late Pennsylvanian and Early Permian Stratigraphy of the Northern Sacramento Mountains, Otero County, New Mexico, by Caryl Otte, Jr.	Otero
60	Geology and Mineral Deposits of the Northern Big Burro Mountains-Redrock Area, Grant County, New Mexico, by C. H. Hewitt	Grant
61	Lexicon of New Mexico Geologic Names: Parts 1, 2, 3 (to supersede Circular 40), by H. L. Jicha, Jr., and Christina Lochman-Balk	
62	Geology of Lordsburg Quadrangle, Hidalgo County, New Mexico, by R. F. Flege, Jr.	Hidalgo
63	Geologic Studies of Union County, New Mexico, by Brewster Baldwin and W. R. Muehlberger	Union
64	Some Ordovician Corals From New Mexico, Arizona, and Texas, by Dorothy Hill	
65	Metallogenic Provinces of the Southwestern United States and Northern Mexico, by C. W. Burnham	
66	Summary of Pennsylvanian Sections in Southwestern New Mexico and Southeastern Arizona, by F. E. Kottowski	
67	Mineral Deposits of Lincoln County, New Mexico, by G. B. Griswold	Lincoln

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| 68 | Gypsum Resources of New Mexico, by R. H. Weber and F. E. Kottlowski | |
| 69 | Lined-Cavity Shaped Charges and Their Use in Rock and Earth Materials, by C. F. Austin | |
| 70 | Geology of the Knight Peak Area, Grant County, New Mexico, by D. L. Ballmann | Grant |
| 71 | Mineral Resources of Taos County, New Mexico, by J. H. Schilling | Taos |

Memoirs

Memoirs of the New Mexico Bureau of Mines and Mineral Resources are a new vehicle of publication; the first was published in 1956. The page size of the memoir accommodates large illustrations and permits monographic treatment of particular topics in a volume of convenient size.

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| | Published during the biennium (or in press): | Counties covered |
| 3 | Middle Pennsylvanian Brachiopods From the Mud Springs Mountains and Derry Hills, New Mexico, by J. L. Gehrig | Sierra |
| 4 | High Mountain Streams: Effects of Geology on Channel Characteristics and Bed Material, by J. P. Miller | Mora, Taos, Santa Fe, San Miguel |
| 5 | The Mississippian of West-Central New Mexico, by A. K. Armstrong | Socorro, Catron, Torrance |
| 6 | Cretaceous-Tertiary Palynology of the Eastern Side of the San Juan Basin, New Mexico, by R. Y. Anderson | San Juan |

Circulars

Circulars of the New Mexico Bureau of Mines and Mineral Resources include reports of interest to miners and prospectors, the petroleum industry, farmers and ranchers, and professional geologists and engineers. The ample size of the page permits the printing of moderate-sized maps and other illustrations. The circular is well suited for brief technical reports.

The circulars embrace a wide variety of subjects: (1) annual developments in the petroleum industry, (2) lists of oil and gas tests

drilled each year, (3) ground-water studies of limited areas, (4) commodity studies of particular minerals in limited areas, (5) brief technical reports, (6) miscellaneous compilations.

Published during the biennium:

Counties
covered

- | | | |
|----|---|------------|
| 52 | Petroleum Developments in New Mexico During 1958, by R. A. Bieberman, R. W. Foster, and J. K. Huenergardt | |
| 54 | Magnetite Taconite Rock in Precambrian Formations in Rio Arriba County, New Mexico, by W. E. Bertholf II | Rio Arriba |
| 55 | Some Scheelite Occurrences in the Magdalena Mining District of New Mexico, by C. F. Austin | Socorro |
| 56 | Geologic Research in New Mexico During 1959, by F. E. Kottowski | |

Scenic Trips to the Geologic Past

The Scenic Trips series attracts attention to the scenery and geologic features of New Mexico. Some areas lend themselves to short trips radiating from one large community, whereas others are best studied along a full-day's trip. In either case, the tourist, the touring geologist, and the science club student and teacher can all profit from the summary of the geology of the area studied.

The series was initiated in 1955 as an experiment, with a description of the Santa Fe area. The Santa Fe guidebook was well received, and six have now been prepared. The newer guidebooks summarize the history of the area in addition to the geology.

Published during the biennium:

Counties
covered

- | | | |
|---|---|---|
| 4 | Southern Zuni Mountains, by R. W. Foster | McKinley,
Valencia |
| 5 | Silver City-Santa Rita-Hurley, New Mexico, by J. H. Schilling | Grant |
| 6 | Trail Guide to the Upper Pecos, by Arthur Montgomery and P. K. Sutherland | Santa Fe,
San Miguel,
Mora,
Rio Arriba |

Geologic Map Series

The Geologic Map series was inaugurated in 1956 and has already become an important medium of geologic publication. The series is designed for those areas that have been mapped geologically, but for which no written report is planned. The explanation of geologic units is expanded more than has been customary, to offset the absence of an accompanying text.

Most of the maps published to date in this series come from reconnaissance geologic mapping in southwestern New Mexico and are listed in the "Thirty-Minute Quadrangle Series." The mapping was done for the new "Geologic Map of New Mexico," which will be on the small scale of 1/6 inch to the mile. The 30-minute quadrangle maps are on a larger scale of 1/2 inch to the mile and therefore show more detail than the State map.

Published during the biennium (or in press):		Counties covered
10	Reconnaissance Geologic Map of Mogollon Thirty-Minute Quadrangle, by R. H. Weber and M. E. Willard	Catron
11	Little Black Peak Fifteen-Minute Quadrangle, East Half, by C. T. Smith and A. J. Budding	Lincoln
12	Reconnaissance Geologic Map of Reserve Thirty-Minute Quadrangle, by R. H. Weber and M. E. Willard	Catron
13	Reconnaissance Geologic Map of Alum Mountain Quadrangle, by M. E. Willard, R. H. Weber, and F. J. Kuellmer	Catron, Grant
14	Reconnaissance Geologic Map of Las Cruces Thirty-Minute Quadrangle, by F. E. Kottowski	Dona Ana
15	Reconnaissance Geologic Map of Virden Thirty-Minute Quadrangle, by W. E. Elston	Grant

Technical Papers

The professional activity of staff members of the Bureau of Mines is presented not only in Bureau publications but also in a variety of outside publications. Much of the work is summarized in technical papers delivered at meetings of geological societies. Such papers are represented by abstracts, which are printed in scientific journals for nationwide distribution.

Guidebooks of the various local and regional geological societies have become an important source of geologic information on

New Mexico. The guidebooks are prepared for field conferences on aspects of the geology of the State. Many of the Bureau's staff members have made important contributions to the preparation of such guidebooks or to the organization of the field conferences.

The technical papers of staff members are listed below:

- Austin, C. F. (jointly with Dr. W. F. Slawson, Univ. of Toronto) (1960) Anomalous Leads From a Selected Geologic Environment in West-Central New Mexico, *Nature*, v. 187, p. 400-401.
- Flower, R. H. (1958) Some Chazyan and Mohawkian Endoceratida, *Jour. Paleont.*, v. 32, p. 433-458.
- (1959) Cambrian-Devonian Beds of Southern New Mexico, *Guidebook of the Sacramento Mountains, Joint Field Conf., Permian Basin Sect., Soc. Econ. Paleont. Mineral., and Roswell Geol. Soc.*, p. 154-171.
- , and Gordon, M. (1959) More Mississippian Belemnites (abs.), *Geol. Soc. Am. Bull.*, p. 1564.
- , and ——— (1959) More Mississippian Belemnites, *Jour. Paleont.*, v. 33, p. 809-842.
- Foster, R. W. (1959) Precambrian Rocks of the Sacramento Mountains Vicinity, *Guidebook of the Sacramento Mountains, Joint Field Conf., Permian Basin Sect., Soc. Econ. Paleont. Mineral., and Roswell Geol. Soc.*, p. 137-153.
- (1959) Petroleum Exploration in Northeastern New Mexico, *Guidebook of the Southern Sangre de Cristo Mountains, New Mexico, 7th Field Conf., Panhandle Geol. Soc.*, p. 1-24.
- , Willard, M. E., Schilling, J. H., Weber, R. H., Ostrander, R. E., Smith, J. A., Kottowski, F. E., and Smith, C. T. (1959) Geologic Road Logs for 1st, 2nd, and 3rd Days, *Guidebook of West-Central New Mexico, 10th Field Conf., N. Mex. Geol. Soc.*, p. 12-51.
- Kottowski, F. E. (1958) Geologic History of the Rio Grande Near El Paso, Franklin and Hueco Mountains *Guidebook, West Texas Geol. Soc.*, p. 46-54.
- , and Foster, R. W. (1959) Buried Pre-Cenozoic Rocks of the Datil-Mogollon Plateau in New Mexico (abs.), *Geol. Soc. Am. Bull.*, v. 70, p. 1728.
- (1959) Real Wildcat Country--Pennsylvanian of SW New Mexico, *Oil and Gas Jour.*, v. 57, n. 16, p. 148-151.
- (1959) Sedimentary Rocks of the San Andres Mountains, *Guidebook of the Sacramento Mountains, Joint Field Conf., Permian Basin Sect., Soc. Econ. Paleont. Mineral., and Roswell Geol. Soc.*, p. 259-277.

- (1959) Pennsylvanian Rocks on the Northeast Edge of the Datil Plateau, Guidebook of West-Central New Mexico, 10th Field Conf., New Mexico Geol. Soc., p. 57-62.
- (1960) Geology and Coal Deposits of the Switz City Quadrangle, Indiana, U. S. Geol. Survey Coal Inv. Map C-41.
- 1959 (1960) Geology and Coal Deposits of the Coal City Quadrangle, Indiana, U. S. Geol. Survey Coal Inv. Map C-28.
- Kueller, F. J. (1959) X-ray Intensity Measurements on Perthitic Materials. I. Theoretical Considerations, Jour. Geol., v. 67, p. 648-660.
- (1960) X-ray Intensity Measurements on Perthitic Materials. II. Data From Natural Alkali Feldspars, Jour. Geol., v. 68, p. 307-323.
- (1960) Compositional Variation of Alkali Feldspars in Some Intrusive Rocks Near Globe-Miami, Arizona, Econ. Geol., v. 55, p. 557-562.
- Sun, M.-S. (1959) Determination of Selenium by X-ray Spectroscopic Method (abs.), 13th Annual Meeting Program, New Mexico Geol. Soc., April 23-25, 1959.
- , and Weege, R. J. (1959) Native Selenium From Grants, New Mexico, Am. Mineral., v. 44, p. 1309-1311.
- (1960) Differential Thermal Analysis of Shattuckite (abs.), Annual Meeting Program, Geol. Soc. Am., Cordilleran Sect., May 5-9, 1960.
- Weber, R. H. (1960) Review of Minerals of New Mexico, by S. A. Northrop, N. Mex. Quart., v. 30, p. 77-78.
- Willard, M. E. (1959) Tertiary Stratigraphy of Northern Catron County, New Mexico, Guidebook of West-Central New Mexico, 10th Field Conf., N. Mex. Geol. Soc., p. 92-99.

PERSONNEL

Of the 13 full-time professional staff members serving the State Bureau of Mines and Mineral Resources at the beginning of the biennium, 12 remained with the Bureau throughout the 2-year period. Two additions were made during the biennium.

Dr. Brewster Baldwin, after 7 years of service with the Bureau, resigned his position as economic geologist in August 1958 to accept a position as professor of geology at Middlebury College, in Vermont.

Dr. Carl F. Austin joined the staff in September 1958 after having received a Ph. D. degree in geological engineering from the University of Utah. Following a year's study of lined-cavity explosives as a postdoctorate research fellow, Dr. Austin was appointed a regular member of the Bureau staff as a geological and mining engineer in July 1959. Drawing upon his past experience in various phases of mining and geological engineering, Dr. Austin has undertaken a number of important projects during the last year.

Dr. Roshan B. Bhappu was appointed metallurgist for the Bureau in March 1959. The Colorado School of Mines awarded him the degree of Metallurgical Engineer in 1950, the M. S. degree in 1951, and the D. Sc. degree in 1953. For 3 years he was associated with the Colorado School of Mines Research Foundation as a research metallurgist. Prior to joining the Bureau, Dr. Bhappu was resident metallurgist for the Miami Copper Co. for 4 years. His broad academic and practical background in the field of extractive metallurgy should enable him to make valuable contributions to the development of the mineral industries of New Mexico.

Dr. Frederick J. Kuellmer, economic geologist on the Bureau staff, was awarded a National Science Foundation senior postdoctoral fellowship for a period of 12 months beginning in September 1959. The research program undertaken by Dr. Kuellmer during the tenure of this fellowship is a study of micaceous minerals conducted at the Eidgenössische Technische Hochschule in Zurich, Switzerland. Dr. Kuellmer received a leave of absence from the Bureau covering the time required for the completion of this assignment.



Bureau Staff

Back row (left to right): Kase, Griswold, Sun, Kopicki, Bonnicksen, Stahmann, Stephenson, Bushman, Bieberman, Foster, Arnold, Austin, Weber, Chen, Brooke, Chavez.

Center row: Bingler, Richards, Stahmann, Edgar, Price, Vigil, Miller, Niccum.

Front row: Hasan, Willard, Marino, Runnina, Kottowski, Thompson, Bhappu, Flower, Bertholf, Miller.

John H. Schilling, who had served on the Bureau staff during the period from 1954 to 1956, was reemployed during the biennium from February 1959 to March 1960 to complete two projects for the Bureau: a bulletin on the mineral resources of Taos County and a Scenic Trip guidebook for the Silver City, Santa Rita, and Hurley area. In March 1960 Mr. Schilling left the Bureau to join the staff of the Nevada Bureau of Mines.

Again during this biennium as in the previous biennium, Dr. Edmund H. Kase, Jr., publications editor and lecturer in humanities for the New Mexico Institute of Mining and Technology, has supervised the editorial preparation and printing of Bureau publications.

As in the past, wives of students have accepted employment with the Bureau and have been of great assistance in performing the required office work. The Bureau is especially fortunate to have the services of Mrs. Shirlee Stahmann, Mrs. Nadine Richards, and Mrs. Bessie Vigil, three student wives who have been in charge of the operations of the Bureau's business office.

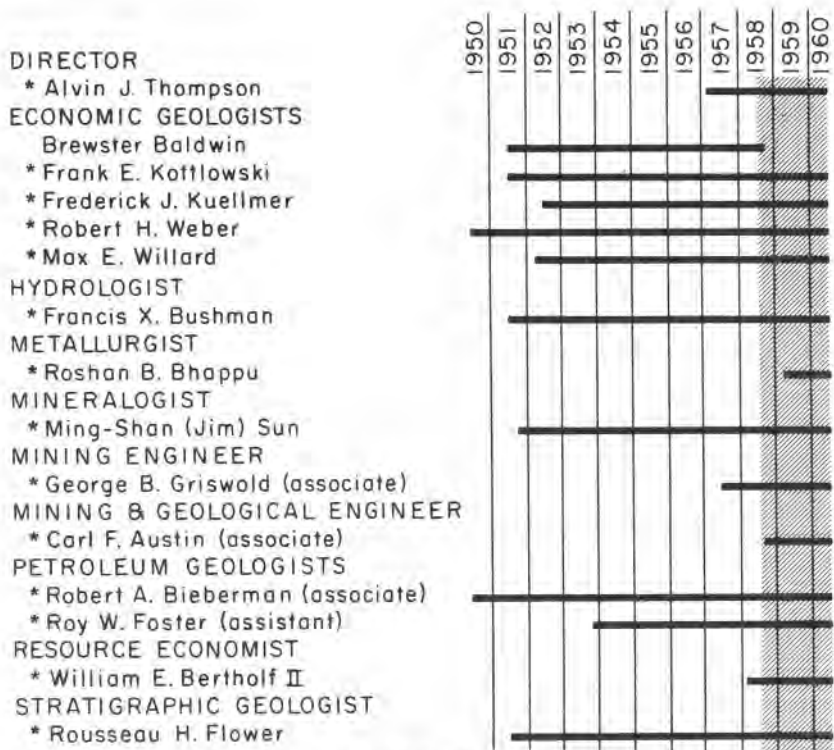
Many students are employed part time by the Bureau of Mines. Some, particularly graduate assistants, receive technical experience under professional members of the staff. Others help prepare illustrations and geologic maps for reports.

The names of all who have worked for the Bureau in the past biennium are listed below.

Professional Staff

Most of the members of the professional staff of the State Bureau of Mines and Mineral Resources have served the Bureau continuously for 8 or more years. During this period the staff has become familiar with almost every part of New Mexico. Certain members, moreover, have specialized knowledge of each main field of geology. This professional group has thus become a valuable resource of the State.

The service record of members of the professional staff associated with the Bureau during the past biennium appears on the following page.



Other Staff

- * Arnold, William E.
- * Chavez, Richard R.
- * Edgar, Mrs. Myrtie M.
- Greenwald, Mrs. Lelia C.
- Huenergardt, Mrs. Joann K.
- * Price, Robert L.
- * Richards, Mrs. Nadine D.
- * Stahmann, Mrs. Shirlee K.
- * Vigil, Mrs. Bessie S.

Chief Draftsman
Laboratory Assistant
Secretary to the Director
Office Manager
Clerk-Typist
Draftsman
Secretary
Secretary
Clerk-Typist

Temporary Employees

- * Bonnichsen, Bill
- Caine, Mrs. Theresa M.
- Campodonica, Bartolome N.
- Carman, Mrs. Joyce C.
- * Niccum, Mrs. Glenda K.

Draftsman
Typist
Draftsman
Clerk-Typist
Clerk-Typist

* Employed at end of biennium.

Geologists and Engineers on Special Projects

Armstrong, Augustus K.	University of Cincinnati
* Elston, Wolfgang E.	University of New Mexico
* Gillerman, Elliot	University of Kansas
Jahns, Richard H.	California Institute of Technology
Latvala, Woodrow J.	N. Mex. Institute of Mining and Technology
* Muehlberger, William R.	University of Texas
Schilling, John H.	N. Mex. Institute of Mining and Technology
* Smith, Clay T.	N. Mex. Institute of Mining and Technology
Sutherland, Patrick K.	University of Oklahoma

Student Employees

Baker, Miss Mary F.	Hicks, R. Gale
* Bingler, Edward C.	Huenergardt, William, Jr.
* Blymn, Miss Linda P.	Imprescia, Richard J.
Borys, Ronald T.	* Kopicki, Robert J.
* Brooke, James N.	* Lacey, Miss Dorothy G.
Carman, John H.	* Littleton, Miss Mary E.
* Casteel, Gary B.	* Marino, Miguel A.
Chang, Li-Yu	* Miller, William E.
Chapman, Miss Wendie F.	Muse, James W.
* Chen, Tse-Pu	Pearse, Thomas E.
Clark, Lucius V.	Renault, Jacques R.
Colclasure, Miss Ellen L.	* Running, John R.
Farrar, Miss B. Shirley	Russell, Jack E.
Fleming, Miss Carolyn S.	Shafer, Barry P.
Garcia, Meliton M.	* Stahmann, William S.
Garcia, Moises J.	* Stephenson, Donald A.
Garrett, Charles R.	Thompson, Donald E.
Goodman, Darril E.	Wilshusen, John P.
Hambleton, Arthur W.	Wolff, Frederick E.
Hardt, Miss Jo Ruth	Worley, Morris T.
* Hasan, Syed Mir	Wright, Lloyd A.
Hibert, Charles L.	

Publications Supervisor

- * Kase, Edmund H., Jr.

* Employed at end of biennium.

FINANCIAL STATEMENT

The Business Manager of the New Mexico Institute of Mining and Technology, who supervises the finances of the Bureau, has submitted the following statement:

STATE BUREAU OF MINES - GENERAL

<u>Receipts</u>	<u>1958-1959</u>		<u>1959-1960</u>	
Beginning balance July 1	\$ 15,206		\$ 11,813	
State appropriation	254,628		306,000	
Receipts from sales of bulletins, etc.	<u>7,279</u>		<u>6,366</u>	
TOTAL revenue		\$277,113		\$324,179
<u>Disbursements and Commitments</u>				
Personal services:				
Regular salaries	131,133		144,185	
Part-time salaries	<u>35,346</u>	166,479	<u>38,224</u>	182,409
Travel and automotive:				
Travel and per diem	7,827		6,451	
Gas, repairs, and insurance	<u>4,204</u>	12,031	<u>4,647</u>	11,098
Repairs and maintenance	<u>535</u>	535	<u>530</u>	530
Supplies and materials:				
Postage and resale supplies	3,787		2,351	
Office supplies	2,086		3,394	
Laboratory and scientific supplies	<u>3,351</u>	9,224	<u>4,124</u>	9,869
Printing and reproduction	<u>29,780</u>	29,780	<u>29,447</u>	29,447
Other operating expense:				
Telephone and telegraph	1,634		1,730	
Professional services	6,405		7,765	
Retirement	4,015		7,134	
Social Security	2,801		3,821	
Overhead	10,650		11,600	
Freight, express, insurance, audit, repairs, subscriptions, etc.	<u>9,993</u>	35,498	<u>10,176</u>	42,226
Capital outlay		<u>11,753</u>		<u>14,610</u>
TOTAL expenditures		265,300		290,189
Year-end balance		11,813		33,990

FINANCIAL STATEMENT

BASIC GEOLOGY

<u>Receipts</u>	<u>1958-1959</u>	<u>1959-1960</u>
Beginning balance July 1	\$ 322	\$ 919
State appropriation	<u>10,000</u>	<u>10,000</u>
TOTAL revenue	10,322	\$10,919
<u>Disbursements and Commitments</u>		
Salaries	8,403	9,705
Travel	<u> </u>	<u>197</u>
Overhead	<u>1,000</u>	<u>1,000</u>
TOTAL expenditures	\$9,403	\$10,902
Year-end balance	\$ 919	\$ 17

GROUND-WATER SURVEYS

<u>Receipts</u>	<u>1958-1959</u>	<u>1959-1960</u>
Beginning balance July 1	\$ 470	\$ 470
State appropriation	<u>10,000</u>	<u>10,000</u>
TOTAL revenue	\$10,470	\$10,470
<u>Disbursements and Commitments</u>		
Salaries	8,000	8,000
Printing and publication	1,000	1,000
Overhead	<u>1,000</u>	<u>1,000</u>
TOTAL expenditures	\$10,000	\$10,000
Year-end balance	\$ 470	\$ 470

MINERAL PRODUCTION IN NEW MEXICO, 1958-1959

Crude oil production exceeded 100 million barrels for the first time in 1959. Substantial increases in the quantity of natural gas and natural-gas liquids also were recorded, and the total value of all petroleum products reached a value of 421 million dollars in 1959. Petroleum products accounted for approximately two-thirds of total value of mineral production during the year.

The production of uranium concentrates in New Mexico in 1959 is estimated at 14 million pounds valued at approximately 112 million dollars, making uranium the second most important mineral commodity now being produced in this State.

The value of potash production, which decreased from its peak value of \$75.1 million in 1957 to \$69.1 million in 1958, rose during 1959 to near the peak value.

Copper production declined 16,000 tons, compared with 1958, mainly because of the strike that idled the Chino mine of the Kennecott Copper Corporation from August to nearly year's end. The value of copper production reached a 10-year low during 1959. The value of production of the other base metals was unusually low during the biennium also as these metals continued to suffer from low prices which have prevailed since 1957. The value of zinc production, which in 1957 amounted to \$7.1 million, was \$1.8 million in 1958 and only \$1.1 million in 1959. The value of lead production, which in 1957 amounted to \$1.54 million, dropped to \$260,000 in 1958 and \$191,000 in 1959.

A marked increase in construction activities during the biennium resulted in an increase in value of sand, gravel, and stone production from \$8.0 million in 1957 to \$12.9 million in 1958. This high level of production was more than maintained in 1959.

Although the production of manganese ore and concentrates reached new highs in 1958 and 1959, exceeding \$2 million in value for each of the two years, most of the mining and milling of this material stopped when purchases by the government were halted in August 1959. A sharp decrease in the production of this commodity during 1960 is anticipated.

Perlite sold or used by producers in New Mexico was the seventh-ranking mineral in terms of value in 1959. New Mexico continued to be the leading perlite State, producing 54 percent of the nation's total for the 1959 calendar year. The value of pumice production remained at around the million-dollar level during each of the years 1958 and 1959.

MINERAL PRODUCTION IN NEW MEXICO
IN THE CALENDAR YEAR 1959

		<u>Value *</u>
Crude oil	105.7 million bbl	
Natural gas	777.8 billion cu ft	\$421,273,000
Natural-gas liquids	816.3 million gal	
Potassium salts (K ₂ O equivalent)	2,189,000 tons	74,117,000
Copper [†]	39,700 tons	24,369,000
Uranium (concentrates)	7,000 tons [‡]	112,000,000 [‡]
Zinc [†]	4,636 tons	1,066,000
Sand, gravel, and stone	12,921,000 tons	13,874,000
Manganese ore and concentrates (35% or more Mn)	27,528 tons	2,248,000
Lead [†]	829 tons	191,000
Perlite (crude)	240,642 tons	2,121,000
Helium	16.9 million cu ft	264,000
Molybdenum [†]	300 tons [‡]	700,000 [‡]
Pumice	493,000 tons	1,023,000
Salt (common)	36,000 tons	322,000
Coal	149,000 tons	837,000
Silver [†]	159,000 troy oz	144,000
Lime	16,000 tons	209,000
Gold [†]	3,155 troy oz	110,000
Clays	45,000 tons	77,000
Barite	320 tons	6,000
Mica: sheet	247 lb	2,000
scrap	210 tons	7,000
Gem stones	----	39,000
Beryllium	11 tons	6,000
TOTAL (estimated)[‡]		\$657,000,000

*Except as otherwise noted, values taken from preliminary annual figures issued by the U. S. Bureau of Mines.

†Recoverable content of ores, etc.

‡Estimates by the New Mexico Bureau of Mines and Mineral Resources.

§Other products, on which no reliable estimates of value can be made at the present time, are iron ore, manganese ore and concentrates (5% to 35% Mn), carbon dioxide, cement, magnesium compounds, vanadium, and rare earths.